The Georgia Department of Juvenile Justice

Earth Systems

Units of Instruction Resource Manual

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**Acknowledgements**

The Georgia Department of Juvenile Justice Department of Education would like to thank the many educators who have helped to create this Earth Systems Units of Instruction Resource Manual. The educators have been particularly helpful in sharing their ideas and resources to ensure the completion and usefulness of this manual.

Students served by the DJJ require a special effort if they are to become contributing and participating members of their communities. Federal and state laws, regulations, and rules will mean nothing in the absence of professional commitment and dedication by every staff member.

The Georgia Department of Juvenile Justice is very proud of its school system. The school system is Georgia’s 181st and is accredited by the Southern Association of Colleges and Schools (SACS). The DJJ School System has been called exemplary by the US Department of Justice. This didn’t just happen by chance; rather it was the hard work of many teachers, clerks, instructors and administrators that earned DJJ these accolades and accreditations. The DJJ education programs operate well because of the dedicated staff. These dedicated professionals are the heart of our system.

These Content Area Units of Instruction were designed to serve as a much needed tool for delivering meaningful whole group instruction. In addition, this resource will serve as a supplement to the skills and knowledge provided by the Georgia Department of Juvenile Justice Curriculum Activity Packets (CAPs).

I would like to thank all the DJJ Teaching Staff, the Content Area Leadership Teams, Kimberly Harrison, DJJ Special Education/Curriculum Consultant and Martha Patton, Curriculum Director for initiating this project and seeing it through. Thank you all for your hard work and dedication to the youth we serve.

Sincerely yours,

James “Jack” Catrett, Ed.D.

Associate Superintendent

**Mission**

The mission of Department of Juvenile Justice Science Consortium (DJJSC) is to build a multiparty effort statewide to achieve continuous, systemic and sustainable improvements in the education system serving the Science students of the Department of Juvenile Justice (DJJ).

**Vision**

To achieve the mission of the DJJSC, members work collaboratively in examining the Georgia Performance Standards. These guidelines speak specifically to teachers being able to: deliver meaning content pertaining to the Characteristics of Science and its content standards across the Science units of instruction. The DJJSC will master and develop whole-group unit lessons built around Curriculum Activity Packets (CAPs), critique student work, and work as a team to solve the common challenges of teaching within DJJ. Additionally, the DJJSC jointly analyzes student test data in order to: develop strategies to eradicate common academic deficits among students, align curriculum, and create a coherent learning pathway across grade levels. The DJJSC also reviews research articles, attends workshops or courses, and invites consultants to assist in the acquisition of necessary knowledge and skills. Finally, DJJSC members observe one another in the classroom through focus walks.

**Introduction**

The Earth Systems Units of Instruction Resource Manual is a tool that has been created to serve as a much needed tool for delivering meaningful whole group instruction. This manual is a supplement to the skills and knowledge provided by the Georgia Department of Juvenile Justice Curriculum Activity Packets (CAPs). It is imperative that our students learn to identify and investigate problems scientifically, and to work in cooperative learning groups. Best practices in education indicate that teachers should first model new skills for students. Next, teachers should provide opportunities for guided practice. Only then should teachers expect students to successfully complete an activity independently. The Earth Systems Units of Instruction meets that challenge.

|  |  |
| --- | --- |
|  | **The Georgia Department of Juvenile Justice** **Office of Education** **Direct Instruction Lesson Plan** |
| Teacher: |
| Subject:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Date:\_\_\_\_\_\_\_\_\_\_\_\_\_to­\_\_\_\_\_\_\_\_\_\_\_­­\_\_\_\_\_\_\_Period □ 1st□ 2nd□ 3rd□ 4th□ 5th□ 6th | Students will engage in: □ Independent activities □ pairing □ Cooperative learning □ hands-on □ Peer tutoring □ Visuals  □ technology integration □ Simulations  □ a project □ centers □ lecture □ Other  |
| Essential Question(s):Standards:CAPs Covered:Grade Level:\_\_\_\_ Unit:\_\_\_\_\_\_RTI Tier for data collection: 2 or 3Tier 2 Students:Tier 3 Students: |
| **Time** | **Procedures Followed:** | **Material/Text**  |
| \_\_\_\_\_\_\_Minutes  | Review of Previously Learned Material/Lesson Connections:Recommended Time: 2 Minutes |  |
|  \_\_\_\_\_\_\_Minutes  | Display the Georgia Performance Standard(s) (project on blackboard via units of instruction located at<http://thevillage411.weebly.com/units-of-instruction2.html>, or print on blackboard) Read the Georgia Performance Standard(s) aloud and explain it to your students. You can rephrase the Georgia Performance Standard to make sure your students understand it.Display the Essential Question(s) (project on blackboard via units of instruction, or print on blackboard). Read the Essential Question (s) aloud and explain it to your students. You can rephrase the Essential Question (s) to make sure your students understand it.Recommended Time: 2 Minutes |  |
| \_\_\_\_\_\_\_Minutes | Introduce task by stating the purpose of today’s lesson. Recommended Time: 2 Minutes |  |
| \_\_\_\_\_\_\_Minutes | Engage students in conversation by asking open ended questions related to the essential question(s). Recommended Time: 2 Minutes |  |
| \_\_\_\_\_\_\_Minutes  | Begin whole group instruction with corrective feedback:Recommended Time: 10 Minutes |  |
| \_\_\_\_\_\_\_Minutes  |  Lesson Review/Reteach:Recommended Time: 2 Minutes |  |
| \_\_\_\_\_\_\_Minutes  | Independent Work CAPs:Recommended Time: 30 Minutes |  |
| Teacher Reflections:  |

The Instructional Rotation Matrix has been designed to assist science teachers in providing a balanced approach to utilizing the Science Units of Instruction across all grade levels on a rotating schedule.

|  |  |  |  |
| --- | --- | --- | --- |
| Monday | Tuesday | Wednesday | Thursday |
| 6th Grade ContentMiddle School | 9th Grade ContentHigh School | 7th Grade ContentMiddle School | 10th Grade ContentHigh School |
| 8th Grade ContentMiddle School | 11th Grade ContentHigh School | 6th Grade ContentMiddle School | 12th Grade ContentHigh School |
| 7th Grade ContentMiddle School | 9th Grade ContentHigh School | 8th Grade ContentMiddle School | 10th Grade ContentHigh School |
| 6th Grade ContentMiddle School | 11th Grade ContentHigh School | 7th Grade ContentMiddle School | 12th Grade ContentHigh School |

**Georgia Performance Standards**

SCSh1 Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.

a. Exhibit the above traits in their own scientific activities.

b. Recognize that different explanations often can be given for the same evidence.

c. Explain that further understanding of scientific problems relies on the design and execution of new experiments which may reinforce or weaken opposing explanations.

 SCSh2 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.

SCSh3 Students will identify and investigate problems scientifically.

a. Suggest reasonable hypotheses for identified problems.

b. Develop procedures for solving scientific problems.

c. Collect, organize and record appropriate data.

d. Graphically compare and analyze data points and/or summary statistics.

e. Develop reasonable conclusions based on data collected.

f. Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.

SCSh4 Students will use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

a. Develop and use systematic procedures for recording and organizing information.

b. Use technology to produce tables and graphs.

c. Use technology to develop, test, and revise experimental or mathematical models.

SCSh5 Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.

a. Trace the source on any large disparity between estimated and calculated answers to problems.

b. Consider possible effects of measurement errors on calculations.

c. Recognize the relationship between accuracy and precision.

d. Express appropriate numbers of significant figures for calculated data, using scientific notation where appropriate.

e. Solve scientific problems by substituting quantitative values, using dimensional analysis and/or simple algebraic formulas as appropriate.

 SCSh6 Students will communicate scientific investigations and information clearly.

a. Write clear, coherent laboratory reports related to scientific investigations.

b. Write clear, coherent accounts of current scientific issues, including possible alternative interpretations of the data.

c. Use data as evidence to support scientific arguments and claims in written or oral presentations.

d. Participate in group discussions of scientific investigation and current scientific issues.

 SCSh7 Students will analyze how scientific knowledge is developed. Students will recognize that:

a. The universe is a vast single system in which the basic principles are the same everywhere.

b. Universal principles are discovered through observation and experimental verification.

c. From time to time, major shifts occur in the scientific view of how the world works. More often, however, the changes that take place in the body of scientific knowledge are small modifications of prior knowledge. Major shifts in scientific views typically occur after the observation of a new phenomenon or an insightful interpretation of existing data by an individual or research group.

d. Hypotheses often cause scientists to develop new experiments that produce additional data.

e. Testing, revising, and occasionally rejecting new and old theories never ends.

 SCSh8 Students will understand important features of the process of scientific inquiry. Students will apply the following to inquiry learning practices:

a. Scientific investigators control the conditions of their experiments in order to produce valuable data.

b. Scientific researchers are expected to critically assess the quality of data including possible sources of bias in their investigations’ hypotheses, observations, data analyses, and interpretations.

c. Scientists use practices such as peer review and publication to reinforce the integrity of scientific activity and reporting.

d. The merit of a new theory is judged by how well scientific data are explained by the new theory.

e. The ultimate goal of science is to develop an understanding of the natural universe which is free of biases.

f. Science disciplines and traditions differ from one another in what is studied, techniques used, and outcomes sought.

SCSh9 Students will enhance reading in all curriculum areas by:

a. Reading in All Curriculum Areas

Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.

Read both informational and fictional texts in a variety of genres and modes of discourse.

Read technical texts related to various subject areas.

b. Discussing books

Discuss messages and themes from books in all subject areas.

Respond to a variety of texts in multiple modes of discourse.

Relate messages and themes from one subject area to messages and themes in another area.

Evaluate the merit of texts in every subject discipline.

Examine author’s purpose in writing.

Recognize the features of disciplinary texts.

c. Building vocabulary knowledge

Demonstrate an understanding of contextual vocabulary in various subjects.

Use content vocabulary in writing and speaking.

Explore understanding of new words found in subject area texts.

d. Establishing context

Explore life experiences related to subject area content.

Discuss in both writing and speaking how certain words are subject area related.

Determine strategies for finding content and contextual meaning for unknown words.

SES1 Students will investigate the composition and formation of Earth systems, including the Earth's relationship to the solar system.

a. Describe the early evolution of the Earth and solar system, including the formation of Earth's solid layers (core, mantle, crust), the distribution of major elements, the origin of internal heat sources, and the mechanism by which heat transfer drives plate tectonics.

b. Explain how the composition of the Earth's crust, mantle and core is determined and compare it to that of other solar system objects.

c. Describe how the decay of radioactive isotopes is used to determine the age of rocks, Earth, and solar system.

d. Describe how the Earth acquired its initial oceans and atmosphere.

e. Identify the transformations and major reservoirs that make up the rock cycle, hydrologic cycle, carbon cycle, and other important geochemical cycles.

SES2 Students will understand how plate tectonics creates certain geologic features, materials, and hazards.

a. Distinguish among types of plate tectonic settings produced by plates diverging, converging, and sliding past each other.

b. Relate modern and ancient geologic features to each kind of plate tectonic setting.

c. Relate certain geologic hazards to specific plate tectonic settings.

d. Associate specific plate tectonic settings with the production of particular groups of igneous and metamorphic rocks and mineral resources.

e. Explain how plate tectonics creates and destroys sedimentary basins through time.

 SES3 Students will explore the actions of water, wind, ice, and gravity that create landforms and systems of landforms (landscapes).

a. Describe how surface water and groundwater act as the major agents of physical and chemical weathering.

b. Explain how soil results from weathering and biological processes acting on parent rock.

c. Describe the processes and hazards associated with both sudden and gradual mass wasting.

d. Relate the past and present actions of ice, wind, and water to landform distribution and landscape evolution.

e. Explain the processes that transport and deposit material in terrestrial and marine sedimentary basins, which result, over time, in sedimentary rock.

SES4 Students will understand how rock relationships and fossils are used to reconstruct the Earth's past.

a. Describe and apply principles of relative age (superposition, original horizontality, cross-cutting relations, and original lateral continuity) and describe how unconformities form.

b. Interpret the geologic history of a succession of rocks and unconformities.

c. Apply the principle of uniformitarianism to relate sedimentary rock associations and their fossils to the environments in which the rocks were deposited.

d. Explain how sedimentary rock units are correlated within and across regions by a variety of methods (e.g., geologic map relationships, the principle of fossil succession, radiometric dating, and paleomagnetism).

e. Use geologic maps and stratigraphic relationships to interpret major events in Earth history (e.g., mass extinction, major climatic change, tectonic events).

SES5 Students will investigate the interaction of insolation and Earth systems to produce weather and climate.

a. Explain how latitudinal variations in solar heating create atmospheric and ocean currents that redistribute heat globally.

b. Explain the relationship between air masses and the surfaces over which they form.

c. Relate weather patterns to interactions among ocean currents, air masses, and topography.

d. Describe how temperature and precipitation produce the pattern of climate regions (classes) on Earth.

e. Describe the hazards associated with extreme weather events and climate change (e.g., hurricanes, tornadoes, El Niño/La Niña, global warming).

 SES6 Students will explain how life on Earth responds to and shapes Earth systems.

a. Relate the nature and distribution of life on Earth, including humans, to the chemistry and availability of water.

b. Relate the distribution of biomes (terrestrial, freshwater, and marine) to climate regions through time.

c. Explain how geological and ecological processes interact through time to cycle matter and energy, and how human activity alters the rates of these processes (e.g., fossil fuel formation and combustion).

d. Describe how fossils provide a record of shared ancestry, evolution, and extinction that is best explained by the mechanism of natural selection.

e. Identify the evolutionary innovations that most profoundly shaped Earth systems: photosynthetic prokaryotes and the atmosphere; multicellular animals and marine environments; land plants and terrestrial environments.

|  |
| --- |
|  DJJ Earth SystemsGeorgia Performance Standards:  Curriculum Map                                             |
| **1st Semester** | **2nd Semester** |
| Earth Science | Composition of Earth | Surface Processes on Earth | The Atmosphere and the Oceans | The Dynamic Earth | Geologic Time | Resources and the Environment | Beyond Earth |
| Chapter1 | CAPs1-4 | Chapter 3 | CAPs9-11 | Chapter 7 | CAPs 19-22 | Chapter 11 | CAPs 32-34 | Chapter 17 | CAPs49-53 | Chapter 21 | CAPs62-64 | Chapter 24 | CAPs72-75 | Chapter 27 | CAPs81-83 |
| 2 | 5-8 | 4 | 12-13 | 8 | 23-26 | 12 | 35-37 | 18 | 54-56 | 22 | 65-67 | 25 | 76-77 | 28 | 84-86 |
|  |  | 5 | 14-15 | 9 | 27-29 | 13 | 38-41 | 19 | 57-59 | 23 | 68-71 | 26 | 78-80 | 29 | 87-89 |
|  |  | 6 | 16-18 | 10 | 30-31 | 14 | 42-44 | 20 | 60-61 |  |  |  |  | 30 | 90-92 |
|  |  |  |  |  |  | 15 | 45-46 |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  | 16 | 47-48 |  |  |  |  |  |  |  |  |
| **GPS:** SCSh1  SCSh2  SCSh3 SCSh6  SCSh7  SCSh8SEV 4SEV 5  | **GPS:**SCSh3 SCSh6  SCSh7  SCSh8SCSh6SCSh7SCSh9SEV1SEV2SEV3 SEV5 | **GPS:**SCSh2SCSh3SCSh4SCSh5SCSh6SCSh9SEV1SEV2SEV3SEV4 SEV5 | **GPS:**SCSh3 SCSh9 SES5SCSh1 SCSh4  | **GPS:**SCSh2SCSh3SCSh4SCSh5SCSh6SCSh9 | **GPS:**SCSh4SCSh6SCSh7SCSh9SES5b  | **GPS:**SCSh3 SCSh6  SCSh7  SCSh8 | **GPS:**SCSh3 SCSh6  SCSh7  SCSh8SCSh9 |
| **Focus CAPs:**4,8 | **Focus CAPs:**11,13,15,18 | **Focus CAPs:**22,26,29,31 | Focus CAPs:34,37,41,44,48 | **Focus CAPs:**53,56,59,61 | **Focus CAPs:**64,67,71 | **Focus CAPs:**75,77,80 | **Focus CAPs:**83,86,89,92 |

**Enduring Understandings & Essential Question**

**Earth Science**

**Enduring Understandings:**

Earth scientist use specific methods to investigate Earth and beyond

Earth scientist use mapping technologies to investigate and describe the world

**Essential Questions:**

What are the steps of a scientific method?

How does remote sensing work?

Why is remote sensing needed in cartography?

Why is GPS navigation important to earth scientist?

**Composition of Earth**

**Enduring Understandings:**

The variety of substances on Earth results from the way that atoms are arranged and combined

Minerals are integral part of daily life

Igneous rocks were the first rocks to form as Earth cooled from a molten mass to the crystalline rocks of the early crust

Most rocks are formed from preexisting rocks through external and internal geologic processes

Atoms are the basic building blocks of all matter

**Essential Questions:**

What is an atom?

What are the components of an atom?

What is the concept of isotopes?

What is a mineral?

How are minerals formed?

How are minerals classified?

What are igneous rock formations?

What is the composition of magma?

What factors affect how rocks melt and crystallize?

**Surfaces Processes on Earth**

**Enduring Understandings:**

Weathering and erosion are agents of change on Earth’s surface

Movements due to gravity, winds, and glaciers shape and change Earth’s surface

Surface water moves materials produced by weathering and shapes the surface of Earth

Precipitation and infiltration contribute to groundwater, which is stored in underground reservoirs until it surfaces as a spring or is drawn from a well

**Essential Questions:**

What are the differences between mechanical weathering and chemical weathering?

What are the factors that affect mechanical weathering and chemical weathering?

What variables affect the rate of weathering?

What is the relationship between gravity and mass movement?

What factors affect mass movement?

What affect does mass movement have on people?

How does surface water move weathered material?

How does a stream carry its load?

How does a floodplain develop?

**The Atmosphere and the Oceans**

**Enduring Understandings:**

The composition, structure, and properties of Earth’s atmosphere form the basis of Earth’s weather and climate

Weather patterns can be observed, analyzed, and predicted

The exchange of thermal energy in the atmosphere sometimes occurs with great violence that varies in form, size, and duration

The different climates on Earth are influenced by natural factors as well as human activities

**Essential Questions:**

What are the gas and particle compositions of the atmosphere?

How is energy transferred into the atmosphere?

What is weather?

What is climate?

How is weather created?

How are air masses formed?

How are thunderstorm formed?

What is the cycle life of a thunderstorm?

**The Dynamic Earth**

**Essential Questions:**

Most geologic activity occurs at the boundaries between plates

Volcanoes develop from magna moving upward from deep within earth

Mountains form through dynamic processes which crumple, fold, and create faults in Earth’s crust

**Enduring Understandings:**

What is continental drift?

How does evidence of Ancient climates support continental drift?

How are plate tectonics influenced by the formation of volcanoes?

What are the parts of a volcano?

What are the three types of movement of faults?

What are the three types of seismic waves?

**Geologic Time**

**Enduring Understandings:**

Scientist use several methods to learn about Earth’s long history

The oceans and atmosphere formed and life began during the three eons of the Precambrian, which spans nearly 90 percent of Earth’s history

Complex life developed and diversified during the three eras of the Phanerozoic as the continents moved into their present positions

**Essential Questions:**

What is the elevation distribution of earth’s surface?

What is Isostasy?

How does earth’s crust respond to the addition and removal of mass?

How old is Earth?

What were the heat sources of early Earth?

What is passive margin?

How does transgressions and regressions indicate sea-level changes?

What were the tectonic forces that shaped Laurentia during the Paleozoic?

**Resources and the Environment**

**Enduring Understandings:**

People and other organisms use Earth’s resources for everyday living

People use energy resources, most of which originate from the Sun, for everyday living

The use of natural resources can impact Earth’s land, air, and water

Water is essentially for all life, yet it is unevenly distributed on Earth’s surface

**Essential Questions:**

What are resources?

How are resources categorize?

How are resources unevenly distributed on Earth?

Why is the sun the source of most energy on earth?

How does coal form?

What are the typical patterns of population growth of organisms?

What happens to populations when they reach carrying capacity?

What environmental factors affect population growth?

**Beyond the Earth**

**Enduring Understandings:**

The sun, Earth, and the Moon form a dynamic system that influences all life on earth

Using the laws of motion and gravitation, astronomers can understand the orbits and the properties of the planets and other objects in the solar system

The life cycle of every star is determined by its mass, luminosity, magnitude, temperature, and composition

Observations of galaxy expansion, cosmic background radiation, and the Big Bang theory described an expanding universe that is 13.7 billion years old

**Essential Questions:**

What are moon phases?

How did the moon form?

What are lunar properties and structures?

How was the Solar System formed?

How does gravity relate to the motion of objects in the solar system?

What features describe a planet?

What are the layers and features of the Sun?

What is the process of energy production in the Sun?

What are the three types of spectra?

**Earth Science**

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Respond to a variety of texts in multiple modes of discourse.

Relate messages and themes from one subject area to messages and themes in another area.

Evaluate the merit of texts in every subject discipline.

Examine author’s purpose in writing.

Recognize the features of disciplinary texts.

c. Building vocabulary knowledge

Demonstrate an understanding of contextual vocabulary in various subjects.

Use content vocabulary in writing and speaking.

Explore understanding of new words found in subject area texts.

**Task: 1**

**Essential Question(s):**

What are the steps of a scientific method?

**Resources:**

[What strategies are involved in solving a science problem virtual lesson](http://www.glencoe.com/sites/common_assets/science/virtual_labs/ES01/ES01.html)

**Teacher’s Place:**

Prior to beginning the performance activity, the teacher should implement the following steps using teaching techniques you have found to be effective for your students.

1. Explain the activity (activity requirements)

2. Display the Georgia Performance Standard(s) (project on blackboard via units of instruction located at <http://thevillage411.weebly.com/units-of-instruction2.html>

3. Read the Georgia Performance Standard(s) aloud and explain it to your students. You can rephrase the Georgia Performance Standard to make sure your students understand it.

4. Display the Essential Question(s) (project on blackboard via units of instruction, or print on blackboard)

5. Read the Essential Question (s) aloud and explain it to your students. You can rephrase the Essential Question (s) to make sure your students understand it.

6. Review unit vocabulary with students. <http://www.glencoe.com/qe/efcsec.php?qi=14444>

7. Introduce the following:

a. The Nature of Science: Methods of Scientist p.10

8. Engage students in conversation by asking students to describe a question or problem that they faced recently. Then ask students how did they answer the question or solve the problem? Write answers on the blackboard. As a class, analyze whether the process the students used was logical, efficient, and successful.

9. Discuss answers with the students using the following questioning techniques as applicable:

**Questioning Techniques:**

**Memory Questions**

 Signal words: who, what, when, where?

 Cognitive operations: naming, defining, identifying, designating

**Convergent Thinking Questions**

 Signal words: who, what, when, where?

Cognitive operations: explaining, stating relationships, comparing and

contrasting

 **Divergent Thinking Questions**

 Signal words: imagine, suppose, predict, if/then

Cognitive operations: predicting, hypothesizing, inferring, reconstructing

 **Evaluative Thinking Questions**

 Signal words: defend, judge, justify (what do you think)?

10. Guide students into the activity utilizing [What strategies are involved in solving a science problem virtual lesson](http://www.glencoe.com/sites/common_assets/science/virtual_labs/ES01/ES01.html)

11. Complete the activity with the students (some tasks may require students to work independently, peer to peer, learning circles [2-3 students] or as a whole group [the entire class]. Therefore the teacher may serve as activity leader and or facilitator. When an activity calls for students to work in learning circles you should assign roles to students individually i.e. recorder, discussion leader or presenter)

12. At the end of the **\*whole group learning session**, students will transition into independent CAP assignments.

**\*The phrase, “whole group learning session” is utilized “rather than, the end of the activity” because all of the activities may not be completed in one day.**

Activity

The teacher and students will complete [What strategies are involved in solving a science problem virtual lesson](http://www.glencoe.com/sites/common_assets/science/virtual_labs/ES01/ES01.html) as a whole group activity. Students will be divided into cooperative learning groups to complete the journal activity as a ticket out the door.

**Task: 2**

**Essential Question(s):**

What are the steps of a scientific method?

**Resources:**

<http://www.sti.nasa.gov/tto/apollo.htm>

[Visualizing Scientific Methods Concept](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Scientific_Methods_1.swf)

**Teacher’s Place:**

Prior to beginning the performance activity, the teacher should implement the following steps using teaching techniques you have found to be effective for your students.

1. Explain the activity (activity requirements)

2. Display the Georgia Performance Standard(s) (project on blackboard via units of instruction located at <http://thevillage411.weebly.com/units-of-instruction2.html> units of instruction page, or print on blackboard)

3. Read the Georgia Performance Standard(s) aloud and explain it to your students. You can rephrase the Georgia Performance Standard to make sure your students understand it.

4. Display the Essential Question(s) (project on blackboard via units of instruction, or print on blackboard)

5. Read the Essential Question (s) aloud and explain it to your students. You can rephrase the Essential Question (s) to make sure your students understand it.

6. Review unit vocabulary with students. <http://www.glencoe.com/qe/efcsec.php?qi=14444>

7. Review the following:

a. The Nature of Science: Methods of Scientist p.10

8. Engage students in conversation by asking students to describe a question or problem that they faced recently. Then ask students how did they answer the question or solve the problem? Write answers on the blackboard. As a class, analyze whether the process the students used was logical, efficient, and successful.

9. Discuss answers with the students using the following questioning techniques as applicable:

**Questioning Techniques:**

**Memory Questions**

 Signal words: who, what, when, where?

 Cognitive operations: naming, defining, identifying, designating

**Convergent Thinking Questions**

 Signal words: who, what, when, where?

Cognitive operations: explaining, stating relationships, comparing and

contrasting

 **Divergent Thinking Questions**

 Signal words: imagine, suppose, predict, if/then

Cognitive operations: predicting, hypothesizing, inferring, reconstructing

 **Evaluative Thinking Questions**

 Signal words: defend, judge, justify (what do you think)?

10. Guide students into the activity utilizing [Visualizing Scientific Methods Concept](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Scientific_Methods_1.swf)

11. Complete the activity with the students (some tasks may require students to work independently, peer to peer, learning circles [2-3 students] or as a whole group [the entire class]. Therefore the teacher may serve as activity leader and or facilitator. When an activity calls for students to work in learning circles you should assign roles to students individually i.e. recorder, discussion leader or presenter)

12. At the end of the **\*whole group learning session**, students will transition into independent CAP assignments.

**\*The phrase, “whole group learning session” is utilized “rather than, the end of the activity” because all of the activities may not be completed in one day.**

**Activities**

Necessity is the mother of invention." This is an American saying that most teenagers probably have not heard. It suggests that inventions are sometimes created to fill specific needs. People generally create and invent because they see a need or have a desire to do something that can't be done because current technology. Sometimes, inventions are the by-product of scientific investigations or advances in technology. As scientists seek answers to the questions that interest them, someone else sees the potential in it, and uses their discovery in ways the originators never dreamed about. For example, did you know that CAT Scanners and MRI technology (Computer-Aided Tomography and Magnetic Resonance Imaging), used in hospitals worldwide, came from technology developed to computer-enhance pictures of the moon for the Apollo program (<http://www.sti.nasa.gov/tto/apollo.htm>)

Activity 1

The director at your center has requested that your science class help her answer the following questions: How have travel, communication, computer technology, and other types of technology changed since 1980? What is different? What is better? Have things changed that much? What changes have taken place over a longer period of time? How have advances in all kinds of technology made our lives different?

Activity 2

|  |  |
| --- | --- |
| **Then**  | **Now**  |
| The time is 1980 | The time is the present. |
| You need to set up a meeting between 3 geologists; one from Savannah RYDC, the second from Marietta RYDC, and the third from Augusta RYDC.  |
| **Your Task:**Plan this meeting using the latest technology, machines, tools, and devices that are available to you at the time.You choose where they meet. **Your Limitations:**Time and Cost Within these limitations you need to make the meeting take place in the most time efficient and cost effective manner. |

**Task: 3**

**Essential Question(s):**

How does remote sensing work?

Why is remote sensing needed in cartography?

Why is GPS navigation important to earth scientist?

**Resources:**

[Time Zones](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/TimeZones2_4.swf)

[Map Projections](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/MapProjections2_5.avi)

[Types of Maps and projections](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch02_t02_1.swf)

[Visualizing GPS Satellites\_2.swf](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_GPS_Satellites_2.swf)

**Teacher’s Place:**

Prior to beginning the performance activity, the teacher should implement the following steps using teaching techniques you have found to be effective for your students.

1. Explain the activity (activity requirements)

2. Display the Georgia Performance Standard(s) (project on blackboard via units of instruction located at <http://thevillage411.weebly.com/units-of-instruction2.html> units of instruction page, or print on blackboard)

3. Read the Georgia Performance Standard(s) aloud and explain it to your students. You can rephrase the Georgia Performance Standard to make sure your students understand it.

4. Display the Essential Question(s) (project on blackboard via units of instruction, or print on blackboard)

5. Read the Essential Question (s) aloud and explain it to your students. You can rephrase the Essential Question (s) to make sure your students understand it.

6. Review unit vocabulary with students. <http://www.glencoe.com/qe/efcsec.php?qi=14445>

7. Introduce the following:

a. Mapping our World: Remote Sensing p.41

8. Engage students in conversation by asking students the following question (s): What makes a map a map? Write answers on the blackboard.

9. Discuss answers with the students using the following questioning techniques as applicable:

**Questioning Techniques:**

**Memory Questions**

 Signal words: who, what, when, where?

 Cognitive operations: naming, defining, identifying, designating

**Convergent Thinking Questions**

 Signal words: who, what, when, where?

Cognitive operations: explaining, stating relationships, comparing and

contrasting

 **Divergent Thinking Questions**

 Signal words: imagine, suppose, predict, if/then

Cognitive operations: predicting, hypothesizing, inferring, reconstructing

 **Evaluative Thinking Questions**

 Signal words: defend, judge, justify (what do you think)?

10. Guide students into the activity utilizing [Types of Maps and projections](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch02_t02_1.swf) and

[Visualizing GPS Satellites\_2.swf](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_GPS_Satellites_2.swf)

11. Complete the activity with the students (some tasks may require students to work independently, peer to peer, learning circles [2-3 students] or as a whole group [the entire class]. Therefore the teacher may serve as activity leader and or facilitator. When an activity calls for students to work in learning circles you should assign roles to students individually i.e. recorder, discussion leader or presenter)

12. At the end of the **\*whole group learning session**, students will transition into independent CAP assignments.

**\*The phrase, “whole group learning session” is utilized “rather than, the end of the activity” because all of the activities may not be completed in one day.**

**Activity**

The teacher and students will view [Types of Maps and projections](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch02_t02_1.swf) and [Visualizing GPS Satellites\_2.swf](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_GPS_Satellites_2.swf) as a whole group activity.

The teacher will divide students into cooperative learning groups for the following activity:

**Where in the World Are You?**

The GPS system of satellites was originally designed for strategic defense and navigation purposes. Its’ application to other scientific and everyday activities is astounding. For example, during construction of the tunnel under the English Channel, construction crews on the British and the French sides relied on GPS receivers outside the tunnel to check their positions along the way and to make sure they met exactly in the middle. Other examples of how GPS is currently being used are in navigation systems in cars, and to help scientists in tracking caribou or whale migrations. Just think of the possibilities. What kinds of application can you think of? Devise an application that has practical use in ordinary daily lives, or in a scientific application. Describe how you plan to use the GPS within that application.

*Conception of a Global Positioning System (GPS) satellite in orbit. (Illustration courtesy of NASA.)*

**Composition of Earth**

**Georgia Performance Standards**

SCSh1 Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.

a. Exhibit the above traits in their own scientific activities.

b. Recognize that different explanations often can be given for the same evidence.

c. Explain that further understanding of scientific problems relies on the design and execution of new experiments which may reinforce or weaken opposing explanations.

 SCSh2 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.

SCSh3 Students will identify and investigate problems scientifically.

a. Suggest reasonable hypotheses for identified problems.

b. Develop procedures for solving scientific problems.

c. Collect, organize and record appropriate data.

d. Graphically compare and analyze data points and/or summary statistics.

e. Develop reasonable conclusions based on data collected.

f. Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.

SCSh4 Students will use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

a. Develop and use systematic procedures for recording and organizing information.

b. Use technology to produce tables and graphs.

c. Use technology to develop, test, and revise experimental or mathematical models.

SCSh5 Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.

a. Trace the source on any large disparity between estimated and calculated answers to problems.

b. Consider possible effects of measurement errors on calculations.

c. Recognize the relationship between accuracy and precision.

d. Express appropriate numbers of significant figures for calculated data, using scientific notation where appropriate.

e. Solve scientific problems by substituting quantitative values, using dimensional analysis and/or simple algebraic formulas as appropriate.

 SCSh6 Students will communicate scientific investigations and information clearly.

a. Write clear, coherent laboratory reports related to scientific investigations.

b. Write clear, coherent accounts of current scientific issues, including possible alternative interpretations of the data.

c. Use data as evidence to support scientific arguments and claims in written or oral presentations.

d. Participate in group discussions of scientific investigation and current scientific issues.

 SCSh7 Students will analyze how scientific knowledge is developed. Students will recognize that:

a. The universe is a vast single system in which the basic principles are the same everywhere.

b. Universal principles are discovered through observation and experimental verification.

c. From time to time, major shifts occur in the scientific view of how the world works. More often, however, the changes that take place in the body of scientific knowledge are small modifications of prior knowledge. Major shifts in scientific views typically occur after the observation of a new phenomenon or an insightful interpretation of existing data by an individual or research group.

d. Hypotheses often cause scientists to develop new experiments that produce additional data.

e. Testing, revising, and occasionally rejecting new and old theories never ends.

 SCSh8 Students will understand important features of the process of scientific inquiry. Students will apply the following to inquiry learning practices:

a. Scientific investigators control the conditions of their experiments in order to produce valuable data.

b. Scientific researchers are expected to critically assess the quality of data including possible sources of bias in their investigations’ hypotheses, observations, data analyses, and interpretations.

c. Scientists use practices such as peer review and publication to reinforce the integrity of scientific activity and reporting.

d. The merit of a new theory is judged by how well scientific data are explained by the new theory.

e. The ultimate goal of science is to develop an understanding of the natural universe which is free of biases.

f. Science disciplines and traditions differ from one another in what is studied, techniques used, and outcomes sought.

SCSh9 Students will enhance reading in all curriculum areas by:

a. Reading in All Curriculum Areas

Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.

Read both informational and fictional texts in a variety of genres and modes of discourse.

Read technical texts related to various subject areas.

b. Discussing books

Discuss messages and themes from books in all subject areas.

Respond to a variety of texts in multiple modes of discourse.

Relate messages and themes from one subject area to messages and themes in another area.

Evaluate the merit of texts in every subject discipline.

Examine author’s purpose in writing.

Recognize the features of disciplinary texts.

c. Building vocabulary knowledge

Demonstrate an understanding of contextual vocabulary in various subjects.

Use content vocabulary in writing and speaking.

Explore understanding of new words found in subject area texts.

d. Establishing context

Explore life experiences related to subject area content.

**Task: 1**

**Essential Question(s):**

What is an atom?

What are the components of an atom?

What is the concept of isotopes?

**Resources:**

[The Atom](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Atoms3_1.avi)

[Periodic Table of the Elements](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/PeriodicTableoftheElements3_2%20.swf)

[Ionic Bonding](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/IonicBonding3_11.mpg)

[Electron Flow](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/ElectronFlow3_12.SWF)

[pH Scale](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/pHScale3_16.swf)

[Visualizing Bonds](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Bonds_3.swf)

**Teacher’s Place:**

Prior to beginning the performance activity, the teacher should implement the following steps using teaching techniques you have found to be effective for your students.

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2. Display the Georgia Performance Standard(s) (project on blackboard via units of instruction located at <http://thevillage411.weebly.com/units-of-instruction2.html> units of instruction page, or print on blackboard)

3. Read the Georgia Performance Standard(s) aloud and explain it to your students. You can rephrase the Georgia Performance Standard to make sure your students understand it.

4. Display the Essential Question(s) (project on blackboard via units of instruction, or print on blackboard)

5. Read the Essential Question (s) aloud and explain it to your students. You can rephrase the Essential Question (s) to make sure your students understand it.

6. Review unit vocabulary with students. <http://www.glencoe.com/qe/efcsec.php?qi=14446>

7. Introduce the following:

a. Matter and Change: Matter p.60

8. Engage students in conversation by asking students the following question (s): Why are atoms called the basic building blocks of all matter? Write answers on the blackboard.

9. Discuss answers with the students using the following questioning techniques as applicable:

**Questioning Techniques:**

**Memory Questions**

 Signal words: who, what, when, where?

 Cognitive operations: naming, defining, identifying, designating

**Convergent Thinking Questions**

 Signal words: who, what, when, where?

Cognitive operations: explaining, stating relationships, comparing and

contrasting

 **Divergent Thinking Questions**

 Signal words: imagine, suppose, predict, if/then

Cognitive operations: predicting, hypothesizing, inferring, reconstructing

 **Evaluative Thinking Questions**

 Signal words: defend, judge, justify (what do you think)?

10. Guide students into the activity utilizing by viewing:

[The Atom](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Atoms3_1.avi)

[Periodic Table of the Elements](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/PeriodicTableoftheElements3_2%20.swf)

[Ionic Bonding](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/IonicBonding3_11.mpg)

[Electron Flow](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/ElectronFlow3_12.SWF)

[pH Scale](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/pHScale3_16.swf)

[Visualizing Bonds](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Bonds_3.swf)

11. Complete the activity with the students (some tasks may require students to work independently, peer to peer, learning circles [2-3 students] or as a whole group [the entire class]. Therefore the teacher may serve as activity leader and or facilitator. When an activity calls for students to work in learning circles you should assign roles to students individually i.e. recorder, discussion leader or presenter)

12. At the end of the **\*whole group learning session**, students will transition into independent CAP assignments.

**\*The phrase, “whole group learning session” is utilized “rather than, the end of the activity” because all of the activities may not be completed in one day.**

**Activity**

The teacher and students will complete In What State Do You Exist as a whole group activity.

**In What State Do You Exist?**

If you were to stand on a corner of a busy street and ask passers-by the following question, "In what states can matter exist?" would most folks, probably answer, "Oh, that’s easy, there are three, solids, liquids, and gases." What would be your response to their answer? Right or wrong?

They would be wrong. From what we know, there are four states of matter: solids, liquids, gases, and plasmas. Solids, liquids and gases are very familiar in our lives, but matter, as plasmas, is a relatively new idea. Plasmas have been in existence since the very beginnings of the solar system. They exist at very high temperatures and consist of freely moving electrons, which have been stripped from the nuclei of atoms, and ions.

Plasmas are much more common than you would think. "In fact, ninety-nine percent of the universe is in some form of a plasma state, including lightning, very hot flames, nebulas, the Sun, and other stars."

*"Courtesy of SOHO consortium. SOHO*
*is a project of international cooperation between ESA and*
*NASA."* The gases on the sun exist as plasmas."

Here on Earth we see plasmas as lightning, in lighting devices like neon signs, and in the Aurora Borealis. What really makes plasmas special though, is their potential, earthly role in the production of a virtually inexhaustible source of energy through the process of nuclear fusion.

Plasmas are the key to nuclear fusion, which can be simply defined as the combination of lighter atomic nuclei into heavier nuclei, resulting in the release of energy. Scientists believe that the fuel for the fusion process is hydrogen, an element found in abundance on Earth, in the form of water. In order for fusion reactions to occur, the particles must be hot enough (temperature), in sufficient number (density), and well contained (confinement time). The intense gravitational forces present in stars provide these conditions and plasmas exist there naturally. Intense research is currently being conducted to sustain nuclear fusion on Earth. The results could lead to a reduction in energy problems.

**What is the Problem?**

Read again the conditions that are required for fusion to occur:

1. Fusion is such an efficient way to produce energy. Make some educated guesses as to why we aren't using it on Earth now.
2. Review again, the conditions that must be present to maintain a fusion reaction; besides the problems with temperature, are the other two conditions reproducible on earth? What do you think? Why or why not?

**Task: 2**

**Essential Question(s):**

What is a mineral?

How are minerals formed?

How are minerals classified?

**Resources:**

[Mohs Scale of Hardness Concept](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch04_t04_2.swf)

[Special Properties of Minerals Concept](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch04_t04_3.swf)

[Visualizing the Silica Tetrahedron](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_the_Silica_Tetrahedron_4.swf)

**Teacher’s Place:**

Prior to beginning the performance activity, the teacher should implement the following steps using teaching techniques you have found to be effective for your students.

1. Explain the activity (activity requirements)

2. Display the Georgia Performance Standard(s) (project on blackboard via units of instruction located at <http://thevillage411.weebly.com/units-of-instruction2.html> units of instruction page, or print on blackboard)

3. Read the Georgia Performance Standard(s) aloud and explain it to your students. You can rephrase the Georgia Performance Standard to make sure your students understand it.

4. Display the Essential Question(s) (project on blackboard via units of instruction, or print on blackboard)

5. Read the Essential Question (s) aloud and explain it to your students. You can rephrase the Essential Question (s) to make sure your students understand it.

6. Review unit vocabulary with students. <http://www.glencoe.com/qe/efcsec.php?qi=14447>

7. Introduce the following:

a. Minerals: What is a mineral? p.86

8. Engage students in conversation by asking students the following question (s): Are the following items minerals or non minerals: salt, coal, mica, amber, pearl, and sugar. Write answers on the blackboard.

9. Discuss answers with the students using the following questioning techniques as applicable:

**Questioning Techniques:**

**Memory Questions**

 Signal words: who, what, when, where?

 Cognitive operations: naming, defining, identifying, designating

**Convergent Thinking Questions**

 Signal words: who, what, when, where?

Cognitive operations: explaining, stating relationships, comparing and

contrasting

 **Divergent Thinking Questions**

 Signal words: imagine, suppose, predict, if/then

Cognitive operations: predicting, hypothesizing, inferring, reconstructing

 **Evaluative Thinking Questions**

 Signal words: defend, judge, justify (what do you think)?

10. Guide students into the activity by viewing:

[Mohs Scale of Hardness Concept](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch04_t04_2.swf)

[Special Properties of Minerals Concept](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch04_t04_3.swf)

[Visualizing the Silica Tetrahedron](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_the_Silica_Tetrahedron_4.swf)

11. Complete the activity with the students (some tasks may require students to work independently, peer to peer, learning circles [2-3 students] or as a whole group [the entire class]. Therefore the teacher may serve as activity leader and or facilitator. When an activity calls for students to work in learning circles you should assign roles to students individually i.e. recorder, discussion leader or presenter)

12. At the end of the **\*whole group learning session**, students will transition into independent CAP assignments.

**\*The phrase, “whole group learning session” is utilized “rather than, the end of the activity” because all of the activities may not be completed in one day.**

**Activity**

The teacher and students will complete **Gem Sleuths** as a whole group activity.

**Gem Sleuths**

Have you ever heard the saying "A diamond is a girl’s best friend?" What’s that about? Why are diamonds so valuable? What makes a gem, a gem?

Gems have been sought after, and marveled at, for thousands of years and yet, they are just minerals. Gems or gemstones are valuable because they have several valuable characteristics: beauty, rarity, durability, demand, tradition, and portability.

Because they are rare, they are expensive. People have been trying to synthetically duplicate gemstones for many years, sometimes with great success, sometimes not.

A synthetic stone is defined as "a substance which has been produced artificially, and which has the same chemical composition, crystal structure and physical properties as its natural counterpart." As synthetic gemstones become more common, it is important for gemologists, jewelers, and consumers to be familiar with the properties and characteristics of the real thing and the synthetic. How does one tell a synthetic gem from the real thing? Since gems are minerals, characteristics such as luster, hardness, streak color, density and specific gravity, can be used to identify the gem. Another important characteristic, the presence of inclusions, is also helpful in distinguishing a natural gem from a synthetic gem. Many natural gems contain tiny inclusions of other minerals. And many synthetic gems will contain small gas bubbles and faint growth rings. In some cases it may be nearly impossible to tell a natural gem from a synthetic gem.

**Situation:**

You are a gemologist. A customer comes to your shop with two emeralds that they have inherited and they want to know how much to insure them for. You know that emeralds are some of the most successfully synthesized gems and because of this you know you must carefully analyze the gems.

**Problem:**

You go to work and come up with the information in the table below. Use this information and the information from the web resource pages to determine whether these gems are real or synthetic.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Mineral | ChemicalFormula  | Hardness | Type of ImperfectionsPresent  | Color | Specific Gravity | Real or Synthetic? |
| Emerald 1 | Be**3**Al2SiO6 | 7.5 | Parasite crystals | Deep green | 2.7  |   |
| Emerald 2 | Be**3**Al2SiO6 | 7.3 | "Nail head" phenakite crystals, in parallel patterns | Greenwith yellowish tint  | 2.5 |   |

**Reference Websites:**

1. [**The Mineral and Gemstone Kingdom**](http://www.minerals.net/gemstone/gemstone/emerald/emerald.htm)
2. [**Geo Gem - Gemology: Synthetic Gems**](http://www.geogem.com/syntheticgem.html) \*Scroll down to "Synthetic Emeralds (General)"

**Task: 3**

**Essential Question(s):**

What are igneous rock formations?

What is the composition of magma?

What factors affect how rocks melt and crystallize?

**Resources:**

[Types of Magna Concept](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch05_t05_1.swf)

[Visualizing Fractional Crystallixation and Crystal Settling Concept](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Fractional_Crystallixation_and_Crystal_Settling_5.swf)

**Teacher’s Place:**

Prior to beginning the performance activity, the teacher should implement the following steps using teaching techniques you have found to be effective for your students.

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3. Read the Georgia Performance Standard(s) aloud and explain it to your students. You can rephrase the Georgia Performance Standard to make sure your students understand it.

4. Display the Essential Question(s) (project on blackboard via units of instruction, or print on blackboard)

5. Read the Essential Question (s) aloud and explain it to your students. You can rephrase the Essential Question (s) to make sure your students understand it.

6. Review unit vocabulary with students. <http://www.glencoe.com/qe/efcsec.php?qi=14448>

7. Introduce the following:

a. Igneous Rocks: What are Igneous Rocks? p. 112

8. Engage students in conversation by asking students the following question (s): What happens when molten material cools and crystallizes? Write answers on the blackboard.

9. Discuss answers with the students using the following questioning techniques as applicable:

**Questioning Techniques:**

**Memory Questions**

 Signal words: who, what, when, where?

 Cognitive operations: naming, defining, identifying, designating

**Convergent Thinking Questions**

 Signal words: who, what, when, where?

Cognitive operations: explaining, stating relationships, comparing and

contrasting

 **Divergent Thinking Questions**

 Signal words: imagine, suppose, predict, if/then

Cognitive operations: predicting, hypothesizing, inferring, reconstructing

 **Evaluative Thinking Questions**

 Signal words: defend, judge, justify (what do you think)?

10. Guide students into the activity by viewing: [Types of Magna Concept](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch05_t05_1.swf) and

[Visualizing Fractional Crystallization and Crystal Settling Concept](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Fractional_Crystallixation_and_Crystal_Settling_5.swf)

11. Complete the activity with the students (some tasks may require students to work independently, peer to peer, learning circles [2-3 students] or as a whole group [the entire class]. Therefore the teacher may serve as activity leader and or facilitator. When an activity calls for students to work in learning circles you should assign roles to students individually i.e. recorder, discussion leader or presenter)

12. At the end of the **\*whole group learning session**, students will transition into independent CAP assignments.

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**Activity**

The teacher and students will complete Igneous Rocks from Deep Within as a whole group activity.

**Igneous Rocks from Deep Within**

**Introduction:**

In Jules Verne’s novel, "Journey to the Center of the Earth," Professor Hardwigg and his nephew, Harry, take a journey down into the interior of Earth. As they traveled deeper and deeper, they encountered strange "worlds," a mid-earth ocean, and odd forms of life, all unlike anything on the surface. Their discoveries on this fictional adventure were far different from what scientists have determined that our Earth is actually like below the surface.

Today, scientists describe Earth as being divided into four layers, the solid inner core, the liquid outer core, the mantle and the crust. They tell us that the crust is made of rocks composed primarily of granite and basalt. The mantle is composed of a rock called peridotite, and parts of the upper mantle are partially melted. The core is composed of iron and nickel. The outer core is liquid and the inner core is solid. Have you ever wondered how we know all of this?

Well, most of our information comes from studying seismic wave travel times and patterns of seismic waves produced by earthquakes. Using over 100 years of seismic data, Earth’s interior has been mapped pretty precisely, but this evidence is indirect. Geologists, like other scientists, long to put their hands on mantle material and so they seek concrete evidence to support the findings from the indirect methods.

Our most direct evidence of what the mantle is made of comes from one of our most precious gems–diamonds, and the type of igneous rock in which they are found – kimberlites.

Kimberlites are formed from magma that comes from deep within the mantle in explosive eruptions. The diamonds are not formed in the eruption. They form at great depths, where intense heat and pressure allow the carbon atoms that make up the diamond to form the dense crystalline structure that makes diamonds so hard and dense. The eruption simply acts as the elevator, bringing them rapidly to the surface. Not only do these eruptions bring diamonds up from the mantle but the diamonds often contain inclusions or small bits of rock from the mantle. These little inclusions are more precious to the geologist than the diamond. These inclusions are the hard evidence that geologists are searching for!

So, what’s the problem? Well, let’s get back to the kimberlites. Their shapes are quite different from most igneous rock intrusions. Your text describes them as tube shaped, but most sources describe them as carrot shaped, 30-90 m across at the surface, narrowing as you descend. This shape indicates a rapid rise and explosion as the magma reached the surface.

**Problem:**

**Think About This-**What conditions could have created a narrow at depth, wider as it nears the surface, kind of "blow hole."

Things to think about as you tackle this problem:

* Composition of the magma.
* Substances encountered on the way up.
* How conditions of heat and pressure change as the magma is forced to the surface
* How these changes might affect the substances in the magma.
* How the intense heat and rapid rise of the magma may affect the substances, like groundwater, as it is encountered as the magma is forced to the surface.
* Watch the animation of diamonds being brought to the surface and the eruption that brings them. (Scroll down below the first diagram for the link)
[**http://geology.about.com/science/geology/ gi/dynamic/offsite.htm?http://www.amnh.org /exhibitions/diamonds/**](http://geology.about.com/science/geology/%20gi/dynamic/offsite.htm?http://www.amnh.org%20/exhibitions/diamonds/)

**Surface Processes on Earth**

**Georgia Performance Standards**

SCSh1 Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.

a. Exhibit the above traits in their own scientific activities.

b. Recognize that different explanations often can be given for the same evidence.

c. Explain that further understanding of scientific problems relies on the design and execution of new experiments which may reinforce or weaken opposing explanations.

 SCSh2 Students will use standard safety practices for all classroom laboratory and field investigations.

a. Follow correct procedures for use of scientific apparatus.

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SCSh3 Students will identify and investigate problems scientifically.

a. Suggest reasonable hypotheses for identified problems.

b. Develop procedures for solving scientific problems.

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e. Develop reasonable conclusions based on data collected.

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 SCSh6 Students will communicate scientific investigations and information clearly.

a. Write clear, coherent laboratory reports related to scientific investigations.

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d. Participate in group discussions of scientific investigation and current scientific issues.

 SCSh7 Students will analyze how scientific knowledge is developed. Students will recognize that:

1. The universe is a vast single system in which the basic principles are the same

everywhere.

b. Universal principles are discovered through observation and experimental verification.

c. From time to time, major shifts occur in the scientific view of how the world works. More often, however, the changes that take place in the body of scientific knowledge are small modifications of prior knowledge. Major shifts in scientific views typically occur after the observation of a new phenomenon or an insightful interpretation of existing data by an individual or research group.

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d. The merit of a new theory is judged by how well scientific data are explained by the new theory.

e. The ultimate goal of science is to develop an understanding of the natural universe which is free of biases.

f. Science disciplines and traditions differ from one another in what is studied, techniques used, and outcomes sought.

SCSh9 Students will enhance reading in all curriculum areas by:

a. Reading in All Curriculum Areas

Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.

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Discuss messages and themes from books in all subject areas.

Respond to a variety of texts in multiple modes of discourse.

Relate messages and themes from one subject area to messages and themes in another area.

Evaluate the merit of texts in every subject discipline.

Examine author’s purpose in writing.

Recognize the features of disciplinary texts.

c. Building vocabulary knowledge

Demonstrate an understanding of contextual vocabulary in various subjects.

Use content vocabulary in writing and speaking.

**Task: 1**

**Essential Question(s):**

What are the differences between mechanical weathering and chemical weathering?

What are the factors that affect mechanical weathering and chemical weathering?

What variables affect the rate of weathering?

**Resources:**

[Visualizing Soil Orders Concept](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Soil_Orders_7.swf)

**Teacher’s Place:**

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6. Review unit vocabulary with students. <http://www.glencoe.com/qe/efcsec.php?qi=14450>

7. Introduce the following:

a. Weathering, Erosion, and Soil: Weathering p. 164

8. Engage students in conversation by having students to give the definition of weather and weathering.: What causes the materials on or near earth’s surface to break down? Write answers on the blackboard.

9. Discuss answers with the students using the following questioning techniques as applicable:

**Questioning Techniques:**

**Memory Questions**

 Signal words: who, what, when, where?

 Cognitive operations: naming, defining, identifying, designating

**Convergent Thinking Questions**

 Signal words: who, what, when, where?

Cognitive operations: explaining, stating relationships, comparing and

contrasting

 **Divergent Thinking Questions**

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Cognitive operations: predicting, hypothesizing, inferring, reconstructing

 **Evaluative Thinking Questions**

 Signal words: defend, judge, justify (what do you think)?

10. Guide students into the activity by viewing [Visualizing Soil Orders Concept](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Soil_Orders_7.swf)

11. Complete the activity with the students (some tasks may require students to work independently, peer to peer, learning circles [2-3 students] or as a whole group [the entire class]. Therefore the teacher may serve as activity leader and or facilitator. When an activity calls for students to work in learning circles you should assign roles to students individually i.e. recorder, discussion leader or presenter)

12. At the end of the **\*whole group learning session**, students will transition into independent CAP assignments.

**\*The phrase, “whole group learning session” is utilized “rather than, the end of the activity” because all of the activities may not be completed in one day.**

**Activity**

The teacher and students will complete Where has all the Soil Gone as a whole group activity.

**Where Has All the Soil Gone?**

Erosion by water and wind are naturally occurring processes that have formed many of the natural wonders that we treasure and seek to preserve in our national parks. Erosion by water was the sole creator of the Grand Canyon and the intricately beautiful landscape called the Badlands National Park in South Dakota. Winds have carried tons and tons of sand to create the area we call Great Sand Dunes National Park in Colorado and it has sculpted many of the desert monuments in Monument Valley throughout Utah and Arizona.

These wonders of nature are treasures to humans. Yet the word erosion often carries with it a negative connotation, doesn’t it? When we think of erosion we think of beach erosion and soil erosion, two processes that humans fight to prevent with various methods, some more successful than others.

Soil formation, as you know, is a slow process. "Soil-making processes are notoriously slow, requiring from 200 to 1,000 years to form 2.5 centimeters of topsoil under normal agricultural conditions." And due to various activities of humans and "depending on the region, topsoil is currently being lost 16 to 300 times faster than it can be replaced." This is a dismal set of statistics to be sure, but there are efforts taking place to conserve soil through various means. No one soil conservation management system works in every area due to differences in soil type, topography, type of farming operation, and climate. Conservation practices, which reduce wind speed, reduce rate and amount of water movement, and/or increase soil organic matter levels, continue to spread worldwide, giving soil a chance to remain where it is and to remain fertile.

With this in mind take a look at the map below to see how our country fares in the area of wind and soil erosion:

First lets look at what this map shows:

* Estimated water and wind erosion on cropland or agricultural land only.
* The gray areas are Federal lands and are not included in the data though erosion is happening on those lands as well.
* Each blue dot represents 200,000 tons of average annual erosion due to water (1,068 million tons per year).
* Each red dot represents 200,000 tons of average annual erosion due to wind (840.5million tons per year).

**Problem:**

* Locate the region of the country that you live in. How would you describe the soil erosion problems in your area based on this map?
* What pattern do you note for the relationship between water erosion and river watershed areas?
* In what areas of the country is wind erosion common? Are there any patterns discernable here?

**Think About This:**

Looking at the water erosion areas and their relationship to rivers:

* Where does all of this soil go?
	+ Does it make it to the oceans?
	+ If it does, what landforms are created at the mouths of rivers as the stream flow decreases and the soil carried by the water is deposited there?
	+ Why are these areas so fertile?

**Another thought:**

Much of the East Coast of the United States has beach erosion problems. Normally this sediment reaches the coast and provides sand for beaches. However, today, this natural flow of sediment has been interrupted or halted in many areas.

* What factors may cause the disruption of sediment reaching the coasts?

**Task: 2**

**Essential Question(s):**

What is the relationship between gravity and mass movement?

What factors affect mass movement?

What affect does mass movement have on people?

**Resources:**

[Rockslides](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Rockslides8_7.swf)

[Dune Migration](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/DuneMigration8_18.swf)

[Glacier Formaiton](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/GlacierFormaiton8_20.avi)

[Types of Dunes Concept](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch08_t08_1.swf)

[Visualizing Continental Glacial Features](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Continental_Glacial_Features_8.swf)

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5. Read the Essential Question (s) aloud and explain it to your students. You can rephrase the Essential Question (s) to make sure your students understand it.

6. Review unit vocabulary with students. <http://www.glencoe.com/qe/efcsec.php?qi=14451>

7. Introduce the following:

a. Mass, Mass Movements Movements, Wind, and Glaciers: p.192

8. Engage students in conversation by asking students the following question (s): How does gravity cause mass movement to occur? Write answers on the blackboard.

9. Discuss answers with the students using the following questioning techniques as applicable:

**Questioning Techniques:**

**Memory Questions**

 Signal words: who, what, when, where?

 Cognitive operations: naming, defining, identifying, designating

**Convergent Thinking Questions**

 Signal words: who, what, when, where?

Cognitive operations: explaining, stating relationships, comparing and

contrasting

 **Divergent Thinking Questions**

 Signal words: imagine, suppose, predict, if/then

Cognitive operations: predicting, hypothesizing, inferring, reconstructing

 **Evaluative Thinking Questions**

 Signal words: defend, judge, justify (what do you think)?

10. Guide students into the activity by viewing:

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11. Complete the activity with the students (some tasks may require students to work independently, peer to peer, learning circles [2-3 students] or as a whole group [the entire class]. Therefore the teacher may serve as activity leader and or facilitator. When an activity calls for students to work in learning circles you should assign roles to students individually i.e. recorder, discussion leader or presenter)

12. At the end of the **\*whole group learning session**, students will transition into independent CAP assignments.

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**Activity**

The teacher and students will review Slipping and Sliding: Landslides as a whole group activity. Then the teacher will place the students into cooperative learning groups to complete the activity.

**Slipping and Sliding: Landslides**

|  |
| --- |
| **Extra! Extra! Read all about it!****The Oregonian****Landslides again threaten to close portion of U.S. 101**Saturday, January 8, 2000"An area along U.S. 101 about 10 miles north of Florence continues to plague travelers with landslides that might close the road through the weekend.For the second time in a week, more than 50 yards of mud and rocks slid across the highway Thursday and kept it closed through early afternoon Friday. Although the highway was passable later Friday early afternoon, Oregon Department of Transportation officials advised people to find alternate routes."**Muzi.com News: [LatelineNews: 3/12/1998]****Jiangxi Landslides Killed 4 People**"Four people were reportedly killed and three others seriously injured late Sunday night and early Monday morning after they were hit by two landslides in the city of Ruijin in the southern Jiangxi Province, China Daily reported. The landslides occurred after the area had been pounded by heavy rainfall for three days, affecting 82 villages in 11 townships, blocking local roads and shutting down telecommunications services."**The Atlantic Monthly**January 1, 1999**"The Liquid Earth"** by Brenda Bell"Ground failures of various sorts occur in every state; according to the National Research Council, they annually cause more deaths (twenty-five to fifty) and greater economic loss (roughly estimated at $1.5 billion) than all other natural hazards combined." |

**Problem:**

**Background Information**

Take a look at these headlines and news excerpts. They are indicative of the fear, unpredictability, and devastation that are characteristic of mass movements, such as land and mudslides. Pretty nasty events, and costly too, don’t you think?

As human populations grow, and our desire to build and live in areas vulnerable to mass movements increases, the risks of economic loss and loss of life will continue to rise. In an effort to reduce the risk from landslides, United States Geological Survey scientists monitor and study conditions in steeply sloped areas. In 1998 a study was performed in an effort to determine the "threshold temperature" after which landslides are most likely to occur in connection with winter snow-melt. The ability to predict the threshold temperature allows the USGS, and other governmental agencies, to issue warnings of increased potential for landslide activity in areas that are susceptible to snowmelt landslides. The early warnings have the potential to save lives and possibly prevent destruction of property.

**Analysis:**

The graph below was included in the study to present the data collected. Look at the graph, the key, and the explanation below it to determine the following.

First let’s practice reading the graph:

1. How many landslide events occurred within week 1 at threshold temperature 56o? What percent would this be?
2. How many landslide events occurred within week 3 at threshold temperature 56o? What percent would this be?
3. Look at the line that records the number of events that occurred within week 3. After the occurrence of which threshold temperature did 21 of the events occur?
4. At what threshold temperature does the 2-week line intersect with the 3-week line and how many events had occurred at that temperature?

Now,

1. Imagine you are a member of the research team that performed this study and you must make a recommendation to agencies about when to warn the citizens living in your community about the potential risk of landslides. Following the occurrence of which threshold temperature would you recommend issuing warnings and what evidence would you use to support your recommendation?
2. Ask your teacher to let you know if your findings agree with what the actual researchers found.

**Task: 3**

**Essential Question(s):**

How does surface water move weathered material?

How does a stream carry its load?

How does a floodplain develop?

**Resources:**

[Water Cycle Concept](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/WaterCycle9_1.swf)

[Meander Formation](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/MeanderFormaiton9_14%20.avi)

[Visualizing Erosion and Deposition](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Erosion_and_Deposition_in_a_Meander_9.swf)

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7. Introduce the following:

a. Surface Water: Surface Water Movement p.224

8. Engage students in conversation by asking students the following question (s): What makes up clouds? Write answers on the blackboard.

9. Discuss answers with the students using the following questioning techniques as applicable:

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**Activity**

The teacher and students will complete Wetlands: Worthless or Worth Saving? as a whole group activity.

**Wetlands: Worthless or Worth Saving?**

Historically, wetlands have been seen as land with little or no monetary value. Over the years, they have been drained and filled in. Between the late 1700s and the mid-1980s, over half of the wetlands in the lower 48 states were lost primarily for agricultural purposes, and more recently for building and development projects. Times are changing, and we are beginning to realize that wetlands are economically valuable in many ways. For example, did you know that more than half of all U.S. adults (98 million people) hunt, fish, bird watch, or photograph wildlife? These activities, which rely on healthy wetlands, added an estimated $59.5 million to the national economy in 1991. As a second example, an estimated 71% of the $26.8 billion a year fishery processing and sales industry is derived from fish species that during their life cycles depend directly or indirectly on coastal wetlands. That’s no small change!

Your text also describes wetlands as being important in flood control. And wetlands are vital in maintaining water quality by filtering out sediments and pollutants as water flows through them.

It is not very difficult to assign a dollar value to the contributions of wetlands involving the recreation and fishing industries. However in other instances, it is difficult to put a dollar value on what "services" wetlands provide. Flood control is an example of a service provided by wetlands. Unlike the dollar value assigned by the fishing or recreation industries, it is difficult to put a dollar value on wetlands for preventing flood damage.

It can be somewhat mind boggling to follow the many different methods of estimation used to determine the economic value of an acre of wetland, so we won’t go into all that. The following estimate, $9,600 per acre, per year, is based on estimates from 12 different studies (in 1996 dollar values).

**Problem:**

1. Based on the estimate of $9,600 per acre per year, and the information below, what is the estimated annual value of the services and real contributions provided by wetlands?

About 100 million acres of wetlands remain today in the lower 48 states, representing less than 5% of the landmass in the continental United States.

1. What percent of the Gross Domestic Product (GDP) for 1996 would this be?

\*Gross Domestic Product is the total output of goods and services produced by labor and property in the United States, at value market prices.

GDP – 1996 – 7,813.2 billion dollars

1. So, what do you think? Are wetlands worth saving or worthless?

**The Atmosphere and the Oceans**

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Relate messages and themes from one subject area to messages and themes in another area.

Evaluate the merit of texts in every subject discipline.

Examine author’s purpose in writing.

Recognize the features of disciplinary texts.

c. Building vocabulary knowledge

Demonstrate an understanding of contextual vocabulary in various subjects.

Use content vocabulary in writing and speaking.

Explore understanding of new words found in subject area texts.

d. Establishing context

Explore life experiences related to subject area content.

**Task: 1**

**Essential Question(s):**

What are the gas and particle compositions of the atmosphere?

How is energy transferred into the atmosphere?

**Resources:**

[Conduction Convection and Radiation](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/ConductionConvectionandRadiation11_7.avi)

[Components of the Atmosphere](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch11_t11_1.swf)

[Visualizing the Layers of the Atmosphere](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_the_Layers_of_the_Atomsphere_11.swf)

**Teacher’s Place:**

Prior to beginning the performance activity, the teacher should implement the following steps using teaching techniques you have found to be effective for your students.

1. Explain the activity (activity requirements)

2. Display the Georgia Performance Standard(s) (project on blackboard via units of instruction located at <http://thevillage411.weebly.com/units-of-instruction2.html> units of instruction page, or print on blackboard)

3. Read the Georgia Performance Standard(s) aloud and explain it to your students. You can rephrase the Georgia Performance Standard to make sure your students understand it.

4. Display the Essential Question(s) (project on blackboard via units of instruction, or print on blackboard)

5. Read the Essential Question (s) aloud and explain it to your students. You can rephrase the Essential Question (s) to make sure your students understand it.

6. Review unit vocabulary with students. <http://www.glencoe.com/qe/efcsec.php?qi=14454>

7. Introduce the following:

a. Atmosphere: Atmospheric Basics p.282

8. Engage students in conversation by asking students the following question (s): How is energy transferred throughout earth’s atmosphere? Write answers on the blackboard.

9. Discuss answers with the students using the following questioning techniques as applicable:

**Questioning Techniques:**

**Memory Questions**

 Signal words: who, what, when, where?

 Cognitive operations: naming, defining, identifying, designating

**Convergent Thinking Questions**

 Signal words: who, what, when, where?

Cognitive operations: explaining, stating relationships, comparing and

contrasting

 **Divergent Thinking Questions**

 Signal words: imagine, suppose, predict, if/then

Cognitive operations: predicting, hypothesizing, inferring, reconstructing

 **Evaluative Thinking Questions**

 Signal words: defend, judge, justify (what do you think)?

10. Guide students into the activity by viewing:

[Conduction Convection and Radiation](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/ConductionConvectionandRadiation11_7.avi)

 [Components of the Atmosphere](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch11_t11_1.swf)

[Visualizing the Layers of the Atmosphere](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_the_Layers_of_the_Atomsphere_11.swf)

11. Complete the activity with the students (some tasks may require students to work independently, peer to peer, learning circles [2-3 students] or as a whole group [the entire class]. Therefore the teacher may serve as activity leader and or facilitator. When an activity calls for students to work in learning circles you should assign roles to students individually i.e. recorder, discussion leader or presenter)

12. At the end of the **\*whole group learning session**, students will transition into independent CAP assignments.

**\*The phrase, “whole group learning session” is utilized “rather than, the end of the activity” because all of the activities may not be completed in one day.**

**Activity**

The teacher and students will review A Weighty Matter as a whole group activity. Students will then be placed in cooperative learning groups to complete the activity.

**A Weighty Matter**

Every second of every minute of every hour of every day our bodies are being pressed in at all points by the air that surrounds us, and we don’t even notice. We live in an ocean of gases—nitrogen, oxygen, carbon dioxide, water vapor, argon, and traces of other gases in extremely small amounts. Because the atoms that make up each of the atmospheric gases has mass, the gravity of Earth attracts the mass of the atoms. This gravitational pull of the air toward Earth causes air pressure.

To form a mental picture of "air pressure," picture this a column of air that is as tall as the atmosphere 500 km at the upper reaches of thermosphere and 1 inch by 1 inch wide (see diagram below). Let’s think about how this affects us. We will use inches for this problem instead of centimeters because one of the standard units for pressure is psi (pounds per square inch).

On Earth, the average pressure at sea level caused by a column of air such as this is 14.7 pounds per square inch (14.7 psi). This means that the pressure on that 1-inch by 1-inch square on Earth’s surface is equal to a weight of 14.7 pounds or 6.62 kilograms.

**Problem:**

Since we live at the bottom of this "ocean" of air, each inch of our bodies has 14.7 psi being exerted upon it. If the average surface area of the skin of an adult is about 3100 in2, how many total pounds of pressure are being exerted on his or her body? Why don’t we implode? How would this amount change as we went up in altitude? Why?

**Task: 2**

**Essential Question(s):**

What is weather?

What is climate?

How is weather created?

How are air masses formed?

**Resources:**

[Fronts](%20http%3A/glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Fronts12_8.swf)

[Air Mass Characteristics](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch12_t12_1.swf)

[Visualizing the Coriolis Effect](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_the_Coriolis_Effect_12.swf)

**Teacher’s Place:**

Prior to beginning the performance activity, the teacher should implement the following steps using teaching techniques you have found to be effective for your students.

1. Explain the activity (activity requirements)

2. Display the Georgia Performance Standard(s) (project on blackboard via units of instruction located at <http://thevillage411.weebly.com/units-of-instruction2.html> units of instruction page, or print on blackboard)

3. Read the Georgia Performance Standard(s) aloud and explain it to your students. You can rephrase the Georgia Performance Standard to make sure your students understand it.

4. Display the Essential Question(s) (project on blackboard via units of instruction, or print on blackboard)

5. Read the Essential Question (s) aloud and explain it to your students. You can rephrase the Essential Question (s) to make sure your students understand it.

6. Review unit vocabulary with students. <http://www.glencoe.com/qe/efcsec.php?qi=14455>

7. Introduce the following:

a. Meteorology: The Causes of Weather p.314

8. Engage students in conversation by asking students the following question (s): What is the difference between weather and climate? Write answers on the blackboard.

9. Discuss answers with the students using the following questioning techniques as applicable:

**Questioning Techniques:**

**Memory Questions**

 Signal words: who, what, when, where?

 Cognitive operations: naming, defining, identifying, designating

**Convergent Thinking Questions**

 Signal words: who, what, when, where?

Cognitive operations: explaining, stating relationships, comparing and

contrasting

 **Divergent Thinking Questions**

 Signal words: imagine, suppose, predict, if/then

Cognitive operations: predicting, hypothesizing, inferring, reconstructing

 **Evaluative Thinking Questions**

 Signal words: defend, judge, justify (what do you think)?

10. Guide students into the activity by viewing:

 [Fronts](%20http%3A/glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Fronts12_8.swf)

[Air Mass Characteristics](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch12_t12_1.swf)

[Visualizing the Coriolis Effect](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_the_Coriolis_Effect_12.swf)

11. Complete the activity with the students (some tasks may require students to work independently, peer to peer, learning circles [2-3 students] or as a whole group [the entire class]. Therefore the teacher may serve as activity leader and or facilitator. When an activity calls for students to work in learning circles you should assign roles to students individually i.e. recorder, discussion leader or presenter)

12. At the end of the **\*whole group learning session**, students will transition into independent CAP assignments.

**\*The phrase, “whole group learning session” is utilized “rather than, the end of the activity” because all of the activities may not be completed in one day.**

**Activity**

The teacher and students will complete Flight Height and the Jet Stream as a whole group activity. Students will then be placed in cooperative learning groups to complete the activity.

**Flight Height and the Jet Stream**

If you have ever witnessed the flight of a hot air balloon, you know that it is an amazingly beautiful sight as it silently floats through the air. The only sound is from an occasional burst of the burners as a flame is lit to keep the air inside the balloon warm. As you learned in the last chapter, the top of the troposphere occurs roughly at 10 km. At these same altitudes, we find one of the most dynamic and influential wind systems on Earth—the jet streams. These wind systems are extensively studied by balloonists seeking to use them to their advantage in attempts at making trips around the world, and record setting balloon voyages.

As an amateur balloonist, for this problem, you need to take a crash course in "Jet Steam 101."

Characteristics of the jet stream that are important to know:

* blow from west to east around the world
* are a few hundred feet wide and often less than three feet thick
* reach average speeds of 120 mph
* usually stronger in the winter
* their changing nature can make them a "wild ride" rather than bringing smooth sailing
* jet streams are affected by surface conditions such that they sometimes take a sharp northerly route and then bend back toward the south in what are called ridges and troughs
* their altitude may change in varying degrees
* near the poles, they are generally found at lower altitudes (8 km)
* near the equator they can be found at higher latitudes, about 16 km
* the transition between altitudes is not always smooth, but can be abrupt

**Problem:**

Imagine that you are a balloonist in the planning stages of attempting a record setting, trans-USA balloon flight. You know that the jet stream is going to be the key to your success. Armed with a top of the line balloon that will get you to the altitudes that are required, basic knowledge of the jet streams given above, and a map of the jet steam on the day you are going to make your trip, **plot a course for your trip.**

Use the map at bottom of this Web page  [**http://ww2010.atmos.uiuc.edu/(Gh)/
guides/mtr/cyc/upa/jet.rxml**](http://ww2010.atmos.uiuc.edu/%28Gh%29/guides/mtr/cyc/upa/jet.rxml)

\*Notice the wind speed key at the bottom of the map. Also notice that there are "two" jet streams over the U. S.

These are some of the things you will want to consider when planning the route:

* From what point will you launch (what city)?
* At what general speed will you travel?
* At what general altitude?
* Will you have to beware of any ridges or troughs in the jet stream that may take you out of the way, and lengthen your journey? Can they be avoided?
* What time of year will your flight take place?
* Where is your approximate landing point (what city)?

**Task: 3**

**Essential Question(s):**

How are thunderstorm formed?

What is the cycle life of a thunderstorm?

**Resources:**

[Thunderstorms Development](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/ThunderstormsDevelopment13_1.swf)

[Tornado Formation](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/TornadoFormation13_10.swf)

[Tropical Cyclones](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/TropicalCyclones13_12.swf)

[Fujita Tornado Intensity Scale](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch13_t13_1.swf)

[The Heat Index](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch13_t13_2.swf)

[Visualizing Cyclone Formation](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Cyclone_Formaiton_13.swf)

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5. Read the Essential Question (s) aloud and explain it to your students. You can rephrase the Essential Question (s) to make sure your students understand it.

6. Review unit vocabulary with students. <http://www.glencoe.com/qe/efcsec.php?qi=14456>

7. Introduce the following:

a. The Nature of Storms: Thunderstorms p.344

8. Engage students in conversation by asking students the following question (s): What determines the intensity and duration of a thunder storm? Write answers on the blackboard.

9. Discuss answers with the students using the following questioning techniques as applicable:

**Questioning Techniques:**

**Memory Questions**

 Signal words: who, what, when, where?

 Cognitive operations: naming, defining, identifying, designating

**Convergent Thinking Questions**

 Signal words: who, what, when, where?

Cognitive operations: explaining, stating relationships, comparing and

contrasting

 **Divergent Thinking Questions**

 Signal words: imagine, suppose, predict, if/then

Cognitive operations: predicting, hypothesizing, inferring, reconstructing

 **Evaluative Thinking Questions**

 Signal words: defend, judge, justify (what do you think)?

10. Guide students into the activity by viewing:

[Thunderstorms Development](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/ThunderstormsDevelopment13_1.swf)

[Tornado Formation](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/TornadoFormation13_10.swf)

[Tropical Cyclones](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/TropicalCyclones13_12.swf)

[Fujita Tornado Intensity Scale](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch13_t13_1.swf)

[The Heat Index](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch13_t13_2.swf)

[Visualizing Cyclone Formation](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Cyclone_Formaiton_13.swf)

11. Complete the activity with the students (some tasks may require students to work independently, peer to peer, learning circles [2-3 students] or as a whole group [the entire class]. Therefore the teacher may serve as activity leader and or facilitator. When an activity calls for students to work in learning circles you should assign roles to students individually i.e. recorder, discussion leader or presenter)

12. At the end of the **\*whole group learning session**, students will transition into independent CAP assignments.

**\*The phrase, “whole group learning session” is utilized “rather than, the end of the activity” because all of the activities may not be completed in one day.**

**Activity**

The teacher and students will complete Doppler Radar: A Key to Tracking Severe Weather the Perfect Storm as a whole group activity. Students will then be placed in cooperative learning groups to complete the activity.

**Doppler Radar: A Key to Tracking Severe Weather the Perfect Storm**

In the 2000 blockbuster movie, "The Perfect Storm," the captain of the swordfish ship, *Andrea Gail*, received regular weather reports via a type of onboard FAX system. The captain monitored weather factors, such as barometric pressure, temperature, wind speed, and radar images that showed the converging paths of three storm systems. In this true story, the three weather systems met head on, out in the North Atlantic, to produce one of the most intense storms in recorded history. Receiving meteorological reports allows ship captains to keep their ship and crew out of harms way, and in good fishing waters.

**Severe or Clear?**

Severe or Clear? When the weather is clear, we don't pay much attention to the weather reports given by the local meteorologists. But in the event of a severe weather system, such as a blizzard, thunderstorm, hurricane, or tornado we look to them to give us the most current, precise information possible. We expect them to predict the path of these storms, to tell us how fast the winds will blow, when to expect them in our area, and when the storms will be over. One of the most important tools used by the meteorologist to provide us with this information is Doppler radar. Doppler radar works by using the reflective nature of water in the atmosphere. Radar waves are sent out from a transmitter. These waves bounce off of, and are scattered by, raindrops, hail, and other things like large flocks of birds and buildings. As the scattered radar beam returns to the radar station, a receiver collects and measures the intensity of the beam. An image is produced from the returned radar beams giving information about a storm's intensity. The image is usually color enhanced by computers to clearly show the intensity of the weather activity within a storm system.

**Problem 1**

Look at the Doppler radar image below. You can see that various colors are used to represent the different intensities of precipitation within a storm. Using the key beside the radar image, determine where the centers of heaviest precipitation are located. If you were a weather forecaster, how would you describe this storm that is affecting the state of Texas?

**Problem 2**

Doppler radar is also used to detect the relative velocity of storm movement, that is, the motion of winds toward and away from the radar location. In a relative storm velocity image, blues and greens represent parts of the storm system where winds are moving toward the radar, and reds and yellows represent winds blowing away from the radar. A combination of these two colors extremely close to each other in a very small area of the radar image, is often the signature of a tornado. Take a look at the Doppler radar images below. Locate the tornado signatures.

Take a look at the Doppler radar images below. Can you find the tornado signatures? 1.

2.

**NOAA**

1. <http://www.nssl.noaa.gov/noaastory/book.html>
2. <http://www.spc.noaa.gov/coolimg/cape_may.htm>

**Websites to Visit:**

1. [**IMAX Film - Storm Chasers: Streaming Video of Tornado formation**](http://redrock.ncsa.uiuc.edu/AOS/imax.html)
2. [**The Franklin Institute Online: Radar-ology**](http://sln.fi.edu/weather/radar/radar.html)
3. [**Radar Meteorology: Online Remote Sensing Guide**](http://ww2010.atmos.uiuc.edu/%28Gh%29/guides/rs/rad/home.rxml)
4. [**Severe Storms: Online Meteorology Guide**](http://ww2010.atmos.uiuc.edu/%28Gh%29/guides/mtr/svr/home.rxml)

**The Dynamic Earth**

**Georgia Performance Standards**

SCSh1 Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.

a. Exhibit the above traits in their own scientific activities.

b. Recognize that different explanations often can be given for the same evidence.

c. Explain that further understanding of scientific problems relies on the design and execution of new experiments which may reinforce or weaken opposing explanations.

 SCSh2 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.

SCSh3 Students will identify and investigate problems scientifically.

a. Suggest reasonable hypotheses for identified problems.

b. Develop procedures for solving scientific problems.

c. Collect, organize and record appropriate data.

d. Graphically compare and analyze data points and/or summary statistics.

e. Develop reasonable conclusions based on data collected.

f. Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.

SCSh4 Students will use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

a. Develop and use systematic procedures for recording and organizing information.

b. Use technology to produce tables and graphs.

c. Use technology to develop, test, and revise experimental or mathematical models.

SCSh5 Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.

a. Trace the source on any large disparity between estimated and calculated answers to problems.

b. Consider possible effects of measurement errors on calculations.

c. Recognize the relationship between accuracy and precision.

d. Express appropriate numbers of significant figures for calculated data, using scientific notation where appropriate.

e. Solve scientific problems by substituting quantitative values, using dimensional analysis and/or simple algebraic formulas as appropriate.

 SCSh6 Students will communicate scientific investigations and information clearly.

a. Write clear, coherent laboratory reports related to scientific investigations.

b. Write clear, coherent accounts of current scientific issues, including possible alternative interpretations of the data.

c. Use data as evidence to support scientific arguments and claims in written or oral presentations.

d. Participate in group discussions of scientific investigation and current scientific issues.

 SCSh7 Students will analyze how scientific knowledge is developed. Students will recognize that:

a. The universe is a vast single system in which the basic principles are the same everywhere.

b. Universal principles are discovered through observation and experimental verification.

c. From time to time, major shifts occur in the scientific view of how the world works. More often, however, the changes that take place in the body of scientific knowledge are small modifications of prior knowledge. Major shifts in scientific views typically occur after the observation of a new phenomenon or an insightful interpretation of existing data by an individual or research group.

d. Hypotheses often cause scientists to develop new experiments that produce additional data.

e. Testing, revising, and occasionally rejecting new and old theories never ends.

 SCSh8 Students will understand important features of the process of scientific inquiry. Students will apply the following to inquiry learning practices:

a. Scientific investigators control the conditions of their experiments in order to produce valuable data.

b. Scientific researchers are expected to critically assess the quality of data including possible sources of bias in their investigations’ hypotheses, observations, data analyses, and interpretations.

c. Scientists use practices such as peer review and publication to reinforce the integrity of scientific activity and reporting.

d. The merit of a new theory is judged by how well scientific data are explained by the new theory.

e. The ultimate goal of science is to develop an understanding of the natural universe which is free of biases.

f. Science disciplines and traditions differ from one another in what is studied, techniques used, and outcomes sought.

SCSh9 Students will enhance reading in all curriculum areas by:

a. Reading in All Curriculum Areas

Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.

Read both informational and fictional texts in a variety of genres and modes of discourse.

Read technical texts related to various subject areas.

b. Discussing books

Discuss messages and themes from books in all subject areas.

Respond to a variety of texts in multiple modes of discourse.

Relate messages and themes from one subject area to messages and themes in another area.

Evaluate the merit of texts in every subject discipline.

Examine author’s purpose in writing.

Recognize the features of disciplinary texts.

c. Building vocabulary knowledge

Demonstrate an understanding of contextual vocabulary in various subjects.

Use content vocabulary in writing and speaking.

Explore understanding of new words found in subject area texts.

d. Establishing context

Explore life experiences related to subject area content.

**Task: 1**

**Essential Question(s):**

What is continental drift?

How does evidence of Ancient climates support continental drift?

**Resources:**

[Continental Drift](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/ContinentalDrift17_2.AVI)

[Summary of Convergent Boundaries](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch17_t17_1.swf)

[Visualizing Seafloor Spreading](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Seafloor_Spreading_17.swf)

**Teacher’s Place:**

Prior to beginning the performance activity, the teacher should implement the following steps using teaching techniques you have found to be effective for your students.

1. Explain the activity (activity requirements)

2. Display the Georgia Performance Standard(s) (project on blackboard via units of instruction located at <http://thevillage411.weebly.com/units-of-instruction2.html> units of instruction page, or print on blackboard)

3. Read the Georgia Performance Standard(s) aloud and explain it to your students. You can rephrase the Georgia Performance Standard to make sure your students understand it.

4. Display the Essential Question(s) (project on blackboard via units of instruction, or print on blackboard)

5. Read the Essential Question (s) aloud and explain it to your students. You can rephrase the Essential Question (s) to make sure your students understand it.

6. Review unit vocabulary with students. <http://www.glencoe.com/qe/efcsec.php?qi=14461>

7. Introduce the following:

a. Plate Tectonics: Drifting Continents p.468

8. Engage students in conversation by asking students the following question (s): Is there scientific evidence that the continents were once joined together? Write answers on the blackboard.

9. Discuss answers with the students using the following questioning techniques as applicable:

**Questioning Techniques:**

**Memory Questions**

 Signal words: who, what, when, where?

 Cognitive operations: naming, defining, identifying, designating

**Convergent Thinking Questions**

 Signal words: who, what, when, where?

Cognitive operations: explaining, stating relationships, comparing and

contrasting

 **Divergent Thinking Questions**

 Signal words: imagine, suppose, predict, if/then

Cognitive operations: predicting, hypothesizing, inferring, reconstructing

 **Evaluative Thinking Questions**

 Signal words: defend, judge, justify (what do you think)?

10. Guide students into the activity by viewing:

[Continental Drift](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/ContinentalDrift17_2.AVI)

[Summary of Convergent Boundaries](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch17_t17_1.swf)

[Visualizing Seafloor Spreading](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Seafloor_Spreading_17.swf)

11. Complete the activity with the students (some tasks may require students to work independently, peer to peer, learning circles [2-3 students] or as a whole group [the entire class]. Therefore the teacher may serve as activity leader and or facilitator. When an activity calls for students to work in learning circles you should assign roles to students individually i.e. recorder, discussion leader or presenter)

12. At the end of the **\*whole group learning session**, students will transition into independent CAP assignments.

**\*The phrase, “whole group learning session” is utilized “rather than, the end of the activity” because all of the activities may not be completed in one day.**

**Activity**

The teacher and students will complete Splitting at the Seams as a whole group activity.

Students will then be placed in cooperative learning groups to complete the activity.

Splitting At the Seams

Imagine that you are flying over the surface of Earth. You fly over the planet, taking note of the mountains, canyons, vast plains, and even the varied topography of the seafloor. You marvel that these wonders appear to have been around for a long time and still seem so stable. Your communications and photos tell of a planet covered by water and old, stable landforms.

However, as you have been discovering, Earth is a dynamic planet. This quick flyover did not take time to investigate Earth the way that humans have over the last five hundred years or so. As you know, landforms change, sometimes slowly, sometimes over night. Earth’s crust is a moving mass of various large slabs called plates. These plates, whose movement is fueled by the heat within Earth, bump and grind against each other in some places—convergent zones—and move apart in other places—divergent zones. It is the interaction of this convergence and divergence of plates that you will be thinking about more closely in this problem.

Problem:

Geologists usually associate a divergent zone, where new crust is forming, with a complimentary subduction zone, where crust is being pulled down into the mantle. Think about the Great Rift Valley. There is a divergent zone several thousand miles to the west and another several hundred miles to the east, and there is no subduction zone between them. This means that crust is being created between these two zones.

What kinds of geologic activity might take place on the African Plate due to having divergent boundaries on all but the northernmost boundaries?

**Task: 2**

**Essential Question(s):**

How are plate tectonics influenced by the formation of volcanoes?

What are the parts of a volcano?

**Resources:**

[Subduction](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Subduction18_2.swf)

[Divergent Plate Boundaries](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/DivergentPlateBoundaries18_3.swf)

[Types of Volcanoes](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch18_t18_1.swf)

[Visualizing Eruptions](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Eruptions_18.swf)

[Caldera Formation](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/CalderaFormaiton18_8.avi)

**Teacher’s Place:**

Prior to beginning the performance activity, the teacher should implement the following steps using teaching techniques you have found to be effective for your students.

1. Explain the activity (activity requirements)

2. Display the Georgia Performance Standard(s) (project on blackboard via units of instruction located at <http://thevillage411.weebly.com/units-of-instruction2.html> units of instruction page, or print on blackboard)

3. Read the Georgia Performance Standard(s) aloud and explain it to your students. You can rephrase the Georgia Performance Standard to make sure your students understand it.

4. Display the Essential Question(s) (project on blackboard via units of instruction, or print on blackboard)

5. Read the Essential Question (s) aloud and explain it to your students. You can rephrase the Essential Question (s) to make sure your students understand it.

6. Review unit vocabulary with students. <http://www.glencoe.com/qe/efcsec.php?qi=14462>

7. Introduce the following:

a. Volcanism: Volcanoes p.500

8. Engage students in conversation by asking students the following question (s): What role do plate tectonics play in the location of volcanoes? Write answers on the blackboard.

9. Discuss answers with the students using the following questioning techniques as applicable:

**Questioning Techniques:**

**Memory Questions**

 Signal words: who, what, when, where?

 Cognitive operations: naming, defining, identifying, designating

**Convergent Thinking Questions**

 Signal words: who, what, when, where?

Cognitive operations: explaining, stating relationships, comparing and

contrasting

 **Divergent Thinking Questions**

 Signal words: imagine, suppose, predict, if/then

Cognitive operations: predicting, hypothesizing, inferring, reconstructing

 **Evaluative Thinking Questions**

 Signal words: defend, judge, justify (what do you think)?

10. Guide students into the activity by viewing:

[Subduction](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Subduction18_2.swf)

[Divergent Plate Boundaries](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/DivergentPlateBoundaries18_3.swf)

[Types of Volcanoes](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch18_t18_1.swf)

[Visualizing Eruptions](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Eruptions_18.swf)

[Caldera Formation](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/CalderaFormaiton18_8.avi)

11. Complete the activity with the students (some tasks may require students to work independently, peer to peer, learning circles [2-3 students] or as a whole group [the entire class]. Therefore the teacher may serve as activity leader and or facilitator. When an activity calls for students to work in learning circles you should assign roles to students individually i.e. recorder, discussion leader or presenter)

12. At the end of the **\*whole group learning session**, students will transition into independent CAP assignments.

**\*The phrase, “whole group learning session” is utilized “rather than, the end of the activity” because all of the activities may not be completed in one day.**

**Activity**

The teacher and students will review Faster than a Speeding Bullet, More Powerful than a Locomotive as a whole group activity. Students will then be placed in cooperative learning groups to complete the activity.

**Faster than a Speeding Bullet, More Powerful than a Locomotive**

No, we’re not talking about Superman; we’re talking about the eruptive power of volcanoes, specifically composite volcanoes. Composite volcanoes are commonly associated with subduction zones—plate boundaries at which one plate is pulled under another. These are volcanoes that form from alternating eruptions of lava, ash, cinders, and other pyroclastic solids of varying sizes. The violent eruptions often cause widespread devastation of the surrounding area. Composite volcanoes are found along the western margins of North and South America and around the Mediterranean. One volcanic event in North America was the eruption of Mt. St. Helens in 1980. Another volcanic event—the eruption of Mt. Vesuvius—occurred in A.D. 79 in the Mediterranean.

**Getting a Feel for These Two Eruptions:**

Take a look at the following Web sites to get a "feel" for the devastation caused by each of these eruptions.

[**Mt. Vesuvius**](http://urban.arch.virginia.edu/struct/pompeii/volcanic.html)
Here you will read general descriptions of the eruption and a good explanation of the terms used to describe volcanic eruptions.

[**Mt. St. Helens**](http://vulcan.wr.usgs.gov/Volcanoes/MSH/May18/description_may18_1980.html)
This site has a lot of information about the eruption taken from various news reports.

**Recording some data:**

Using the Web sites listed above, find the following information for each volcano. This information will be used in the Problem section.

**Problem:**

Why have the stories of these eruptions been told throughout history?

Take a look at the data you have collected. How would you rate these two eruptions? Which was most powerful? Which was most destructive? Which moved the most material into surrounding areas? Which caused the most deaths?

1. Create an "eruption scale" from 1 – 10, with 1 as the lowest and 10 the greatest on the scale.
2. How did you rate them? Mt. St. Helens? \_\_\_\_\_\_ Mt. Vesuvius? \_\_\_\_\_\_
3. Discuss your findings with other groups of students in your class and compare your ratings and the methods you used to determine the ratings

**Task: 3**

**Essential Question(s):**

What are the three types of movement of faults?

What are the three types of seismic waves?

**Resources:**

 [Faults](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Faults19_1.swf)

[Seismic Waves](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/SeismicWaves19_5.avi)

[Seismometers](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Seismometers19_7.swf)

[P and S waves](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/PandSwaves19_9.swf)

[Tsunami](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Tsunami19_23.swf)

[Types of Faults](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch19_t19_1.swf)

[Modified Mercalli Scale](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch19_t19_2.swf)

[Visualizing Seismic Waves](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Seismic_Waves_19.swf)

**Teacher’s Place:**

Prior to beginning the performance activity, the teacher should implement the following steps using teaching techniques you have found to be effective for your students.

1. Explain the activity (activity requirements)

2. Display the Georgia Performance Standard(s) (project on blackboard via units of instruction located at <http://thevillage411.weebly.com/units-of-instruction2.html> units of instruction page, or print on blackboard)

3. Read the Georgia Performance Standard(s) aloud and explain it to your students. You can rephrase the Georgia Performance Standard to make sure your students understand it.

4. Display the Essential Question(s) (project on blackboard via units of instruction, or print on blackboard)

5. Read the Essential Question (s) aloud and explain it to your students. You can rephrase the Essential Question (s) to make sure your students understand it.

6. Review unit vocabulary with students. <http://www.glencoe.com/qe/efcsec.php?qi=14463>

7. Introduce the following:

a. Earthquakes: Forces within Earth p.528

8. Engage students in conversation by asking students the following question (s): what determines when a material will break? Write answers on the blackboard.

9. Discuss answers with the students using the following questioning techniques as applicable:

**Questioning Techniques:**

**Memory Questions**

 Signal words: who, what, when, where?

 Cognitive operations: naming, defining, identifying, designating

**Convergent Thinking Questions**

 Signal words: who, what, when, where?

Cognitive operations: explaining, stating relationships, comparing and

contrasting

 **Divergent Thinking Questions**

 Signal words: imagine, suppose, predict, if/then

Cognitive operations: predicting, hypothesizing, inferring, reconstructing

 **Evaluative Thinking Questions**

 Signal words: defend, judge, justify (what do you think)?

10. Guide students into the activity by viewing:

[Faults](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Faults19_1.swf)

[Seismic Waves](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/SeismicWaves19_5.avi)

[Seismometers](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Seismometers19_7.swf)

[P and S waves](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/PandSwaves19_9.swf)

[Tsunami](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Tsunami19_23.swf)

[Types of Faults](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch19_t19_1.swf)

[Modified Mercalli Scale](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch19_t19_2.swf)

[Visualizing Seismic Waves](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Seismic_Waves_19.swf)

11. Complete the activity with the students (some tasks may require students to work independently, peer to peer, learning circles [2-3 students] or as a whole group [the entire class]. Therefore the teacher may serve as activity leader and or facilitator. When an activity calls for students to work in learning circles you should assign roles to students individually i.e. recorder, discussion leader or presenter)

12. At the end of the **\*whole group learning session**, students will transition into independent CAP assignments.

**\*The phrase, “whole group learning session” is utilized “rather than, the end of the activity” because all of the activities may not be completed in one day.**

**Activity**

The teacher and students will review Walls of Water: Tsunamis as a whole group activity. Students will then be placed in cooperative learning groups to complete the activity.

**Walls of Water: Tsunamis**

The loud blaring of the natural disaster warning horns awakens you. You stumble in the dark to find the lights. As you quickly get into your clothes, you recognize the sound of this particular horn as the one that tells you a tsunami is on its way. Getting out of the house as quickly as you can, you join your neighbors in the streets. You all move inland as quickly as possible, heading for the safety of higher ground. In minutes, you reach the point beyond which the authorities believe you will be safe, and the waiting begins. You wait in the night for the passing of a wave that, without the warning system, could have resulted in death. If you live in coastal areas around the world, where seismic activity occurs on the ocean floor, this might be a familiar scenario.

As we have learned in this chapter, seismic events, like earthquakes, occur in places where the earth’s crust is brittle and faulted. When an earthquake takes place on the ocean floor, and there is a vertical displacement of the ocean water above it a tsunami may be born. Tsunamis are actually a series of waves that are set off from the seismic event, like the ripples that occur when a rock is thrown into a pond. To gain a good visual idea of how this happens, visit the PBS Website – "Savage Earth: Predicting Tsunamis." Watch the animation of the birth of a tsunami at a subduction zone. (<http://www.pbs.org/wnet/savageearth/animations/tsunami/index.html> )

In the open ocean, the tsunami waves may be little more than a meter high, yet they travel at incredible speeds, up to 700 km per hour. As the waves approach the coastal area, an unusual receding of the water at the shoreline often precedes them. Following this, the first wave nears the shore, growing higher and higher as it enters shallow water; often up to 45 feet tall. The wave does not break, as a typical ocean wave, but remains a wall of speeding water, plowing over everything in its path.

According to statistics posted by the Federal Emergency Management Agency (FEMA) since 1945, tsunamis have killed more people than earthquakes. So, the question becomes, how do we warn people about an approaching tsunami? As in the scenario at the beginning of the feature, citizens in countries around the Pacific Ocean, such as Japan receive warning by horns. We have a warning system here in the United States too – the Tsunami Warning Center in Palme, Alaska. The seismometer, a series of tsunami detectors on the ocean floor, and buoys on the surface are key elements in the warning game. As the tsunami passes, signals are sent to warning centers and citizens are warned. Experts say that giving people even 5 minutes warning may move them far enough inland to save their lives.

**The Problem:**

**Assume:**

* Only earthquake waves can be detected as a warning of a possible tsunami approach.
* There will be no electronically generated warnings from other countries.

**The situation:**

An earthquake occurs 70 km ESE of Nikolski, Alaska (52.7N, 167.9W). This earthquake has produced mass vertical movements of the type that produces tsunamis.

* There are no seafloor or buoy detectors between the epicenter and Nikolski.
* There are detectors between the epicenter and the other cities involved in this problem.
* P-waves travel at 6 km/sec.
* The distance from the epicenter to Kodiak, Alaska is 1,238 km.
* The distance from the epicenter to coastal Tokyo, Japan is 4,342 km.
* The distance from the epicenter to coastal San Francisco, California is 3,841 km.

**Determine:**

1. How long will it take the first p-wave to reach
	1. Nikolski, Alaska?
	2. Kodiak, Alaska?
	3. Tokyo, Japan?
	4. San Francisco, California?

**Then, following the earthquake:**

1. How long will it take a tsunami, traveling the average speed of 700km/hour, to reach:
	1. Nikolski, Alaska?
	2. Kodiak, Alaska?
	3. Tokyo, Japan?
	4. San Francisco, California?
2. In which cases will there be enough, or not enough, time to warn citizens of these coastal communities of the approaching tsunami? Discuss what would be the best way to warn citizens living in coastal areas for each city.

**Geologic Time**

**Georgia Performance Standards**

SCSh1 Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.

a. Exhibit the above traits in their own scientific activities.

b. Recognize that different explanations often can be given for the same evidence.

c. Explain that further understanding of scientific problems relies on the design and execution of new experiments which may reinforce or weaken opposing explanations.

 SCSh2 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.

SCSh3 Students will identify and investigate problems scientifically.

a. Suggest reasonable hypotheses for identified problems.

b. Develop procedures for solving scientific problems.

c. Collect, organize and record appropriate data.

d. Graphically compare and analyze data points and/or summary statistics.

e. Develop reasonable conclusions based on data collected.

f. Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.

SCSh4 Students will use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

a. Develop and use systematic procedures for recording and organizing information.

b. Use technology to produce tables and graphs.

c. Use technology to develop, test, and revise experimental or mathematical models.

SCSh5 Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.

a. Trace the source on any large disparity between estimated and calculated answers to problems.

b. Consider possible effects of measurement errors on calculations.

c. Recognize the relationship between accuracy and precision.

d. Express appropriate numbers of significant figures for calculated data, using scientific notation where appropriate.

e. Solve scientific problems by substituting quantitative values, using dimensional analysis and/or simple algebraic formulas as appropriate.

 SCSh6 Students will communicate scientific investigations and information clearly.

a. Write clear, coherent laboratory reports related to scientific investigations.

b. Write clear, coherent accounts of current scientific issues, including possible alternative interpretations of the data.

c. Use data as evidence to support scientific arguments and claims in written or oral presentations.

d. Participate in group discussions of scientific investigation and current scientific issues.

 SCSh7 Students will analyze how scientific knowledge is developed. Students will recognize that:

a. The universe is a vast single system in which the basic principles are the same everywhere.

b. Universal principles are discovered through observation and experimental verification.

c. From time to time, major shifts occur in the scientific view of how the world works. More often, however, the changes that take place in the body of scientific knowledge are small modifications of prior knowledge. Major shifts in scientific views typically occur after the observation of a new phenomenon or an insightful interpretation of existing data by an individual or research group.

d. Hypotheses often cause scientists to develop new experiments that produce additional data.

e. Testing, revising, and occasionally rejecting new and old theories never ends.

 SCSh8 Students will understand important features of the process of scientific inquiry. Students will apply the following to inquiry learning practices:

a. Scientific investigators control the conditions of their experiments in order to produce valuable data.

b. Scientific researchers are expected to critically assess the quality of data including possible sources of bias in their investigations’ hypotheses, observations, data analyses, and interpretations.

c. Scientists use practices such as peer review and publication to reinforce the integrity of scientific activity and reporting.

d. The merit of a new theory is judged by how well scientific data are explained by the new theory.

e. The ultimate goal of science is to develop an understanding of the natural universe which is free of biases.

f. Science disciplines and traditions differ from one another in what is studied, techniques used, and outcomes sought.

SCSh9 Students will enhance reading in all curriculum areas by:

a. Reading in All Curriculum Areas

Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.

Read both informational and fictional texts in a variety of genres and modes of discourse.

Read technical texts related to various subject areas.

b. Discussing books

Discuss messages and themes from books in all subject areas.

Respond to a variety of texts in multiple modes of discourse.

Relate messages and themes from one subject area to messages and themes in another area.

Evaluate the merit of texts in every subject discipline.

Examine author’s purpose in writing.

Recognize the features of disciplinary texts.

c. Building vocabulary knowledge

Demonstrate an understanding of contextual vocabulary in various subjects.

Use content vocabulary in writing and speaking.

Explore understanding of new words found in subject area texts.

d. Establishing context

Explore life experiences related to subject area content.

**Task: 1**

**Essential Question(s):**

What is the elevation distribution of earth’s surface?

What is Isostasy?

How does earth’s crust respond to the addition and removal of mass?

**Resources:**

[Angular Unconformity](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/AngularUnconformity21_10.swf)

[Alpha Decay](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/AlphaDecay21_13.swf)

[Half Life](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/HalfLife21_15.mpg)

[Half-Life of Selected Radioactive Isotopes](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch21_t21_1.swf)

[Visualizing the Geologic Time Scale](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_the_Geologic_Time_Scale_21.swf)

**Teacher’s Place:**

Prior to beginning the performance activity, the teacher should implement the following steps using teaching techniques you have found to be effective for your students.

1. Explain the activity (activity requirements)

2. Display the Georgia Performance Standard(s) (project on blackboard via units of instruction located at <http://thevillage411.weebly.com/units-of-instruction2.html> units of instruction page, or print on blackboard)

3. Read the Georgia Performance Standard(s) aloud and explain it to your students. You can rephrase the Georgia Performance Standard to make sure your students understand it.

4. Display the Essential Question(s) (project on blackboard via units of instruction, or print on blackboard)

5. Read the Essential Question (s) aloud and explain it to your students. You can rephrase the Essential Question (s) to make sure your students understand it.

6. Review unit vocabulary with students. <http://www.glencoe.com/qe/efcsec.php?qi=14465>

7. Introduce the following:

a. Mountain Building: Crust-Mantle Relationship p.562

8. Engage students in conversation by asking students the following question (s): What does the thickness and density of a mountain determine about the mountain? Write answers on the blackboard.

9. Discuss answers with the students using the following questioning techniques as applicable:

**Questioning Techniques:**

**Memory Questions**

 Signal words: who, what, when, where?

 Cognitive operations: naming, defining, identifying, designating

**Convergent Thinking Questions**

 Signal words: who, what, when, where?

Cognitive operations: explaining, stating relationships, comparing and

contrasting

 **Divergent Thinking Questions**

 Signal words: imagine, suppose, predict, if/then

Cognitive operations: predicting, hypothesizing, inferring, reconstructing

 **Evaluative Thinking Questions**

 Signal words: defend, judge, justify (what do you think)?

10. Guide students into the activity by viewing:

[Angular Unconformity](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/AngularUnconformity21_10.swf)

[Alpha Decay](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/AlphaDecay21_13.swf)

[Half Life](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/HalfLife21_15.mpg)

[Half-Life of Selected Radioactive Isotopes](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch21_t21_1.swf)

[Visualizing the Geologic Time Scale](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_the_Geologic_Time_Scale_21.swf)

11. Complete the activity with the students (some tasks may require students to work independently, peer to peer, learning circles [2-3 students] or as a whole group [the entire class]. Therefore the teacher may serve as activity leader and or facilitator. When an activity calls for students to work in learning circles you should assign roles to students individually i.e. recorder, discussion leader or presenter)

12. At the end of the **\*whole group learning session**, students will transition into independent CAP assignments.

**\*The phrase, “whole group learning session” is utilized “rather than, the end of the activity” because all of the activities may not be completed in one day.**

**Activity**

The teacher and students review Fact or Inference (Inference, What’s That?) as a whole group activity. Students will then be placed in cooperative learning groups to complete the activity.

**Fact or Inference (Inference, What’s That?)**

Fragments of Earth’s history are captured in sedimentary rock layers found around the world. Using the evidence found in these rock strata, geologists have constructed the geologic time scale—a timeline of Earth’s geologic and biologic history.

No human was present to witness this history, so geologists must take the actual observations or data that they have collected, and make assumptions based on that data. These assumptions are called inferences. Chapter 21 describes the methods that geologists employ to make inferences about the age of sedimentary rock layers and fossils. Collecting facts and making inferences from them are critical skills for scientists to develop in order to interpret their findings. In this problem, you will develop your skills of observation and practice making inferences.

**Problem:**

**Let’s practice:**

1. Do some brainstorming. Think of items/things for which it is important to know the age.
2. Discuss the methods you use to determine the age of each item.
3. Choose one item from your list for which you used its external characteristics to judge its age.

**Clarification:**

By determining an item’s age through the observations of its external features, you have used the same skills that geologists use to determine relative age and to make inferences about age based on their observations.

\*\*Note: When we observe, we collect the facts. When we analyze the facts, we make inferences about what these facts suggest.

**Try it:**

Examine the picture below, make observations, and then determine what inferences can be made from the facts you have collected.

Photo courtesy of Photographer: J & K Hollingsworth, Fish and Wildlife Service photo

Controlled or prescribed burns are important tools used by managers of national wildlife refuges across the country to promote healthy vegetation benefiting wildlife. Periodic burning allows older, matted undergrowth to be cleared away. The new growth comes in much faster and provides better food and cover for a variety of wildlife.

**Task: 2**

**Essential Question(s):**

How old is Earth?

What were the heat sources of early Earth?

**Resources:**

[Miller Urey Experiment](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/MillerUreyExperiment22_14.swf)

[How Life Might Have Begun on Earth: Three Hypotheses](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch22_t22_1.swf)

[Visualizing Continent Formation](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Continent_Formation_22.swf)

**Teacher’s Place:**

Prior to beginning the performance activity, the teacher should implement the following steps using teaching techniques you have found to be effective for your students.

1. Explain the activity (activity requirements)

2. Display the Georgia Performance Standard(s) (project on blackboard via units of instruction located at <http://thevillage411.weebly.com/units-of-instruction2.html> units of instruction page, or print on blackboard)

3. Read the Georgia Performance Standard(s) aloud and explain it to your students. You can rephrase the Georgia Performance Standard to make sure your students understand it.

4. Display the Essential Question(s) (project on blackboard via units of instruction, or print on blackboard)

5. Read the Essential Question (s) aloud and explain it to your students. You can rephrase the Essential Question (s) to make sure your students understand it.

6. Review unit vocabulary with students. <http://www.glencoe.com/qe/efcsec.php?qi=14466>

7. Introduce the following:

a. The Precambrian Earth: Early Earth p.620

8. Engage students in conversation by asking students the following question (s): Can Earth possibly be older than the oldest rocks in its crust? Write answers on the blackboard.

9. Discuss answers with the students using the following questioning techniques as applicable:

**Questioning Techniques:**

**Memory Questions**

 Signal words: who, what, when, where?

 Cognitive operations: naming, defining, identifying, designating

**Convergent Thinking Questions**

 Signal words: who, what, when, where?

Cognitive operations: explaining, stating relationships, comparing and

contrasting

 **Divergent Thinking Questions**

 Signal words: imagine, suppose, predict, if/then

Cognitive operations: predicting, hypothesizing, inferring, reconstructing

 **Evaluative Thinking Questions**

 Signal words: defend, judge, justify (what do you think)?

10. Guide students into the activity by viewing:

 [Miller Urey Experiment](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/MillerUreyExperiment22_14.swf)

[How Life Might Have Begun on Earth: Three Hypotheses](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch22_t22_1.swf)

[Visualizing Continent Formation](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Continent_Formation_22.swf)

11. Complete the activity with the students (some tasks may require students to work independently, peer to peer, learning circles [2-3 students] or as a whole group [the entire class]. Therefore the teacher may serve as activity leader and or facilitator. When an activity calls for students to work in learning circles you should assign roles to students individually i.e. recorder, discussion leader or presenter)

12. At the end of the **\*whole group learning session**, students will transition into independent CAP assignments.

**\*The phrase, “whole group learning session” is utilized “rather than, the end of the activity” because all of the activities may not be completed in one day.**

**Activity**

The teacher and students review Hydrothermal Vent Communities as a whole group activity. Students will then be placed in cooperative learning groups to complete the activity.

**Hydrothermal Vent Communities**

The basic building blocks of life, amino acids, have been found at deep-sea hydrothermal vents. Because of this, some scientists hypothesize that primitive forms of life may have originated in similar environments during the Precambrian. Other scientists disagree, saying that life could not have formed in the harsh environmental conditions that exist at these vents.

What is so harsh about the deep-sea hydrothermal vent environment? The main obstacles to common life forms, would be:

1. the hot water seeping down into Earth’s crust is laden with dissolved toxic chemicals, such as hydrogen sulfide, a colorless gas that is very toxic
2. the heated water emerging from the vents can be as hot as 350ºC
3. at the depths that hydrothermal vents are found, the pressure is extremely high
4. finally, due to depth, hydrothermal vents exist in total darkness

Getting past these hurdles might be easy for a simple life form, as would have existed in the early oceans of Earth, but these conditions are much greater challenges for more complex forms of life. Interestingly though, life does exist at hydrothermal vents. In 1977, research submersibles discovered an amazing variety of creatures. The deep-sea hydrothermal vents are home to entire unique communities, and these have since been found at several hundred locations in the deep oceans around the world.

**Think About This:**

Think about the most common forms of life. The majority of familiar life forms have fairly similar environmental requirements. Think about these requirements and answer the following questions.

-What provides the energy for life (the basis of the food web) as we commonly know it?

-What gases are necessary, either in the air or in the water?

-What is the range above and below sea level in which most life exists?

Therefore, what atmospheric pressures are most life forms subjected to?

-What is the temperature range in which most life exists?

**Problem:**

The conditions at present-day hydrothermal vents are not the same as the conditions that are believed to have existed in Earth’s early oceans and atmosphere. However, imagine the challenges to the development and existence of life in both environments. You will compare the environment and life forms thought to be present in Earth’s early oceans to life as it exists in today’s deep-sea hydrothermal vent communities.

Work in small groups to answer the following questions.

1. Four basic questions were asked in the *Think About This* section. Answer the same questions for the organisms you would imagine might exist in a deep-sea hydrothermal vent environment.
2. From your answers, create (describing, drawing, sculpting, ete.) an organism, food chain, or community that has adaptations, biological features, and any other characteristics that would allow them to exist in the deep-sea hydrothermal vent environment.
3. Share your creations with the other groups in your class. Discuss the different ideas of the other groups. Make a class list of adaptations that you and your classmates believe would benefit organisms that live in a deep-sea hydrothermal vent community.
4. Find out how close your creations come to the real life organisms of deep-sea hydrothermal vent communities. Then discuss your findings. Use the following Web site.
	1. [**Hydrothermal Vent Communities**](http://www.botos.com/marine/vents01.html) -At this site you will find a lesson that has many links to resource sites about vents, conditions at vents, vent food webs, and vent life forms.

**Task: 3**

**Essential Question(s):**

What is passive margin?

How does transgressions and regressions indicate sea-level changes?

What were the tectonic forces that shaped Laurentia during the Paleozoic?

**Resources:**

 [Major Extinctions in the Phanerozoic](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch23_t23_1.swf)

[Visualizing the Basin and Range Province](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_the_Basin%20and_Range_Province_23.swf)

**Teacher’s Place:**

Prior to beginning the performance activity, the teacher should implement the following steps using teaching techniques you have found to be effective for your students.

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2. Display the Georgia Performance Standard(s) (project on blackboard via units of instruction located at <http://thevillage411.weebly.com/units-of-instruction2.html> units of instruction page, or print on blackboard)

3. Read the Georgia Performance Standard(s) aloud and explain it to your students. You can rephrase the Georgia Performance Standard to make sure your students understand it.

4. Display the Essential Question(s) (project on blackboard via units of instruction, or print on blackboard)

5. Read the Essential Question (s) aloud and explain it to your students. You can rephrase the Essential Question (s) to make sure your students understand it.

6. Review unit vocabulary with students. <http://www.glencoe.com/qe/efcsec.php?qi=14467>

7. Introduce the following:

a. The Paleozoic: The Paleozoic Era p.648

8. Engage students in conversation by asking students the following question (s): How do glaciations affect the sea level? Write answers on the blackboard.

9. Discuss answers with the students using the following questioning techniques as applicable:

**Questioning Techniques:**

**Memory Questions**

 Signal words: who, what, when, where?

 Cognitive operations: naming, defining, identifying, designating

**Convergent Thinking Questions**

 Signal words: who, what, when, where?

Cognitive operations: explaining, stating relationships, comparing and

contrasting

 **Divergent Thinking Questions**

 Signal words: imagine, suppose, predict, if/then

Cognitive operations: predicting, hypothesizing, inferring, reconstructing

 **Evaluative Thinking Questions**

 Signal words: defend, judge, justify (what do you think)?

10. Guide students into the activity by viewing: [Major Extinctions in the Phanerozoic](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch23_t23_1.swf) and

[Visualizing the Basin and Range Province](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_the_Basin%20and_Range_Province_23.swf)

11. Complete the activity with the students (some tasks may require students to work independently, peer to peer, learning circles [2-3 students] or as a whole group [the entire class]. Therefore the teacher may serve as activity leader and or facilitator. When an activity calls for students to work in learning circles you should assign roles to students individually i.e. recorder, discussion leader or presenter)

12. At the end of the **\*whole group learning session**, students will transition into independent CAP assignments.

**\*The phrase, “whole group learning session” is utilized “rather than, the end of the activity” because all of the activities may not be completed in one day.**

**Activity**

The teacher and students review The Salt of Earth as a whole group activity . Students will then be placed in cooperative learning groups to complete the activity.

The Salt of Earth

About 260 million years ago, in the Permian Period, much of the western United States was covered by shallow, tropical seas. Large-scale barrier reefs formed in these warm, shallow seas, in areas that are now New Mexico, Texas, and northern Mexico. Barrier reefs can restrict the flow of seawater that is of normal salinity. If the flow is restricted, evaporite deposits can form.

Evaporites are mineral deposits formed when water evaporates from a body of water, leaving behind the minerals that were dissolved in the water. When this process occurs over long periods of time, thick layers of evaporite minerals may be deposited. One of these minerals is halite or common table salt (NaCl). These thick evaporite deposits are valuable mineral resources and are mined for table salt, gypsum, potassium salts, and other minerals. Table salt and the other evaporite minerals have many uses, including:

food seasoning (halite)

food preservative (halite)

road safety in the winter months to melt snow and ice (halite)

fertilizer (potassium salts)

building materials (gypsum)

for use in water softeners (sodium and potassium salts)

for medicinal purposes (halite)

industrial chemicals (as sources of sodium, potassium, calcium, magnesium, and chlorine)

These ancient deposits are also being investigated for their usefulness as possible storage sites for nuclear wastes produced in nuclear power plants.

Think About This:

Nuclear power plants produce energy by harnessing the fission reaction of radioactive elements such as uranium. Once the fuel is used, it is highly radioactive and thermally hot. Currently, spent fuel is stored temporarily (for ten or more years) in cooling ponds, usually on site at the reactor plant. From there, the spent fuel is packed into strong storage casks and stored on concrete slabs, usually on land near the plant. This waste remains dangerously radioactive for many years. Both water storage and dry storage are temporary forms of storage. Most experts throughout the world agree that the most feasible and safe method for the long-term storage of highly radioactive materials is to place them deep underground.

The Problem:

You have covered many areas in your study of Earth. You have looked at Earth from many perspectives, and you have developed an understanding of the processes that form, shape, and change the rocks of the crust and mantle.

A major halite or evaporite deposit makes a good candidate for an underground nuclear waste repository because the layers of salt are highly impermeable. This means that liquids do not easily penetrate the rock layers. Impermeable rock layers will limit groundwater from entering the storage facility and they will also prevent radioactive fluids from leaking.

If you were on a committee responsible for choosing a site for underground storage of nuclear wastes, what other factors, besides the impermeability of the rock layers, would be important? The geologic setting of the potential site will be important. Investigate not only the type of rock in the area, but also the location of faults and other geological features. Consider the environment surrounding the potential storage facility, such as nearby population, transportation routes into and out of the area, security issues, and other factors.

**Resources and the Environment**

**Georgia Performance Standards**

SCSh1 Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.

a. Exhibit the above traits in their own scientific activities.

b. Recognize that different explanations often can be given for the same evidence.

c. Explain that further understanding of scientific problems relies on the design and execution of new experiments which may reinforce or weaken opposing explanations.

 SCSh2 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.

SCSh3 Students will identify and investigate problems scientifically.

a. Suggest reasonable hypotheses for identified problems.

b. Develop procedures for solving scientific problems.

c. Collect, organize and record appropriate data.

d. Graphically compare and analyze data points and/or summary statistics.

e. Develop reasonable conclusions based on data collected.

f. Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.

SCSh4 Students will use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

a. Develop and use systematic procedures for recording and organizing information.

b. Use technology to produce tables and graphs.

c. Use technology to develop, test, and revise experimental or mathematical models.

SCSh5 Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.

a. Trace the source on any large disparity between estimated and calculated answers to problems.

b. Consider possible effects of measurement errors on calculations.

c. Recognize the relationship between accuracy and precision.

d. Express appropriate numbers of significant figures for calculated data, using scientific notation where appropriate.

e. Solve scientific problems by substituting quantitative values, using dimensional analysis and/or simple algebraic formulas as appropriate.

 SCSh6 Students will communicate scientific investigations and information clearly.

a. Write clear, coherent laboratory reports related to scientific investigations.

b. Write clear, coherent accounts of current scientific issues, including possible alternative interpretations of the data.

c. Use data as evidence to support scientific arguments and claims in written or oral presentations.

d. Participate in group discussions of scientific investigation and current scientific issues.

 SCSh7 Students will analyze how scientific knowledge is developed. Students will recognize that:

a. The universe is a vast single system in which the basic principles are the same everywhere.

b. Universal principles are discovered through observation and experimental verification.

c. From time to time, major shifts occur in the scientific view of how the world works. More often, however, the changes that take place in the body of scientific knowledge are small modifications of prior knowledge. Major shifts in scientific views typically occur after the observation of a new phenomenon or an insightful interpretation of existing data by an individual or research group.

d. Hypotheses often cause scientists to develop new experiments that produce additional data.

e. Testing, revising, and occasionally rejecting new and old theories never ends.

 SCSh8 Students will understand important features of the process of scientific inquiry. Students will apply the following to inquiry learning practices:

a. Scientific investigators control the conditions of their experiments in order to produce valuable data.

b. Scientific researchers are expected to critically assess the quality of data including possible sources of bias in their investigations’ hypotheses, observations, data analyses, and interpretations.

c. Scientists use practices such as peer review and publication to reinforce the integrity of scientific activity and reporting.

d. The merit of a new theory is judged by how well scientific data are explained by the new theory.

e. The ultimate goal of science is to develop an understanding of the natural universe which is free of biases.

f. Science disciplines and traditions differ from one another in what is studied, techniques used, and outcomes sought.

SCSh9 Students will enhance reading in all curriculum areas by:

a. Reading in All Curriculum Areas

Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.

Read both informational and fictional texts in a variety of genres and modes of discourse.

Read technical texts related to various subject areas.

b. Discussing books

Discuss messages and themes from books in all subject areas.

Respond to a variety of texts in multiple modes of discourse.

Relate messages and themes from one subject area to messages and themes in another area.

Evaluate the merit of texts in every subject discipline.

Examine author’s purpose in writing.

Recognize the features of disciplinary texts.

c. Building vocabulary knowledge

Demonstrate an understanding of contextual vocabulary in various subjects.

Use content vocabulary in writing and speaking.

Explore understanding of new words found in subject area texts.

d. Establishing context

Explore life experiences related to subject area content.

**Task: 1**

**Essential Question(s):**

What are resources?

How are resources categorize?

How are resources unevenly distributed on Earth?

**Resources:**

[Distillation](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Distillation24_21.swf)

[Visualizing Carbon and Nitrogen Cycles](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Carbon_and_Nitrogen_Cycles_24.swf)

**Teacher’s Place:**

Prior to beginning the performance activity, the teacher should implement the following steps using teaching techniques you have found to be effective for your students.

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3. Read the Georgia Performance Standard(s) aloud and explain it to your students. You can rephrase the Georgia Performance Standard to make sure your students understand it.

4. Display the Essential Question(s) (project on blackboard via units of instruction, or print on blackboard)

5. Read the Essential Question (s) aloud and explain it to your students. You can rephrase the Essential Question (s) to make sure your students understand it.

6. Review unit vocabulary with students. <http://www.glencoe.com/qe/efcsec.php?qi=14468>

7. Introduce the following:

a. Earth Resources: Natural Resources p.678

8. Engage students in conversation by asking students the following question (s): Did you ever receive or give outgrown clothes, toys, or other items to a younger brother, sister, or friend? Write answers on the blackboard.

9. Discuss answers with the students using the following questioning techniques as applicable:

**Questioning Techniques:**

**Memory Questions**

 Signal words: who, what, when, where?

 Cognitive operations: naming, defining, identifying, designating

**Convergent Thinking Questions**

 Signal words: who, what, when, where?

Cognitive operations: explaining, stating relationships, comparing and

contrasting

 **Divergent Thinking Questions**

 Signal words: imagine, suppose, predict, if/then

Cognitive operations: predicting, hypothesizing, inferring, reconstructing

 **Evaluative Thinking Questions**

 Signal words: defend, judge, justify (what do you think)?

10. Guide students into the activity by viewing [Distillation](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Distillation24_21.swf) and [Visualizing Carbon and Nitrogen Cycles](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Carbon_and_Nitrogen_Cycles_24.swf).

11. Complete the activity with the students (some tasks may require students to work independently, peer to peer, learning circles [2-3 students] or as a whole group [the entire class]. Therefore the teacher may serve as activity leader and or facilitator. When an activity calls for students to work in learning circles you should assign roles to students individually i.e. recorder, discussion leader or presenter)

12. At the end of the **\*whole group learning session**, students will transition into independent CAP assignments.

**\*The phrase, “whole group learning session” is utilized “rather than, the end of the activity” because all of the activities may not be completed in one day.**

**Activity**

The teacher and students will complete Crude Oil Supplies – How long with they last as a whole group activity. Students will then be placed in cooperative learning groups to complete the activity.

Crude Oil Supplies – How long with they last?

Earth’s energy resources are classified as either renewable or nonrenewable. An example of a renewable resource is wood. Wood is renewable because trees can be planted, managed, and grown continuously to supply such items as building materials and paper. Examples of nonrenewable resources are fossil fuels such as natural gas and oil. Nonrenewable resources require long periods of time to form, and once used, there are no more reserves.

Fossil fuels are used to supply energy for many of our daily activities, such as producing electricity and transportation. The daily worldwide use of oil is approximately 64.2 million barrels. Multiply that by 365, and the yearly amount totals 23,443,000,000 barrels. One barrel holds 42 gallons.

**Now, Check This Out:**

Proven oil reserves are generally considered to be the amounts geologists have discovered and petroleum engineers can pump out of the ground and into production. As we drill deeper and locate more deposits, this number could change. Because fossil fuels like oil are nonrenewable, the reserves are gone once they have been used up. It will take millions of years to form additional reserves.

**Problem:**

If there is no change in the rate at which we consume oil worldwide how long will these reserves last?

How many years of proven oil reserves are left?

**Discussion Topics:**

As you contemplate the information you have calculated, there are many positive and negative aspects to consider. We are definitely ready for a change in the resources we use to produce energy. Think about the following questions:

* Where are most of the proven oil reserves? How is this a political concern at this time?
* Will the current rate of oil consumption increase or decrease in the future? Why? How will this affect how long the oil reserves will last?
* How old will you be when the current proven oil reserves run out, and how might this affect your life at that time?
* Consider how long it takes oil to form, and how long it takes for these oil reserves to be used.

**Task: 2**

**Essential Question(s):**

Why is the sun the source of most energy on earth?

How does coal form?

**Resources:**

 [Geothermal Power](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/GeothermalPower25_10.swf)

[Advantages of Public Transportation](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch25_t25_1.swf%09)

[Fission Reactor](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/FissionReactor25_11.mpg)

[Visualizing Coal](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Coal_25.swf)

**Teacher’s Place:**

Prior to beginning the performance activity, the teacher should implement the following steps using teaching techniques you have found to be effective for your students.

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2. Display the Georgia Performance Standard(s) (project on blackboard via units of instruction located at <http://thevillage411.weebly.com/units-of-instruction2.html> units of instruction page, or print on blackboard)

3. Read the Georgia Performance Standard(s) aloud and explain it to your students. You can rephrase the Georgia Performance Standard to make sure your students understand it.

4. Display the Essential Question(s) (project on blackboard via units of instruction, or print on blackboard)

5. Read the Essential Question (s) aloud and explain it to your students. You can rephrase the Essential Question (s) to make sure your students understand it.

6. Review unit vocabulary with students. <http://www.glencoe.com/qe/efcsec.php?qi=14469>

7. Introduce the following:

a. Energy Resources: Conventional Energy Resources p.708

8. Engage students in conversation by telling students to identify all the sources of energy in the classroom. Write answers on the blackboard.

9. Discuss answers with the students using the following questioning techniques as applicable:

**Questioning Techniques:**

**Memory Questions**

 Signal words: who, what, when, where?

 Cognitive operations: naming, defining, identifying, designating

**Convergent Thinking Questions**

 Signal words: who, what, when, where?

Cognitive operations: explaining, stating relationships, comparing and

contrasting

 **Divergent Thinking Questions**

 Signal words: imagine, suppose, predict, if/then

Cognitive operations: predicting, hypothesizing, inferring, reconstructing

 **Evaluative Thinking Questions**

 Signal words: defend, judge, justify (what do you think)?

10. Guide students into the activity by viewing:

[Geothermal Power](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/GeothermalPower25_10.swf)

[Advantages of Public Transportation](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch25_t25_1.swf%09)

[Fission Reactor](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/FissionReactor25_11.mpg)

[Visualizing Coal](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Coal_25.swf)

11. Complete the activity with the students (some tasks may require students to work independently, peer to peer, learning circles [2-3 students] or as a whole group [the entire class]. Therefore the teacher may serve as activity leader and or facilitator. When an activity calls for students to work in learning circles you should assign roles to students individually i.e. recorder, discussion leader or presenter)

12. At the end of the **\*whole group learning session**, students will transition into independent CAP assignments.

**\*The phrase, “whole group learning session” is utilized “rather than, the end of the activity” because all of the activities may not be completed in one day.**

**Activity**

The teacher and students will review Solar Energy as a whole group activity. Students will then be placed in cooperative learning groups to complete the activity.

**Solar Energy**

The Sun is a star that lies at the center of our solar system bathing space, and the planets that revolve around it, in energy. Each planet, from Mercury to Pluto, revolves around the Sun at various distances, and as a result, each planet receives varying amounts of radiation. The closer to the Sun, the more intense the radiation. The radiation comes in many forms including light, heat, and X rays. The most important forms of radiation to consider for this problem are heat and light radiation.

As a nation, we comprise 6% of the world’s energy consumers and we use 30 % of Earth’s mineral and energy resources each year. As a result of our heavy reliance on fossil fuels, and in an effort to find ways to reduce air and other kinds of pollution, solar energy has been identified as an alternative energy source.

Realizing that we must begin developing alternative energy resources such as solar energy, states such as North Carolina have instituted tax credits to encourage the installation of solar energy systems in homes and businesses. These credits allow home and business owners to recover some of the initial costs of the installation of a solar energy system. The state gives a 40% credit for solar energy systems on residential buildings and 35% credit for commercial and industrial solar systems.

**Problem:**

Here is an example of the costs, tax credit, and savings given by the North Carolina Solar Center. Use the following information to answer these questions: How long will it take for this business to totally recover the cost of their investment and to begin saving money on their electricity? Is it worthwhile for the business to install the system?

**Solar Ventilation Preheating Case Study**

Fresh Air Make Up for Manufacturing Facility

* Installed cost for a commercial-industrial Sun absorbing wall with 4,700 square feet of collector wall, 3 fans, and 150 feet of duct would be $66,000.
* The system would generate $7,000 per year in fuel savings by preheating ventilation air.

**Effects of Tax Credits on System Cost**

Solar System Cost $66,000

N.C. Solar Tax Credit (35%) $23,100

Federal Solar Tax Credit (10%) $ 6,600

Tax Effect of MACRS\* $ 8,572

**Task: 3**

**Essential Question(s):**

What are the typical patterns of population growth of organisms?

What happens to populations when they reach carrying capacity?

What environmental factors affect population growth?

**Resources:**

[Carrying Capacity](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/CarryingCapacity26_3.avi)

[How Smog Forms](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/HowSmogForms26_12.swf)

[Ozone Depletion](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/OzoneDepletion26_13.swf)

[Agricultural Practices](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Agricultural_Practices_26.swf)

**Teacher’s Place:**

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5. Read the Essential Question (s) aloud and explain it to your students. You can rephrase the Essential Question (s) to make sure your students understand it.

6. Review unit vocabulary with students. <http://www.glencoe.com/qe/efcsec.php?qi=14470>

7. Introduce the following:

a. Human impact on resources: Populations and the Use of Natural Resources p. 734

8. Engage students in conversation by asking students the following question (s): What would life be like in the United States if the population doubled just ten years from now? Write answers on the blackboard.

9. Discuss answers with the students using the following questioning techniques as applicable:

**Questioning Techniques:**

**Memory Questions**

 Signal words: who, what, when, where?

 Cognitive operations: naming, defining, identifying, designating

**Convergent Thinking Questions**

 Signal words: who, what, when, where?

Cognitive operations: explaining, stating relationships, comparing and

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 **Divergent Thinking Questions**

 Signal words: imagine, suppose, predict, if/then

Cognitive operations: predicting, hypothesizing, inferring, reconstructing

 **Evaluative Thinking Questions**

 Signal words: defend, judge, justify (what do you think)?

10. Guide students into the activity by viewing:

[Carrying Capacity](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/CarryingCapacity26_3.avi)

[How Smog Forms](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/HowSmogForms26_12.swf)

[Ozone Depletion](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/OzoneDepletion26_13.swf)

[Agricultural Practices](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Agricultural_Practices_26.swf)

11. Complete the activity with the students (some tasks may require students to work independently, peer to peer, learning circles [2-3 students] or as a whole group [the entire class]. Therefore the teacher may serve as activity leader and or facilitator. When an activity calls for students to work in learning circles you should assign roles to students individually i.e. recorder, discussion leader or presenter)

12. At the end of the **\*whole group learning session**, students will transition into independent CAP assignments.

**\*The phrase, “whole group learning session” is utilized “rather than, the end of the activity” because all of the activities may not be completed in one day.**

**Activity**

The teacher and students will review Human Carrying Capacity: What’s the limitas a whole group activity. Students will then be placed in cooperative learning groups to complete the activity.

**Human Carrying Capacity: What’s the Limit?**

Carrying capacity is defined as, "the number of organisms that any given environment can support". In each environment and on Earth in general, there is a limited supply of resources. As long as the resources remain available, groups of organisms or populations, can continue to exist in that environment. In times of abundance, populations thrive and increase; in times of great scarcity, populations crash. What usually happens, is that resources remain fairly stable and populations of organisms in an environment fluctuate up and down "around" the carrying capacity for that organism. Each element of the resource "bank" can act as a limiting factor. If a resource runs out, the population's growth is limited by its absence.

Some scientists believe that the human population may have already gone far above the "actual" carrying capacity of Earth, and that we are playing on borrowed time and resources. At the time of this writing, the world population was estimated at 6,113,980,320 people and growing. As humans we have the ability to manipulate our resource supplies, and the environment, to allow us to go beyond what the environment can actually support.

Check out the following Web site to see how much the population has increased since this problem was written. Put in your age to see what the population was when you were born. Look at the difference. <http://factfinder.census.gov/servlet/SAFFPopulation>

Things to Think About:

1. Which environmental factors normally act as limiting factors?
2. What factors control or may control the limits of human populations?
3. Ways in which humans manipulate these factors to "outwit" nature.

**Problem:**

The data table below shows some predictions. Based on a steady increase every twenty years, what would the predicted figures be for the year 2030. Discuss with a classmate, or as a group, whether growth at this rate is sustainable, or will the resources run out?

|  |
| --- |
| Population and Availability of Renewable Resources |
|   | 1990 | 2010 (predicted change) | Total % Change | 2030 |
| Population (millions) | 5290 | 7,030 | 33 |   |
| Fish Catch (million tons) | 85 | 102 | 20 |   |
| Irrigated Land (million hectares) | 237 | 277 | 17 |   |
| Crop Land (million hectares) | 1444 | 1,516 | 5 |   |
| Rangeland and Pasture (million hectares) | 3402 | 3,540 | 4 |   |
| Forests (million hectares) | 3413 | 3,165 | -7 |   |

Source: Postel, S. "Carrying Capacity: Earth’s Bottom Line." State of the World, 1994.

**Beyond Earth**

**Georgia Performance Standards**

SCSh1 Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.

a. Exhibit the above traits in their own scientific activities.

b. Recognize that different explanations often can be given for the same evidence.

c. Explain that further understanding of scientific problems relies on the design and execution of new experiments which may reinforce or weaken opposing explanations.

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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.

SCSh3 Students will identify and investigate problems scientifically.

a. Suggest reasonable hypotheses for identified problems.

b. Develop procedures for solving scientific problems.

c. Collect, organize and record appropriate data.

d. Graphically compare and analyze data points and/or summary statistics.

e. Develop reasonable conclusions based on data collected.

f. Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.

SCSh4 Students will use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

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b. Use technology to produce tables and graphs.

c. Use technology to develop, test, and revise experimental or mathematical models.

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a. Trace the source on any large disparity between estimated and calculated answers to problems.

b. Consider possible effects of measurement errors on calculations.

c. Recognize the relationship between accuracy and precision.

d. Express appropriate numbers of significant figures for calculated data, using scientific notation where appropriate.

e. Solve scientific problems by substituting quantitative values, using dimensional analysis and/or simple algebraic formulas as appropriate.

 SCSh6 Students will communicate scientific investigations and information clearly.

a. Write clear, coherent laboratory reports related to scientific investigations.

b. Write clear, coherent accounts of current scientific issues, including possible alternative interpretations of the data.

c. Use data as evidence to support scientific arguments and claims in written or oral presentations.

d. Participate in group discussions of scientific investigation and current scientific issues.

 SCSh7 Students will analyze how scientific knowledge is developed. Students will recognize that:

a. The universe is a vast single system in which the basic principles are the same everywhere.

b. Universal principles are discovered through observation and experimental verification.

c. From time to time, major shifts occur in the scientific view of how the world works. More often, however, the changes that take place in the body of scientific knowledge are small modifications of prior knowledge. Major shifts in scientific views typically occur after the observation of a new phenomenon or an insightful interpretation of existing data by an individual or research group.

d. Hypotheses often cause scientists to develop new experiments that produce additional data.

e. Testing, revising, and occasionally rejecting new and old theories never ends.

 SCSh8 Students will understand important features of the process of scientific inquiry. Students will apply the following to inquiry learning practices:

a. Scientific investigators control the conditions of their experiments in order to produce valuable data.

b. Scientific researchers are expected to critically assess the quality of data including possible sources of bias in their investigations’ hypotheses, observations, data analyses, and interpretations.

c. Scientists use practices such as peer review and publication to reinforce the integrity of scientific activity and reporting.

d. The merit of a new theory is judged by how well scientific data are explained by the new theory.

e. The ultimate goal of science is to develop an understanding of the natural universe which is free of biases.

f. Science disciplines and traditions differ from one another in what is studied, techniques used, and outcomes sought.

SCSh9 Students will enhance reading in all curriculum areas by:

a. Reading in All Curriculum Areas

Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.

Read both informational and fictional texts in a variety of genres and modes of discourse.

Read technical texts related to various subject areas.

b. Discussing books

Discuss messages and themes from books in all subject areas.

Respond to a variety of texts in multiple modes of discourse.

Relate messages and themes from one subject area to messages and themes in another area.

Evaluate the merit of texts in every subject discipline.

Examine author’s purpose in writing.

Recognize the features of disciplinary texts.

c. Building vocabulary knowledge

Demonstrate an understanding of contextual vocabulary in various subjects.

Use content vocabulary in writing and speaking.

Explore understanding of new words found in subject area texts.

**Task: 1**

**Essential Question(s):**

What are moon phases?

How did the moon form?

What are lunar properties and structures?

**Resources:**

[Moon Impact Theory](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/MoonImpactTheory27_9.swf)

[Eclipse](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Eclipse27_21.mov)

[Orbiting Telescopes](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch27_t27_1.swf)

[The Moon and Earth](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch27_t27_2.swf)

[Visualizing the Phases of the Moon](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_the_Phases_of_the_Moon_27.swf)

**Teacher’s Place:**

Prior to beginning the performance activity, the teacher should implement the following steps using teaching techniques you have found to be effective for your students.

1. Explain the activity (activity requirements)

2. Display the Georgia Performance Standard(s) (project on blackboard via units of instruction located at <http://thevillage411.weebly.com/units-of-instruction2.html> units of instruction page, or print on blackboard)

3. Read the Georgia Performance Standard(s) aloud and explain it to your students. You can rephrase the Georgia Performance Standard to make sure your students understand it.

4. Display the Essential Question(s) (project on blackboard via units of instruction, or print on blackboard)

5. Read the Essential Question (s) aloud and explain it to your students. You can rephrase the Essential Question (s) to make sure your students understand it.

6. Review unit vocabulary with students. <http://www.glencoe.com/qe/efcsec.php?qi=14471>

7. Introduce the following:

a. The Sun-Earth-Moon System: The moon p.770

8. Engage students in conversation by asking students the following question (s): Why do astronauts appear weightless while in orbit? Write answers on the blackboard.

9. Discuss answers with the students using the following questioning techniques as applicable:

**Questioning Techniques:**

**Memory Questions**

 Signal words: who, what, when, where?

 Cognitive operations: naming, defining, identifying, designating

**Convergent Thinking Questions**

 Signal words: who, what, when, where?

Cognitive operations: explaining, stating relationships, comparing and

contrasting

 **Divergent Thinking Questions**

 Signal words: imagine, suppose, predict, if/then

Cognitive operations: predicting, hypothesizing, inferring, reconstructing

 **Evaluative Thinking Questions**

 Signal words: defend, judge, justify (what do you think)?

10. Guide students into the activity by viewing:

[Moon Impact Theory](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/MoonImpactTheory27_9.swf)

[Eclipse](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Eclipse27_21.mov)

[Orbiting Telescopes](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch27_t27_1.swf)

[The Moon and Earth](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch27_t27_2.swf)

[Visualizing the Phases of the Moon](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_the_Phases_of_the_Moon_27.swf)

11. Complete the activity with the students (some tasks may require students to work independently, peer to peer, learning circles [2-3 students] or as a whole group [the entire class]. Therefore the teacher may serve as activity leader and or facilitator. When an activity calls for students to work in learning circles you should assign roles to students individually i.e. recorder, discussion leader or presenter)

12. At the end of the **\*whole group learning session**, students will transition into independent CAP assignments.

**\*The phrase, “whole group learning session” is utilized “rather than, the end of the activity” because all of the activities may not be completed in one day.**

**Activity**

The teacher and students will complete The Eyes Have It as a whole group activity. Students will then be placed in cooperative learning groups to complete the activity.

**The Eyes Have It**

For centuries, humans studied the heavens with only their eyes. The eye is a complex and intricate organ, but it is limited in many ways and lacking in its ability to see into the far reaches of space. As you know, the human eye can detect electromagnetic radiation in a very narrow range of wavelengths called visible light.

Astronomers have been challenged to study a vast universe from the confines of our planet using just the human eye. Much of our knowledge of space has been gained through the use of the human eye. However, the invention of the telescope, and the ability to use telescopes to collect various wavelengths of electromagnetic radiation has enabled us to see far into space. Technology has given us the ability to collect more information than we could have with our eyes alone.

**Problem:**

Telescopes have been adapted to collect various wavelengths of electromagnetic radiation. The two types used to collect visible light are reflecting and refracting telescopes. Diagrams and descriptions of these two types of telescopes are found on page 766-769 of your text. Astronomers primarily use reflecting telescopes because they do not have the size limitations that refracting telescopes do. Refracting telescopes are limited in size because of the difficulties in manufacturing a large, flawless glass lens and the problem of supporting a large lens along the edges. The mirrors for reflecting telescopes are easier to manufacture and can be supported from underneath.

1. Take a look at the two diagrams of the refracting and reflecting telescopes on page 766.
2. Do some research. Identify the parts of the human eye, and investigate how it functions. For this information, use the Web sites below.
3. Determine which telescope, refractor or reflector, is more similar to the human eye.
4. Write analogies for each part of the telescope you choose and the parts of the eye.
	* [**Just for Kids: How the eye works**](http://www.aoanet.org/jfk-how-eye-works.html)

**Task: 2**

**Essential Question(s):**

How was the Solar System formed?

How does gravity relate to the motion of objects in the solar system?

What features describe a planet?

**Resources:**

[Gravitational Attraction](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/GravitationalAttraction28_8.swf)

[Physical Data of the Planets](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch28_t28_1.swf)

[Visualizing the Kuiper Belt](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_the_Kuiper_Belt_28.swf)

**Teacher’s Place:**

Prior to beginning the performance activity, the teacher should implement the following steps using teaching techniques you have found to be effective for your students.

1. Explain the activity (activity requirements)

2. Display the Georgia Performance Standard(s) (project on blackboard via units of instruction located at <http://thevillage411.weebly.com/units-of-instruction2.html> units of instruction page, or print on blackboard)

3. Read the Georgia Performance Standard(s) aloud and explain it to your students. You can rephrase the Georgia Performance Standard to make sure your students understand it.

4. Display the Essential Question(s) (project on blackboard via units of instruction, or print on blackboard)

5. Read the Essential Question (s) aloud and explain it to your students. You can rephrase the Essential Question (s) to make sure your students understand it.

6. Review unit vocabulary with students. <http://www.glencoe.com/qe/efcsec.php?qi=14472>

7. Introduce the following:

a. Our Solar System: Formation of the Solar System p.796

8. Engage students in conversation by asking students the following question (s): How did the Solar System form? Write answers on the blackboard.

9. Discuss answers with the students using the following questioning techniques as applicable:

**Questioning Techniques:**

**Memory Questions**

 Signal words: who, what, when, where?

 Cognitive operations: naming, defining, identifying, designating

**Convergent Thinking Questions**

 Signal words: who, what, when, where?

Cognitive operations: explaining, stating relationships, comparing and

contrasting

 **Divergent Thinking Questions**

 Signal words: imagine, suppose, predict, if/then

Cognitive operations: predicting, hypothesizing, inferring, reconstructing

 **Evaluative Thinking Questions**

 Signal words: defend, judge, justify (what do you think)?

10. Guide students into the activity by viewing:

[Gravitational Attraction](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/GravitationalAttraction28_8.swf)

[Physical Data of the Planets](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch28_t28_1.swf)

[Visualizing the Kuiper Belt](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_the_Kuiper_Belt_28.swf)

11. Complete the activity with the students (some tasks may require students to work independently, peer to peer, learning circles [2-3 students] or as a whole group [the entire class]. Therefore the teacher may serve as activity leader and or facilitator. When an activity calls for students to work in learning circles you should assign roles to students individually i.e. recorder, discussion leader or presenter)

12. At the end of the **\*whole group learning session**, students will transition into independent CAP assignments.

**\*The phrase, “whole group learning session” is utilized “rather than, the end of the activity” because all of the activities may not be completed in one day.**

**Activity**

The teacher and students will complete Near Earth Objects as a whole group activity. Students will then be placed in cooperative learning groups to complete the activity.

**Near Earth Objects**

Are hurtling chunks of rock and ice—the leftovers from the creation of the solar system—dangerous? Are comets and asteroids a part of these "leftovers" from the solar system’s formation? They are ice and rock (comets) and rock (asteroids), they do hurtle through space, and they are believed to be remnants from the formation of the solar system. As for being dangerous, that’s a matter of opinion. However, there are several scientists who are studying the asteroids and comets whose orbits cross Earth’s orbit. These objects, periodic comets and asteroids, are referred to as Near-Earth-Objects, or NEOs. They are studied to identify those that may pose an impact threat to Earth.

Earth’s atmosphere is constantly bombarded by particles, and the larger the particle, the greater the effect. Examples of these bombardments are meteors streaking through the night sky. The remnants of large, but ancient impacts can be seen in places like the Barringer Meteor Crater in Arizona. In recent history, an example of a "small" impact of an asteroid took place in the Tunguska wilderness of Siberia in June 1908. Though the chance of being hit by one of these objects seems small, if one were to hit, the effect could be catastrophic. A comparable event would be a massive nuclear attack. The United States government has funded the Spaceguard Survey Program to identify and track Near Earth Objects.

**Problem:**

The Spaceguard Survey Project was officially funded and began operation in 1998. The objective of the survey is to discover and track 90% of the Near Earth Asteroids (NEAs) with a diameter greater than 1 kilometer within ten years, or by 2008. To date, the Massachusetts Institute of Technology-Lincoln Lab LINEAR (Lincoln Near Earth Asteroid Research) group has discovered most of the known NEAs.

* Estimated number of NEAs larger than 1 kilomter—900
* Number discovered through end of 2000—430
* Discovery rate—approximately 5/month
* Estimated completion—2012
1. Given this information, is it possible for the program to attain its goals?
2. With the goal of 90% by 2008, why is it logical that the project completion date is 2012?

\*To read more about NEOs and what NASA and other groups are doing about them check out the following Web site: Asteroid and Comet Impact Hazards - <http://impact.arc.nasa.gov/>

**Task: 3**

**Essential Question(s):**

What are the layers and features of the Sun?

What is the process of energy production in the Sun?

What are the three types of spectra?

**Resources:**

[Doppler Effect](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/DopplerEffect29_13.swf)

[Parallax](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Parallax29_14.mov)

[Star Formation](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/StarFormation29_18.swf)

[Helium Core](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/HeliumCore29_20.mov)

[Relative Properties of the Sun](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch29_t29_1.swf)

[Relationship of Special Types of Stars](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch29_t29_2.swf)

[Properties of Main Sequence Stars](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch29_t29_3.swf)

[Visualizing Star Groupings](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Star_Groupings_29.swf)

**Teacher’s Place:**

Prior to beginning the performance activity, the teacher should implement the following steps using teaching techniques you have found to be effective for your students.

1. Explain the activity (activity requirements)

2. Display the Georgia Performance Standard(s) (project on blackboard via units of instruction located at <http://thevillage411.weebly.com/units-of-instruction2.html> units of instruction page, or print on blackboard)

3. Read the Georgia Performance Standard(s) aloud and explain it to your students. You can rephrase the Georgia Performance Standard to make sure your students understand it.

4. Display the Essential Question(s) (project on blackboard via units of instruction, or print on blackboard)

5. Read the Essential Question (s) aloud and explain it to your students. You can rephrase the Essential Question (s) to make sure your students understand it.

6. Review unit vocabulary with students. <http://www.glencoe.com/qe/efcsec.php?qi=14473>

7. Introduce the following:

a. Stars: The Sun p.830

8. Engage students in conversation by asking students the following question (s): Why is the innermost layer of the Sun’s atmosphere visible? Write answers on the blackboard.

9. Discuss answers with the students using the following questioning techniques as applicable:

**Questioning Techniques:**

**Memory Questions**

 Signal words: who, what, when, where?

 Cognitive operations: naming, defining, identifying, designating

**Convergent Thinking Questions**

 Signal words: who, what, when, where?

Cognitive operations: explaining, stating relationships, comparing and

contrasting

 **Divergent Thinking Questions**

 Signal words: imagine, suppose, predict, if/then

Cognitive operations: predicting, hypothesizing, inferring, reconstructing

 **Evaluative Thinking Questions**

 Signal words: defend, judge, justify (what do you think)?

10. Guide students into the activity by viewing:

[Doppler Effect](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/DopplerEffect29_13.swf)

[Parallax](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Parallax29_14.mov)

[Star Formation](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/StarFormation29_18.swf)

[Helium Core](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/HeliumCore29_20.mov)

[Relative Properties of the Sun](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch29_t29_1.swf)

[Relationship of Special Types of Stars](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch29_t29_2.swf)

[Properties of Main Sequence Stars](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch29_t29_3.swf)

[Visualizing Star Groupings](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Star_Groupings_29.swf)

11. Complete the activity with the students (some tasks may require students to work independently, peer to peer, learning circles [2-3 students] or as a whole group [the entire class]. Therefore the teacher may serve as activity leader and or facilitator. When an activity calls for students to work in learning circles you should assign roles to students individually i.e. recorder, discussion leader or presenter)

12. At the end of the **\*whole group learning session**, students will transition into independent CAP assignments.

**\*The phrase, “whole group learning session” is utilized “rather than, the end of the activity” because all of the activities may not be completed in one day.**

**Activity**

The teacher and students will complete Cyclic Nature of Solar Events as a whole group activity. Students will then be placed in cooperative learning groups to complete the activity.

**Cyclic Nature of Solar Events**

Traveling at speeds of approximately 900 km/s, solar wind streams toward Earth. The wind is composed of particles, mainly electrons and protons, that have escaped the Sun’s gravity. Earth is protected by its magnetosphere, so the solar wind does not usually impact Earth. However, particles of the solar wind can leak into Earth’s magnetosphere. The particles are channeled to a portion of the magnetosphere called the Van Allen radiation belts. The Van Allen radiation belts form large rings above each of Earth’s poles.

Solar activity affects Earth in several ways. One way is the formation of the aurorae, in both the northern and southern hemispheres. Here, the solar wind excites atoms and molecules in Earth’s atmosphere, causing them to emit light. At other times, storm events on the Sun send strong surges of particles, causing geomagnetic storms on Earth. These geomagnetic storms can disrupt electronic activities such as communications and electrical systems.

The largest of these storms are often related to events called coronal mass ejections (CMEs); huge bubbles of plasma ejected from the Sun over the course of several hours. In turn, CMEs are often related to solar prominences. During one of these events, particles can be hurled toward Earth at speeds of up to 2000 km/s, which is much faster than the normal solar wind. These massive storms often result in major disruptions of communications and other electronic activity on Earth.

**Problem:**

As you may know, solar flares, sunspots, and other solar events are cyclical occurrences. At the following Web site address, you will see a graph that shows the cyclical nature of both sunspots and CMEs. Analyze the graph in order to answer the following questions. (The CMEs are labeled as SSC on the graph, which stands for Sudden Storm Commencements).

<http://cnx.org/content/m11970/latest/>

1. What is the relationship between these two phenomena as shown on the graph?
2. Notice that there are peaks for both events and troughs for both events. What is the average number of years between peak years?
3. Notice that there is a portion of the graph, between 1850 and about 1875, where CMEs are not shown. What might be a reason for the absence of data during this time period?
4. What other information does this graph give you?

Task Website

Unit 1

[What strategies are involved in solving a science problem virtual lesson](http://www.glencoe.com/sites/common_assets/science/virtual_labs/ES01/ES01.html)

<http://www.sti.nasa.gov/tto/apollo.htm>

[Visualizing Scientific Methods Concept](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Scientific_Methods_1.swf)

[Time Zones](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/TimeZones2_4.swf)

[Map Projections](http://glencoe.mcgraw-hill.com/sites/0078746361/student_view0/unit1/chapter2/concepts_in_motion.html)

[Types of Maps and projections](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch02_t02_1.swf)

[Visualizing GPS Satellites\_2.swf](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_GPS_Satellites_2.swf)

 [Standardized Test Practice](http://glencoe.mcgraw-hill.com/sites/0078746361/student_view0/unit1/chapter2/standardized_test_practice-english.html)

Unit 2

[The Atom](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Atoms3_1.avi)

[Periodic Table of the Elements](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/PeriodicTableoftheElements3_2%20.swf)

[Ionic Bonding](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/IonicBonding3_11.mpg)

[Electron Flow](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/ElectronFlow3_12.SWF)

[pH Scale](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/pHScale3_16.swf)

[Visualizing Bonds](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Bonds_3.swf)

[Mohs Scale of Hardness Concept](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch04_t04_2.swf)

[Special Properties of Minerals Concept](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch04_t04_3.swf)

[Visualizing the Silica Tetrahedron](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_the_Silica_Tetrahedron_4.swf)

[Types of Magna Concept](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch05_t05_1.swf)

[Visualizing Fractional Crystallixation and Crystal Settling Concept](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Fractional_Crystallixation_and_Crystal_Settling_5.swf)

Unit 3

[Visualizing Soil Orders Concept](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Soil_Orders_7.swf)

[Rockslides](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Rockslides8_7.swf)

[Dune Migration](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/DuneMigration8_18.swf)

[Glacier Formaiton](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/GlacierFormaiton8_20.avi)

[Types of Dunes Concept](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch08_t08_1.swf)

[Visualizing Continental Glacial Features](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Continental_Glacial_Features_8.swf)

[Water Cycle Concept](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/WaterCycle9_1.swf)

[Meander Formation](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/MeanderFormaiton9_14%20.avi)

[Visualizing Erosion and Deposition](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Erosion_and_Deposition_in_a_Meander_9.swf)

Unit 4

[Conduction Convection and Radiation](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/ConductionConvectionandRadiation11_7.avi)

[Components of the Atmosphere](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch11_t11_1.swf)

[Visualizing the Layers of the Atmosphere](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_the_Layers_of_the_Atomsphere_11.swf)

[Fronts](%20http%3A/glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Fronts12_8.swf)

[Air Mass Characteristics](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch12_t12_1.swf)

[Visualizing the Coriolis Effect](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_the_Coriolis_Effect_12.swf)

[Thunderstorms Development](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/ThunderstormsDevelopment13_1.swf)

[Tornado Formation](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/TornadoFormation13_10.swf)

[Tropical Cyclones](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/TropicalCyclones13_12.swf)

[Fujita Tornado Intensity Scale](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch13_t13_1.swf)

[The Heat Index](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch13_t13_2.swf)

[Visualizing Cyclone Formation](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Cyclone_Formaiton_13.swf)

Unit 5

[Continental Drift](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/ContinentalDrift17_2.AVI)

[Summary of Convergent Boundaries](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch17_t17_1.swf)

[Visualizing Seafloor Spreading](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Seafloor_Spreading_17.swf)

[Subduction](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Subduction18_2.swf)

[Divergent Plate Boundaries](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/DivergentPlateBoundaries18_3.swf)

[Types of Volcanoes](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch18_t18_1.swf)

[Visualizing Eruptions](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Eruptions_18.swf)

[Caldera Formation](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/CalderaFormaiton18_8.avi)

[Faults](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Faults19_1.swf)

[Seismic Waves](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/SeismicWaves19_5.avi)

[Seismometers](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Seismometers19_7.swf)

[P and S waves](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/PandSwaves19_9.swf)

[Tsunami](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Tsunami19_23.swf)

[Types of Faults](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch19_t19_1.swf)

[Modified Mercalli Scale](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch19_t19_2.swf)

[Visualizing Seismic Waves](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Seismic_Waves_19.swf)

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[Angular Unconformity](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/AngularUnconformity21_10.swf)

[Alpha Decay](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/AlphaDecay21_13.swf)

[Half Life](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/HalfLife21_15.mpg)

[Half-Life of Selected Radioactive Isotopes](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch21_t21_1.swf)

[Visualizing the Geologic Time Scale](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_the_Geologic_Time_Scale_21.swf)

[Miller Urey Experiment](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/MillerUreyExperiment22_14.swf)

[How Life Might Have Begun on Earth: Three Hypotheses](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch22_t22_1.swf)

[Visualizing Continent Formation](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Continent_Formation_22.swf)

 [Major Extinctions in the Phanerozoic](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch23_t23_1.swf)

[Visualizing the Basin and Range Province](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_the_Basin%20and_Range_Province_23.swf)

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[Distillation](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Distillation24_21.swf)

[Visualizing Carbon and Nitrogen Cycles](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Carbon_and_Nitrogen_Cycles_24.swf)

 [Geothermal Power](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/GeothermalPower25_10.swf)

[Advantages of Public Transportation](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch25_t25_1.swf%09)

[Fission Reactor](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/FissionReactor25_11.mpg)

[Visualizing Coal](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Coal_25.swf)

[Carrying Capacity](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/CarryingCapacity26_3.avi)

[How Smog Forms](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/HowSmogForms26_12.swf)

[Ozone Depletion](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/OzoneDepletion26_13.swf)

[Agricultural Practices](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Agricultural_Practices_26.swf)

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[Moon Impact Theory](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/MoonImpactTheory27_9.swf)

[Eclipse](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Eclipse27_21.mov)

[Orbiting Telescopes](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch27_t27_1.swf)

[The Moon and Earth](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch27_t27_2.swf)

[Visualizing the Phases of the Moon](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_the_Phases_of_the_Moon_27.swf)

[Gravitational Attraction](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/GravitationalAttraction28_8.swf)

[Physical Data of the Planets](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch28_t28_1.swf)

[Visualizing the Kuiper Belt](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_the_Kuiper_Belt_28.swf)

[Doppler Effect](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/DopplerEffect29_13.swf)

[Parallax](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/Parallax29_14.mov)

[Star Formation](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/StarFormation29_18.swf)

[Helium Core](http://glencoe.com/sec/science/earthscience/2007/concept_motion/animated_art/HeliumCore29_20.mov)

[Relative Properties of the Sun](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch29_t29_1.swf)

[Relationship of Special Types of Stars](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch29_t29_2.swf)

[Properties of Main Sequence Stars](http://glencoe.com/sec/science/earthscience/2007/concept_motion/intr_tables/tables/egeu_ch29_t29_3.swf)

[Visualizing Star Groupings](http://glencoe.com/sec/science/earthscience/2007/concept_motion/NGS/Visualizing_Star_Groupings_29.swf)