TOMS RIVER REGIONAL SCHOOLS SCIENCE CURRICULUM Environmental Earth Science Curriculum				
Content Area: Environmental Earth Science				
Course Title: Honors Environmental Earth Science			**Grade Level: 9**	
	Unit 1: Climate Change		**Marking Period 1** Pacing: 45 days	
	Unit 2: Human Sustainability		**Marking Period 2** Pacing: 45 days	
	Unit 3:Earth's Systems		**Marking Period 3** Pacing: 17 days	
	Unit 4: History of Earth		**Marking Period 3** Pacing: 18 days	
	Unit 5: Space Systems		**Marking Period 4** Pacing: 35 days	
Date Created:		**July 2019**		
Board Approved on: August 21, 2019				

TOMS RIVER REGIONAL SCHOOLS SCIENCE CURRICULUM
Environmental Earth Science: Earth Science Unit

Content Area: Environmental Earth Science

Unit Title: History of Earth and Plate Tectonics
Plate Tectonics- Chapter 17 (pacing 6 days)
Volcanism- Chapter 18 (pacing 6 days)
Earthquakes- Chapter 19 (pacing 6 days)

Target Course/Grade Level: 9

Unit Summary
"Earth scientists use the structure, sequence, and properties of rocks, sediments, and fossils, as well as locations of current and past ocean basins, lakes, and rivers, to reconstruct events in Earth's planetary history"- NJ Model Curriculum

Cross-Cutting Concepts:
Patterns:

- Empirical evidence is needed to identify patterns.(HS-ESS1-5)

Stability and Change:

- Much of science deals with constructing explanations of how things change and how they remain stable. (HS-ESS1-6, HS-ESS2-7)
- Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS2-1)

Cause and Effect:

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS4-5)

For further clarification refer to the Next Generation Science Standards:
http://www.nextgenerationscience.org/

Science and Engineering Practices:
Developing and Using Models
Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).

- Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-ESS2-1)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent

student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Apply scientific reasoning to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion. (HS-ESS1-6)

Engaging in Argument from Evidence

Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.

- Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-ESS1-5)

Disciplinary Core Idea:

ESS1.C: The History of Planet Earth

- Continental rocks, which can be older than 4 billion years, are generally much older than the rocks of the ocean floor, which are less than 200 million years old. (HS-ESS1-5)
- Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history. (HS-ESS1-6)

ESS2.A: Earth Materials and Systems

- Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. (HS-ESS2-1) (Note: This Disciplinary Core Idea is also addressed by HS-ESS2-2.)

ESS2.B: Plate Tectonics and Large-Scale System Interactions

- Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history. (ESS2.B Grade 8 GBE) (secondary to HS-ESS1-5),(HS-ESS2-1)
- Plate movements are responsible for most continental and ocean-floor features and for the distribution of most rocks and minerals within Earth's crust. (ESS2.B Grade 8 GBE) (HS-ESS2-1)

Learning Targets

Content Standards

NJ STUDENT LEARNING STANDARDS LINK: http://www.nextgenscience.org/

DCI	Strand
HS-ESS1-6	Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.

HS-ESS1-5	Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
HS-ESS2-1	Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.
HS-ESS2-3	Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
HS-ESS2-7	Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.
HS-LS4-5	Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.
21st Century Themes/Careers Ready Practices:	
9.2.12.CAP.3	Investigate how continuing education contributes to one's career and personal growth.
9.2.12.CAP.5	Assess and modify a personal plan to support current interests and postsecondary plans.
Interdisciplinary Practices	
RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-ESS1-5),(HS-ESS1-6)
RST.11-12.8	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-ESS1-5),(HS-ESS1-6)
WHST.9-12.1	Write arguments focused on discipline-specific content. (HS-ESS1-6)
WHST.9-12.2	Write informative/explanatory texts, including the narration

	of historical events, scientific procedures/ experiments, or technical processes. (HS-ESS1-5)
SL.11-12.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-ESS2-1)
MP.2	Reason abstractly and quantitatively. (HS-ESS1-5),(HS-ESS1-6),(HS-ESS2-1)
MP.4	Model with mathematics. (HS-ESS2-1)
HSN-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-ESS1-5),(HS-ESS1-6),(HS-ESS2-1)
HSN-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling (HS-ESS1-5),(HS-ESS1-6),(HS-ESS2-1)
HSN-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities (HS-ESS1-5),(HS-ESS1-6),(HS-ESS2-1)
HSF-IF.B.5	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. (HS-ESS1-6)
HSS-ID.B.6	Represent data on two quantitative variables on a scatter plot, and describe how those variables are related. (HS-ESS1-6)
Unit Essential Questions · What are the lines of evidence that led Wegner to suggest that Earth's continents have moved? · How does evidence of ancient climates support continental drift? · Why was continental drift not accepted when it was first	**Unit Enduring Understanding** *Students will understand that…* · The shape and geology of the continents suggests that they were once joined together. · Oceanic crust forms at ocean ridges and becomes part of the seafloor. · Volcanoes, mountains, and deep-sea trenches form at the boundaries between the plates. · Convection currents in the mantle cause plate motions. · The locations of volcanoes are mostly determined by plate tectonics. · The composition of magma determines the characteristics of a volcanic eruption.

proposed? · What evidence led to the discovery of seafloor spreading? · What is the significance of magnetic patterns on the seafloor? · How is the process of seafloor spreading explained? · How does the movement of Earth's tectonic plates result in many geologic features? · What are the three types of plate boundaries and the features associated with each? · What are the processes associated with subduction zones? · How is the process of convection explained? · How is convection in the mantle related to the movements of tectonic plates? · What are the processes of ridge push and slab pull? · How do plate tectonics influence the formation of volcanoes? · Where are the major zones of volcanism? · What are the parts of a volcano? · How do volcanic landforms differ?	· Magma that solidifies below ground forms geologic features different from those formed by magma that cools at the surface. · Seismic waves can be used to make images of the internal structure of Earth. · Scientists measure the strength and chart the location of earthquakes using seismic waves. · The probability of an earthquake's occurrence is determined from the history of earthquakes and knowing where and how quickly strain accumulates. · Convergence causes the crust to thicken and form mountain belts. · Mountains on the ocean floor and some mountains on continents form through processes other than convergence. · Scientists organize geologic time to help them communicate about Earth's history. · Scientists use geologic principles to learn the sequence in which geologic events occurred. · Radioactive decay and certain kinds of sediments help scientists determine the numeric age of many rocks. · Fossils provide scientists with a record of the history of life on Earth.

· How does magma type influence a volcano's explosion? · What is the role of pressure and dissolved gases in eruptions? · What kinds of material are ejected by volcanic eruptions? · How are features formed from magma that solidified under Earth's surface described? · What are the different types of intrusive rock bodies? · What geologic processes result in intrusive rocks that appear at Earth's surface? · How are stress and strain defined as they apply to rocks? · What are the three types of movement of faults? · What are three types of seismic waves? · How does a seismometer work? · How have seismic waves been used to determine the structure and composition of Earth's interior? · What are earthquakes magnitude and intensity and how are they measured? · Why are data from	

at least three seismic stations needed to locate an earthquake's epicenter? · Where are Earth's seismic belts? · What factors affect the amount of damage caused by an earthquake? · What are some of the factors considered in earthquake-probability studies? · How are different types of structures affected by earthquakes? · How can the elevation distribution of Earth's surface be described? · What is isostasy and how does it pertain to Earth's mountains? · How does Earth's crust respond to the addition and removal of mass? · What are orogenic processes? · How are the different types of mountains that form along convergent plate boundaries described? · How did the Appalachian Mountains form? · How are radioactive elements used to date rocks and other	

objects? · How are fossils used to interpret Earth's past physical and biological history?	
Unit Objectives *Students will know…* ● The four ways in which entire organisms can be preserved as fossils. ● Five examples of fossilized traces of organisms. ● Wegener's hypothesis of continental drift. ● The process of sea-floor spreading. ● How paleomagnetism provides support for the idea of sea floor spreading. ● Why sea floor spreading provides a mechanism for continental drift. ● The theory of plate tectonics. ● The three types of plate boundaries. ● The three causes of plate movement. ● How movements	**Unit Objectives** *Students will be able to…* ● Describe four ways in which entire organisms can be preserved as fossils. ● Summarize Wegener's hypothesis of continental drift. ● Describe the process of sea-floor spreading. ● Identify how paleomagnetism provides support for the idea of sea floor spreading. ● Explain how sea-floor spreading provides a mechanism for continental drift. ● Summarize the theory of plate tectonics. ● Identify and describe the three types of plate boundaries. ● List and describe three causes of plate movement. ● Identify how movements of tectonic plates change Earth's surface. ● Summarize how movements of tectonic plates have influenced climate and life on Earth. ● Describe the supercontinent cycle. ● Identify the types of plate collisions that form mountains. ● Identify four types of mountains. ● Compare how folded and fault-block mountains form. ● Describe elastic rebound. ● Compare body waves and surface waves. ● Explain how the structure of Earth's interior affects seismic waves. ● Explain why earthquakes generally occur at plate boundaries. ● Describe the instruments used to measure and record earthquakes. ● Summarize the methods scientists use to locate an epicenter. ● Describe the scales used to measure the magnitude

of tectonic plates change Earth's surface. ● How movements of tectonic plates influence climate and life on Earth. ● The supercontinent cycle. ● The definition of elastic rebound. ● The similarities and differences between body waves and surface waves. ● How the structure of earth's interior affect seismic waves. ● Why earthquakes generally occur at plate boundaries. ● The instruments used to measure and record earthquakes. ● The methods scientists use to locate an epicenter. ● The scales used to measure the magnitude and intensity of earthquakes. ● The relationship between tsunamis and earthquakes.	and intensity of earthquakes. ● Discuss the relationship between tsunamis and earthquakes. ● Describe two possible effects of a major earthquake on buildings. ● List three safety techniques to prevent injury caused by earthquake activity. ● Identify four methods scientists use to forecast earthquake risks. ● Describe the three conditions under which magma can form. ● Explain what volcanism is. ● Identify three tectonic settings when volcanoes form.. ● Explain how the composition of magma affects volcanic eruptions and lava flows. ● Describe the five major types of pyroclastic material. ● Identify the three main types of volcanic cones. ● List three events that may signal a volcanic eruption.

• Two possible effects of major earthquake activity. • Four methods scientists use to forecast earthquake risks. • The three conditions under which magma can form. • What volcanism is. • Three tectonic settings where volcanoes form. • How the composition of magma affects volcanic eruptions and lava flows. • The five major types of pyroclastic materials. • The three main types of volcanic cones.. • Three events that may signal a volcanic eruption.	

TOMS RIVER REGIONAL SCHOOLS SCIENCE CURRICULUM **Evidence of Learning**	
Formative Assessments	**Benchmark**
-Observation	- New Jersey Student Learning Assessment; Science

-Homework -Class participation -Venn Diagrams/Graphic Organizers -WebQuests -Do Now -Laboratories/Lab Reports -Notebook -Writing Assignments -Foldables	(NJSLA) - Quarterly Exams - Unit Tests - Performance Assessments
Summative Assessments	**Alternative**
-Writing Assignments - Laboratory Practical -Unit Projects -Midterm/Endterm Exams	- Oral Presentation - Video Recording - Virtual Lab

Modifications (ELLs, Special Education, 504, Gifted and Talented)

Special Education
-Follow all IEP modifications
-Oral instructions
-Record lessons instead of taking notes
-Outlines of lessons
-Study Guides with answers
-Word processor to type notes
-Frequent breaks
-Teacher tutoring
-Peer tutoring
-Cooperative learning group
-Modified assignments (ex. Fewer items per page)
-Follow all IEP modifications

504:
- Utilize graphic organizers to help provide a purpose for reading and increase comprehension
- Assign peer tutor
- Provide clear and specific directions

● Provide class notes ahead of time to allow students to preview material and increase comprehension
● Provide extended time
● Simplify written and verbal instructions

Gifted and Talented
-Peer tutoring
-Cooperative learning groups
-Differentiated instruction
ELL
-Audio books, Movies, and other digital media in lieu of print versions
-Native language texts and native language to English Dictionary
Students at Risk of School Failure:
● Extended Time
● Flexible Grouping
● Small Group Instruction
● Peer Buddies
● Tiered Activities
● Manipulatives
● Graphic Organizers

Curriculum Development Resources/Instructional Materials/Equipment Needed
Teacher Resources:

· Textbook
· Laboratory manuals and equipment
· NJ DOE Model Curriculum Resources:

EarthViewer (IPAd or Android) or for Chrome browsers: Students explore the co-evolution of the geology and biology found on Earth to develop arguments from evidence for the co-evolution of geology and biology found on Earth. If IPads, Androids or Chrome browsers are not available, similar interactives may be found at this link, and this link.
Le Pichon's 1968 seafloor age data: Students map and analyze LePichon's field data to identify patterns in the ages of the ocean floor.
Extensions: Additional maps and data may be found at NOAA Marine Geology and Geophysics and from their image site. An associated research paper may be found here.
Citation for research paper: Muller, R. D., M. Sdrolias, C. Gaina, and W. R. Roest (2008), Age, spreading rates, and spreading asymmetry of the world's ocean crust, Geochem. Geophys. Geosyst., 9, Q04006, doi:10.1029/2007GC001743.
IRIS - Measuring the Rate of Plate Motion: Students compare GPS data of plate motion to determine the rate at which tectonic plates move. Alternatively, students use real-time plate motion data from UNAVCO to determine the rate at which plates move.
IODP: Deep Earth Academy Core Data investigations: Students investigate seafloor core

data to evaluate multiple lines of evidence to support the dynamic plate theory.
GeoMapApp and GeoMapApp educational activities: Students visualize and explore various lines of evidence for plate dynamics and evaluate the strengths of each line of evidence in supporting the dynamic plate theory.
Lithosphere age research paper: Students read this article which describes how seismic data is used to determine the age of the crust, and the inherent issues associated with the procedure. They use this information in their analysis, evaluation, and synthesis of evidence for the dynamic plate theory.
Citation for research paper: Poupinet, G., Shapiro, N.M., Worldwide distribution of ages of the continental lithosphere derived from a global seismic tomographic model, Lithos (2008), doi:10.1016/j.lithos.2008.10.023.
Google Earth Age of the Lithosphere: Students compare the age of the seafloor and continental crust using the data at this site, or USGS data found here or found here.
Geologic time and rates of landscape evolution: Students model rates of landscape evolution to gain an understanding of change over deep, historical, and recent time. Alternatively, students compare rates of erosion of a mountain landscape to agricultural lands by completing this activity.
Hotspot Lesson: Students analyze the rate of movement of the Hawaiian Island chain to further understand rates of change in geologic processes.
How Erosion Builds Mountains: by Mark Brandon and Nicholas Pinter, from Scientific American. Students read this article and identify feedbacks in the mountain building process. To support their model, they gather supporting evidence using this Isostasy model.
Comparing models of the Earth's interior from data: Students compare two models of the Earth's interior and argue from evidence which model more strongly supports the evidence. Seismic Wave: Students receive additional practice in the interpretation of seismic data to model the interior of the Earth.

***resources will vary for each district**

Teacher Notes:

TOMS RIVER REGIONAL SCHOOLS SCIENCE CURRICULUM
Environmental Earth Science: Climate Change

Content Area: Environmental Earth Science

Unit Title: Climate Change
Atmosphere- Chapter 11 (pacing 16 days)

Climate Change- Chapter 14 (pacing 29 days)

Target Course/Grade Level: 9

Unit Summary
"The performance expectations in HS. Climate Change is to help students formulate an answer to the questions: "What regulates earth's climate?" Students understand the system interactions that control climate, with a major emphasis on the mechanisms and implications of climate change. Students can understand the analysis and interpretation of different kinds of geoscience data to construct explanations for the many factors that drive climate change over a wide range of timescales."- State of New Jersey Department of Education

Cross Cutting Concepts:
Cause and Effect:

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS2-4)

Structure and Function:

- The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. (HS-ESS2-5)

Stability and Change:

- Feedback (negative or positive) can stabilize or destabilize a system. (HS-ESS2-2)

Science and Engineering Practices:
Developing and Using Models
Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems

and their components in the natural and designed world(s).

- Use a model to provide mechanistic accounts of phenomena. (HS-ESS2-4)

Analyzing and Interpreting Data

Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.

- Analyze data using computational models in order to make valid and reliable scientific claims. (HS-ESS3-5)

Disciplinary Core Idea:

ESS1.B: Earth and the Solar System

- Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes. (secondary to HS-ESS2-4)

ESS2.A: Earth Materials and Systems

- The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. (HS-ESS2-4)

ESS2.D: Weather and Climate

- The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. (HS-ESS2-4),(secondary to HS-ESS2-2)
- Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-4)

ESS3.D: Global Climate Change

- Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. (HS-ESS3-5)

For further clarification refer to the Next Generation Science Standards: http://www.nextgenscience.org/

Learning Targets

Content Standards **CONTENT STANDARDS LINK: http://www.nextgenscience.org/**	
DCI	**Strand**
HS-ESS2-2	Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
HS-ESS2-4	Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
HS-ESS2-5	Plan and conduct an investigation of the properties of water and its effect on Earth materials and surface processes.
HS-ESS3-5	Analyze geoscience data and the results from global climate models to make an evidence -based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.
21st Century Themes/Careers Ready Practices:	
9.2.12.CAP.3	Investigate how continuing education contributes to one's career and personal growth.
9.2.12.CAP.5	Assess and modify a personal plan to support current interests and postsecondary plans.
Interdisciplinary Practices	
RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-ESS3-5)
RST.11-12.2	Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. (HS-ESS3-5)
RST.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or

	solve a problem. (HS-ESS3-5)
SL.11-12.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-ESS2-4)
MP.2	Reason abstractly and quantitatively.(HS-ESS2-4),(HS-ESS3-5)
MP.4	Model with mathematics. (HS-ESS2-4)
HSN-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-ESS2-4),(HS-ESS3-5)
HSN-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling. (HS-ESS2-4),(HS-ESS3-5)
HSN-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-ESS2-4),(HS-ESS3-5)
Unit Essential Questions · What is the gas and particle composition of the atmosphere? · How is energy transferred in the atmosphere? · What is the difference between weather and climate?	**Unit Enduring Understandings** *Students will understand that…* - Energy is transferred throughout Earth's atmosphere. -List the gases and percentages for the gases that make up the atmosphere -Differentiate between reflection, radiation, and convection -Cite examples for the three processes listed above -Explain how radiation occurs in the atmosphere -Define the Greenhouse Effect -List all of the Greenhouse Gases and the human activities that release them -Explain what happens when cool, polluted ground air is trapped by warm air -Differentiate between weather and climate, give an example of both -Climate of an area is defined by what two characteristics -The increase in sea-level is due to what? -Explain how tall buildings and pavement in an area can change the temperature

	-Cite ways in which you can slow the rate of climate change -Explain why tropical climates are located by the equator -Cite at least five examples of the effects of climate change
Unit Objectives *Students will know…* · The composition of Earth's atmosphere. · Name two effects of air pollution. · How radiant energy reaches Earth. · How visible light and infrared energy warm Earth. · The similarities and differences between radiation, conduction, and convection.	**Unit Objectives** *Students will be able to…* · Describe the composition of Earth's atmosphere. · Identify two effects of air pollution. · Explain how radiant energy reaches Earth. · Describe how visible light and infrared energy warm Earth. · Summarize the processes of radiation, conduction, and convection. · Explain how heat energy affects the changing phases of water. -List the gases and percentages for the gases that make up the atmosphere -Differentiate between reflection, radiation, and convection -Cite examples for the three processes listed above -Explain how radiation occurs in the atmosphere -Define the Greenhouse Effect -List all of the Greenhouse Gases and the human activities that release them -Explain what happens when cool, polluted ground air is trapped by warm air -Differentiate between weather and climate, give an example of both -Climate of an area is defined by what two characteristics -The increase in sea-level is due to what? -Explain how tall buildings and pavement in an area can change the -temperature -Cite ways in which you can slow the rate of climate change -Define the terms hurricane, temperature inversion, and storm surge -Explain why tropical climates are located by the equator -Cite at least five examples of the effects of climate change

Formative Assessments	**Benchmark**
-Observation -Homework -Class participation -Venn Diagrams/Graphic Organizers -WebQuests -Do Now -Laboratories/Lab Reports -Notebook -Writing Assignments -Foldables	- New Jersey Student Learning Assessment; Science (NJSLA) - Quarterly Exams - Unit Tests - Performance Assessments
Summative Assessments	**Alternative**
-Writing Assignments - Laboratory Practical -Unit Projects -Midterm/Endterm Exams	- Oral Presentation - Video Recording - Virtual Lab

Modifications (ELLs, Special Education, 504, Gifted and Talented)

Special Education

-Follow all IEP modifications/504 plan
-Oral instructions
-Record lessons instead of taking notes
-Outlines of lessons
-Study Guides with answers
-Word processor to type notes
-Frequent breaks
-Teacher tutoring
-Peer tutoring
-Cooperative learning group
-Modified assignments (ex. Fewer items per page)
-Follow all IEP modifications

504:

- Utilize graphic organizers to help provide a purpose for reading and increase comprehension
- Assign peer tutor
- Provide clear and specific directions
- Provide class notes ahead of time to allow students to preview material and increase comprehension
- Provide extended time
- Simplify written and verbal instructions

Gifted and Talented

-Peer tutoring

-Cooperative learning groups

-Differentiated instruction

ELL

-Audio books, Movies, and other digital media in lieu of print versions

-Native language texts and native language to English Dictionary

Students at Risk of School Failure:

- Extended Time
- Flexible Grouping
- Small Group Instruction
- Peer Buddies
- Tiered Activities
- Manipulatives
- Graphic Organizers

Curriculum Development Resources/Instructional Materials/Equipment Needed
Teacher Resources:

- Textbook
- Laboratory manuals and equipment
- Science Websites
- **http://www.sciencenetlinks.com**
- **http://strandmaps.nsdl.org/**
- **www.thinkquest.com**
- **www.teachersdomain.org**

***resources will vary for each district**

Teacher Notes:

OCEAN COUNTY SCIENCE CURRICULUM
Environmental Earth Science: Earth Systems, Earth Resources, Energy Resources

Content Area: Environmental Earth Science

Unit Title: Earth Systems, Earth Resources, Energy Resources
Earth Resources-Chapter 24 (pacing 8 days)

Energy Resources- Chapter 25 (pacing 9 days)

Target Course/Grade Level: 9

Unit Summary:
"Earth's system is a complex and dynamic of interconnected systems-principally the geosphere, hydrosphere, atmosphere, and biosphere- that interact over a wide range of temporal and spatial scales. All of the Earth's processes are the result of energy flowing and matter cycling within and among these systems."- State of New Jersey Department of Education

Cross Cutting Concepts:

Energy and Matter

- The total amount of energy and matter in closed systems is conserved. (HS-ESS2-6)
- Energy drives the cycling of matter within and between systems. (HS-ESS2-3)

Structure and Function

- The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. (HS-ESS2-5)

Stability and Change

- Much of science deals with constructing explanations of how things change and how they remain stable. (HS-ESS2-7)
- Feedback (negative or positive) can stabilize or destabilize a system. (HS-ESS2-2)

Science and Engineering Practices:

Developing and Using Models

Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).

- Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-ESS2-3),(HS-ESS2-6)

Planning and Carrying Out Investigations

Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-ESS2-5)

Analyzing and Interpreting Data

Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.

- Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (HS-ESS2-2)

Engaging in Argument from Evidence

Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.

- Construct an oral and written argument or counter arguments based on data and evidence. (HS-ESS2-7)

Disciplinary Core Idea:

ESS2.A: Earth Materials and Systems

- Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes (HS ESS2-2)
- Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth's surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust. Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and gravitational movement of denser materials toward the interior. (HS-ESS2-3)

ESS2.B: Plate Tectonics and Large-Scale System Interactions

- The radioactive decay of unstable isotopes continually generates new energy within Earth's crust and mantle, providing the primary source of the heat that drives mantle

convection. Plate tectonics can be viewed as the surface expression of mantle convection. (HS-ESS2-3)

ESS2.C: The Roles of Water in Earth's Surface Processes

- The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks. (HS-ESS2-5)

ESS2.D: Weather and Climate

- The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space. (HS-ESS2-2)
- Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. (HS-ESS2-6),(HS-ESS2-7)
- Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-6)

Technology connections:

For further clarification refer to the Next Generation Science Standards: http://www.nextgenscience.org/

Learning Targets

CONTENT STANDARDS LINK: http://www.nextgenscience.org/

DCI	Strand
HS-ESS2-2	Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
HS-ESS2-4	Use a model to describe how variations in the flow of water and its effect on Earth materials and surface processes.
HS-ESS2-6	Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
HS-ESS2-7	Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life

	on Earth.
21st Century Themes/Careers Ready Practices:	
9.2.12.CAP.3	Investigate how continuing education contributes to one's career and personal growth.
9.2.12.CAP.5	Assess and modify a personal plan to support current interests and postsecondary plans.
Interdisciplinary Practices	
RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-ESS2-2),(HS-ESS2-3)
RST.11-12.2	Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. (HS-ESS2-2
WHST.9-12.1	Write arguments focused on discipline-specific content. (HS-ESS2-7)
WHST.9-12.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-ESS2-5)
SL.11-12.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-ESS2-3)
MP.2	Reason abstractly and quantitatively. (HS-ESS2-2),(HS-ESS2-3),(HS-ESS2-6)

MP.4	Model with mathematics. (HS-ESS2-3),(HS-ESS2-6)
HSN-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-ESS2-2),(HS-ESS2-3),(HS-ESS2-6)
HSN-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling. (HS-ESS2-3),(HS-ESS2-6)
HSN-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-ESS2-2),(HS-ESS2-3),(HS-ESS2-5),(HS-ESS2-6)
Unit Essential Questions · What are renewable and nonrenewable resources? · What is sustainable yield? · How are resources unevenly distributed on Earth? · Which materials from Earth's crust are considered natural resources? · Why is the need to protect Earth's land surface as a resource important? · How is the uneven distribution of resources worldwide explained? · How is the atmosphere a resource? · How are the carbon and nitrogen cycles illustrated? · What are natural resources of air pollution? · Why are the properties of water important for life on Earth? · How is water distributed	**Unit Enduring Understandings** *Students will understand that…* · Resources are materials that organisms need; once used, some resource can be replaced, whereas other cannot. · Earth's crust provides a wide variety of resources to grow food, supply building materials, and provides metals and minerals. · The atmosphere contains gases required for life on Earth. · Water is essential for all life, yet is unevenly distributed on Earth's surface. · Biomass and fossil fuels store energy from the sun. · Many resources other than fossil fuels can be developed to meet the needs of people on Earth. · Using energy efficiently reduces the consumption of nonrenewable resources.

and used on Earth? · In what ways can humans reduce the need for freshwater resources? · Why is the Sun the source of most energy on Earth? · What materials are used as fuels? · How does coal form? · What are several alternative energy resources? · How can the Sun's energy be harnessed? · How can water, wind, nuclear, and thermal energy be used to generate electricity? · Why might nuclear energy controversial? · How can energy resources be conserved? · How can increasing energy efficiency help preserve fossil fuels? · How can energy be used more efficiently?	
Unit Objectives *Students will know…* · Why coal is a fossil fuel. · The formation of petroleum and natural gas. · How fossil fuels are used today. · How nuclear fission generates electricity. · How geothermal energy may be used as a substitute for fossil fuels. · Two methods for harnessing energy from the sun.	**Unit Objectives** *Students will be able to…* · Explain why coal is a fossil fuel. · Describe the formation of petroleum and natural gas. · Describe how fossil fuels are used today. · Explain how nuclear fission generates electricity. · Explain how geothermal energy may be used as a substitute for fossil fuels. · Describe two methods for harnessing energy from the sun. · Describe four sources of renewable alternative energy.

· Four sources of renewable alternative energy. · The importance of using fossil fuels wisely. · How the environmental impacts of mining can be reduced. · How conservation protects natural resources.	· Describe the importance of using fossil fuels wisely. · Explain how the environmental impacts of mining can be reduced. · Identify how conservation protects natural resources.

OCEAN COUNTY SCIENCE CURRICULUM
Evidence of Learning

Formative Assessments	**Benchmark**
-Observation -Homework -Class participation -Venn Diagrams/Graphic Organizers -WebQuests -Do Now -Laboratories/Lab Reports -Notebook -Writing Assignments -Foldables	- New Jersey Student Learning Assessment; Science (NJSLA) - Quarterly Exams - Unit Tests - Performance Assessments
Summative Assessments	**Alternative**
-Writing Assignments - Laboratory Practical -Unit Projects -Midterm/Endterm Exams	- Oral Presentation - Video Recording - Virtual Lab

Modifications (ELLs, Special Education, 504, Gifted and Talented)

Special Education
-Follow all IEP modifications/504 plan
-Oral instructions

-Record lessons instead of taking notes
-Outlines of lessons
-Study Guides with answers
-Word processor to type notes
-Frequent breaks
-Teacher tutoring
-Peer tutoring
-Cooperative learning group
-Modified assignments (ex. Fewer items per page)
-Follow all IEP modifications

504:
- Utilize graphic organizers to help provide a purpose for reading and increase comprehension
- Assign peer tutor
- Provide clear and specific directions
- Provide class notes ahead of time to allow students to preview material and increase comprehension
- Provide extended time
- Simplify written and verbal instructions

Gifted and Talented
-Peer tutoring
-Cooperative learning groups
-Differentiated instruction

ELL
-Audio books, Movies, and other digital media in lieu of print versions
-Native language texts and native language to English Dictionary

Students at Risk of School Failure:
- Extended Time
- Flexible Grouping
- Small Group Instruction
- Peer Buddies
- Tiered Activities
- Manipulatives
- Graphic Organizers

Curriculum Development Resources/Instructional Materials/Equipment Needed
Teacher Resources:
· Textbook

- Laboratory manuals and equipment
- NJ DOE Model Curriculum Resources:

MY NASA DATA: Students select satellite datasets to answer questions related to system interactions and feedbacks.

Finding the Crater: Students "visit" different K-T boundary sites, evaluate the evidence found in the cores at each site, find these sites on a map, and predict where the impact crater is located.

Images of Change: Students explore these images of the impacts of climate change over time to develop explanations from evidence of how an impact in one component of the Earth system has effects in other components of the Earth system.

Climate Reanalyzer: Students use the Environmental Change Model of the Climate Reanlyzer to study the feedbacks in the climate system.

USGS Realtime Water data and Climate data: Students create and run an investigation to determine the relationship between streamflow and precipitation data, or another parameter.

Greenhouse Effect: Students explore the atmosphere during the ice age and today. What happens when you add clouds? Change the greenhouse gas concentration and see how the temperature changes. Then compare to the effect of glass panes. Zoom in and see how light interacts with molecules. Do all atmospheric gases contribute to the greenhouse effect?

Earth Systems Activity: Students model the carbon cycle and its connection with Earth's climate.

Carbon and Climate: Students run a model of carbon sources and sinks and interpret results to develop their own model of the relationship of the carbon cycle to the Earth's climate. Students can also work through the content of the entire module called Carbon Connections which includes numerous models and interactives to gain a deeper understanding of the role of carbon in the climate system.

EarthViewer (IPAd or Android) or for Chrome browsers: Students explore the co-evolution of the geology and biology found on Earth to develop arguments from evidence for the co-evolution of geology and biology found on Earth. If IPads, Androids or Chrome browsers are not available, similar interactives may be found at this link, and this link.

***resources will vary for each district**

Teacher Notes:

OCEAN COUNTY SCIENCE CURRICULUM
Earth Science: Human Sustainability

Content Area: Earth Science

Unit Title: Human Sustainability
Human Impact on Resources- Chapter 26 (pacing 45 days)

Target Course/Grade Level: 9

Unit Summary:
"Earth's surface processes affect and are affected by human activities. Humans depend on all of the planet's systems for a variety of resources, some of which are renewable or replaceable and some which are not. Natural hazards and other geologic events can significantly alter human populations and activities. Human activities, in turn, can contribute to the frequency, and intensity of some natural hazards." - State of New Jersey Department of Education

Cross Cutting Concepts:
Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS3-1)

Systems and System Models

- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (HS-ESS3-6)

Stability and Change

- Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS3-3)
- Feedback (negative or positive) can stabilize or destabilize a system. (HS-ESS3-4)

Science and Engineering Practices:
Using Mathematics and Computational Thinking Mathematical
Using Mathematics and Computational Thinking Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Create a computational model or simulation of a phenomenon, designed device, process, or system. (HSESS3-3)

- Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-ESS3-6)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific knowledge, principles, and theories.

- Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-ESS3-1)
- Design or refine a solution to a complex real-world problem, based on scientific knowledge, student generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ESS3-4)

Engaging in Argument from Evidence

Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.

- Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations). (HS-ESS3-2)

Disciplinary Core Idea:

ESS2.D: Weather and Climate

- Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. (secondary to HS-ESS3-6)

ESS3.A: Natural Resources

- Resource availability has guided the development of human society. (HS-ESS3-1)
- All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. (HS-ESS3-2)

ESS3.B: Natural Hazards

- Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations. (HS-ESS3-1)

ESS3.C: Human Impacts on Earth Systems

- The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (HS-ESS3-3)
- Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (HS-ESS3-4)

ESS3.D: Global Climate Change

- Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (HS-ESS3-6)

ETS1.B. Developing Possible Solutions

- When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (secondary to HS-ESS3-2),(secondary to HS-ESS3-4)

Technology connections:

For further clarification refer to the Next Generation Science Standards: http://www.nextgenscience.org/

Learning Targets	
DCI	**Strand**
HS-ESS2-2	Analyze geoscience data to make the claim that one change to Earth's surface can create feedback that cause changes to other Earth systems.
HS-ESS3-1	Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
HS-ESS3-2	Evaluate competing design solutions for developing, managing, and utilizing energy and minerals resources based on cost-benefit ratios.
HS-ESS3-3	Create a computational simulation to illustrate the relationship among managements of natural resources, the sustainability of human populations, and biodiversity.
HS-ESS3-4	Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
HS-ESS3-6	Use a computational representation to illustrate the relationships among Earth's system and how those relationships are being modified due to human activity.

21st Century Themes/Careers Ready Practices:	
9.2.12.CAP.3	Investigate how continuing education contributes to one's career and personal growth.
9.2.12.CAP.5	Assess and modify a personal plan to support current interests and postsecondary plans.
Interdisciplinary Practices	
RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-ESS3-1),(HS-ESS3-2),(HS-ESS3-4)
RST.11-12.8	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-ESS3-2),(HS-ESS3-4)
WHST.9-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-ESS3-1)
MP.2	Reason abstractly and quantitatively. (HS-ESS3-1),(HS-ESS3-2),(HS-ESS3-3),(HS-ESS3-4),(HS-ESS3-6)
MP.4	Model with mathematics. (HS-ESS3-3),(HS-ESS3-6)
HSN-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-ESS3-1),(HS-ESS3-4),(HS-ESS3-6)
HSN-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling. (HS-ESS3-1),(HS-ESS3-4),(HS-ESS3-6)
HSN-Q.A.3	3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-ESS3-1),(HS-ESS3-4),(HS-ESS3-6)
Unit Essential Questions	**Unit Enduring Understandings**

· What is the typical pattern of growth of organisms? · What happens to populations when they reach carrying capacity? · What environmental factors affect population growth? · How can mineral extraction impact the environment? · What are some of the environmental issues created by agriculture and forestry and possible solutions? · How does urban development affect soil and water? · What is the relationship between the greenhouse effect and global warming? · What is the sequence of reactions that occur as CFCs cause ozone depletion? · What are the causes and effects of acid precipitation? · In what ways can water be conserved? · What are the types and sources of water pollution? · How can water pollution be reduced?	*Students will understand that…* · More demands are placed on natural resources as the human population increases. · Extraction of materials, farming, and waste disposal can have negative environmental impacts. · Manufacturing processes and burning of fossil fuels can pollute Earth's atmosphere. · Pollution controls and conservation protect water resources.
Unit Objectives *Students will know…* · Forms of pollutants found in air. · The relationship between global warming and the greenhouse effect.	**Unit Objectives** *Students will be able to…* · Name two forms of pollutants found in air. · Relate global warming and the greenhouse effect. · Describe how CFCs cause ozone depletion. · Describe how extracting resources, growing

· How CFC's cause ozone depletion. · How extracting resources, growing food, and urban development contribute to land and water pollution. · Ways that land can be resorted after it is strip-mined for coal. · Three limiting factors that keep populations from growing indefinitely. · Density-dependent and density-independent factors that limit population growth. · Ways surface waters can be polluted. · How residents of a city might reduce water consumption. · The positive impacts of the Clean Water Act. · Ways to minimize the need for irrigation. · Which type of pollution is easier to eliminate.	food, and urban development contribute to land and water pollution. · Propose ways that land can be restored after it is strip-mined for coal. · Explain how an increasing human population places more demands on Earth's natural resources. · Identify three limiting factors that keep populations from growing indefinitely. · Compare density-dependent and density-independent factors that limit population growth. · Identify ways surface waters can be polluted. · Determine how residents of a city might reduce water consumption. · Analyze some of the positive impacts of the Clean Water Act. · Predict some ways to minimize the need for irrigation. · Infer which type of pollution is easier to eliminate.

OCEAN COUNTY SCIENCE CURRICULUM
Evidence of Learning

Formative Assessments	**Benchmark**
-Observation -Homework -Class participation -Venn Diagrams/Graphic Organizers -WebQuests -Do Now -Laboratories/Lab Reports	- New Jersey Student Learning Assessment; Science (NJSLA) - Quarterly Exams - Unit Tests - Performance Assessments

-Notebook -Writing Assignments -Foldables	
Summative Assessments	**Alternative**
-Writing Assignments - Laboratory Practical -Unit Projects -Midterm/Endterm Exams	- Oral Presentation - Video Recording - Virtual Lab

Modifications (ELLs, Special Education, 504, Gifted and Talented)

Special Education

-Follow all IEP modifications
-Oral instructions
-Record lessons instead of taking notes
-Outlines of lessons
-Study Guides with answers
-Word processor to type notes
-Frequent breaks
-Teacher tutoring
-Peer tutoring
-Cooperative learning group
-Modified assignments (ex. Fewer items per page)
-Follow all IEP modifications

504:

- Utilize graphic organizers to help provide a purpose for reading and increase comprehension
- Assign peer tutor
- Provide clear and specific directions
- Provide class notes ahead of time to allow students to preview material and increase comprehension
- Provide extended time
- Simplify written and verbal instructions

Gifted and Talented

-Peer tutoring
-Cooperative learning groups
-Differentiated instruction

ELL

-Audio books, Movies, and other digital media in lieu of print versions
-Native language texts and native language to English Dictionary

Students at Risk of School Failure:
- Extended Time
- Flexible Grouping
- Small Group Instruction
- Peer Buddies
- Tiered Activities
- Manipulatives
- Graphic Organizers

Curriculum Development Resources/Instructional Materials/Equipment Needed

Teacher Resources:
- Textbook
- Laboratory manuals and equipment
- NJ DOE Model Curriculum Resources

Glaciers: Students will explain how environmental conditions (temperature and precipitation) impact glacial mass budget; identify where snow accumulates in a glacier and justify why.

MY NASA DATA: Students gather, display, and interpret incoming and outgoing solar radiation data to develop a model of the interactions of Earth's various surface types and incoming solar radiation.

Solar Variability & Orbital Cycles: Students select scientific readings and datasets and identify relationships among solar variability, orbital cycles, and Earth's climate over various time scales. Modification of OER: Ice Cores and Orbital variations: Students apply the output of this visualization to develop a model of orbital changes as related to Earth's temperature over deep time.

Climate Reanalyzer: Students use the data on this website to assess diurnal, monthly, seasonal, and annual changes in the weather and climate parameters. Alternatively, data may be acquired from NASA NEO or NASA Giovanni.

Climate Reanalyzer: Students use the Environmental Change Model of the Climate Reanalyzer to study the feedbacks in the climate system.

Climate Modeling 101: Students use the information in this tutorial to understand how climate models are created and interpreted. They apply what they learn to the climate model outputs they interpret.

Carbon Cycle Lesson Plan: Students develop and apply basic and/or advanced mathematical modeling skills to climate modeling.

Paleoclimate Data Access: Students select from various paleoclimate datasets. After they understand how the data was collected and how it is interpreted, they display and analyze the data. They interpret the data and seek relationships among the datasets in order to understand changes in the Earth's climate over time.

Carbon Connections Climate Model: Students control the inputs of various climates forcing to observe the outputs on the climate system. Students can also work through the content of the entire module called Carbon Connections which includes numerous models and interactives to gain a deeper understanding of the role of carbon in the climate system.

NASA - Climate Change Impacts and EPA - Climate Change Impacts: Students construct an explanation and cite evidence for how changes in climate have influenced human activity.

Images of Change: Students explore these images of the impacts of climate change over time to develop explanations from evidence of how an impact in one component of the Earth system has effects in other components of the Earth system.

***resources will vary for each district**

Teacher Notes:

OCEAN COUNTY SCIENCE CURRICULUM
Earth Science: Space Systems

Content Area: Earth Science

Unit Title: Space Systems
The Sun-Earth-Moon System- Chapter 27 (pacing 8 days)

Our Solar System- Chapter 28 (pacing 5 days)
Stars-Chapter 29 (pacing 12 days)
Galaxies and the Universe- Chapter 30 (pacing 20 days)

Target Course/Grade Level: 9

Unit Summary

'The planet Earth is a tiny part of a vast universe that has developed over a huge expanse of time. The history of the universe, and of the structures and objects within it, can be deciphered using observations of their present conditions together with knowledge of physics and chemistry." - State of New Jersey Department of Education

Cross Cutting Concepts:

Scale, Proportion, and Quantity:

- The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. (HS-ESS1-1)
- Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g. linear growth vs. exponential growth). (HS-ESS1-4)

Energy and Matter:

- Energy cannot be created or destroyed-only moved between one place and another place, between objects and/or fields, or between systems. (HS-ESS1-2)
- In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. (HS-ESS1-3)

Science and Engineering Practices:

Developing and Using Models

Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).

- Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HSESS1-1)

Using Mathematical and Computational Thinking Mathematical

Using Mathematical and Computational Thinking Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Use mathematical or computational representations of phenomena to describe explanations. (HS-ESS1-4)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-ESS1-2)

Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.

- Communicate scientific ideas (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-ESS1-3)

Disciplinary Core Ideas:
ESS1.A: The Universe and Its Stars

- The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. (HSESS1-1)
- The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. (HS-ESS1- 2),(HS-ESS1-3)
- The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe. (HS-ESS1-2)
- Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. (HS-ESS1- 2),(HS-ESS1-3)

ESS1.B: Earth and the Solar System

- Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. (HS-ESS1-4)

PS3.D: Energy in Chemical Processes and Everyday Life

- Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation. (secondary to HS-ESS1-1)

PS4.B Electromagnetic Radiation

- Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. (secondary to HS-ESS1-2)

Technology connections: For further clarification refer to the Next Generation Science Standards: http://www.nextgenscience.org/	
Learning Targets	
Content Standards. **CONTENT STANDARDS LINK: http://www.nextgenscience.org/**	
DCI	**Strand**
HS-ESS1-1	Develop a model based on evidence to illustrate the life span of the span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.
HS-ESS1-2	Construct an explanation of the Big Bang Theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.
HS-ESS1-3	Communicate scientific ideas about the way stars, over their life cycle, produce elements.
HS-ESS1-4	Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.
HS-ESS1-6	Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct a count of Earth's formation and early history.
21st Century Themes/Careers Ready Practices:	
9.2.12.CAP.3	Investigate how continuing education contributes to one's career and personal growth.
9.2.12.CAP.5	Assess and modify a personal plan to support current interests and postsecondary plans.
Interdisciplinary Practices	
RST.11-12.1	Cite specific textual evidence to support analysis of

	science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-ESS1-1), (HS-ESS1-2)
WHST.9-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-ESS1-2),(HS-ESS1-3)
SL.11-12.4	Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. (HS-ESS1-3)
MP.2	Reason abstractly and quantitatively. (HS-ESS1-1),(HS-ESS1-2),(HS-ESS1-3),(HS-ESS1-4)
MP.4	Model with mathematics. (HS-ESS1-1),(HS-ESS1-4)
HSN-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-ESS1-1),(HS-ESS1-2),(HS-ESS1-4)
HSN-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling. (HS-ESS1-1),(HS-ESS1-2),(HS-ESS1-4)
HSN-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-ESS1-1),(HS-ESS1-2),(HS-ESS1-4)
HSA-SSE.A.1	Interpret expressions that represent a quantity in terms of its context. (HS-ESS1-1),(HS-ESS1-2),(HS-ESS1-4)
HSA-CED.A.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. (HS ESS1-1),(HS-ESS1-2),(HS-ESS1-4)
HSA-CED.A.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. (HS-ESS1-1),(HS-ESS1-2),(HS-ESS1-4)
Unit Essential Questions	**Unit Enduring Understandings**

· What is electromagnetic radiation? · How do telescopes work? · How does space exploration help scientists learn about the universe? · What are the features of the Moon? · What is the theory of the Moon's origin and formation? · What are the relative positions and motions of the Sun, Earth, and Moon? · What are the phases of the Moon? · What are the differences between solstices and equinoxes? · How are eclipses of the Sun and Moon explained? · How did the solar system form? · What are some of the early concepts of the structure of the solar system? · How has our current knowledge of the solar system developed? · What is the relationship between gravity and the motions of the objects in the solar system? · What are some of the space probes used to explore the solar system? · What are the oldest members of the solar system?	*Students will understand that…* · Radiation emitted or reflected by distant objects allows scientists to study the universe. · The Moon, Earth's nearest neighbor in space, is unique among the moons in our system. · Motions of the Sun-Earth-Moon system define Earth's day, month, and year, · The solar system formed from the collapse of an interstellar cloud. · Besides the Sun and planets, there are many other objects in the solar system that are composed primarily of rocks, dust, and ice. · The Sun contains most of the mass of solar system and has many features typical of other stars. · Stellar classification is based on measurement of light spectra, temperature, and composition. · The Sun and other stars follow similar life cycles, leaving the galaxy enriched with heavy elements. · Stars with varying light output allow astronomers to map the Milky Way, which has a halo, spiral arms, and a massive galactic black hole at its center. · Finding galaxies with different shapes reveals the past, present, and future of the universe. · The Big Bang theory was formulated by comparing evidence and models to describe the beginning of the universe.

· How are meteoroids, meteors, and meteorites described? · What is the structure of a comet? · What are the layers and features of the Sun? · How is the process of energy production in the Sun explained? · How are the three types of spectra defined? · How are distances between stars measured? · What is the difference between brightness and luminosity? · What are the properties used to classify stars? · What is the relationship between mass and a star's evolution? · What are the features of massive and regular star life cycles? · How is the universe affected by life cycles of stars? · What is the size and shape of our galaxy? · What are the different kinds of variable stars? · Where are the different types of stars in a galaxy located? · How do astronomers classify galaxies? · How are galaxies organized into clusters and superclusters?	

· How is the expansion of the universe described? · What are the different models of the universe? · How is expansion related to each of the models? · What is the importance of the Hubble constant?	
Unit Objectives *Students will know…* · Characteristics of the universe in terms of time, distance, and organization. · The visible and invisible parts of the electromagnetic spectrum. · Refracting and reflecting telescopes. · How telescopes for non visible electromagnetic radiation differ from light telescopes. · Two lines of evidence for Earth's rotation. · How the change in apparent positions of constellations provides evidence of Earth's rotation and Revolution around the sun. · How Earth's rotation and Revolution provide a basis for measuring time. · How the tilt of Earth's axis and Earth's movement cause seasons. · The nebular hypothesis of the origin of the solar system.	**Unit Objectives** *Students will be able to…* · Describe characteristics of the universe in terms of time, distance, and organization. · Identify the visible and nonvisible parts of the electromagnetic spectrum. · Compare refracting telescopes and reflecting telescopes. · Explain how telescopes for non visible electromagnetic radiation differ from light telescopes. · Describe two lines of evidence for Earth's rotation. · Explain how the change in apparent positions of constellations provides evidence of Earth's rotation and revolution around the sun. · Summarize how Earth's rotation and revolution provide a basis for measuring time. · Explain how the tilt of Earth's axis and Earth's movement cause seasons. · Explain the nebular hypothesis of the origin of the solar system. · Describe how the planets formed. · Describe the formation of the land, the atmosphere, and the oceans of Earth. · Compare the models of the universe developed by Ptolemy and Copernicus. · Summarize Kepler's three laws of planetary motion. · Describe how Newton explained Kepler's laws of motion. · Summarize the features that allow Earth to sustain

· How the planets formed. · The formation of the land, the atmosphere, and the oceans. · The models of the universe developed by Ptolemy and Copernicus. · Kepler's three laws of planetary motion. · How Newton explained Kepler's laws of motion. · The basic characteristics of the inner planets. · The features that allow Earth to sustain life. · The three stages by which the moon formed. · The shape of the moon's orbit around Earth · Why eclipses occur. · How the movements of the moon affect tides on Earth. · The physical characteristics of asteroids and comets. · Where the Kuiper Belt is located. · The differences between meteoroids, meteorites, and meteors. · The relationship between the Oort cloud and comets. · How the sun converts matter into energy in its core. · The similarities between radiative and	life. · Describe the shape of the moon's orbit around Earth. · Explain why eclipses occur. · Describe the appearance of four phases of the moon. · Explain how the movements of the moon affect tides on Earth. · Describe the physical characteristics of asteroids and comets. · Describe where the Kuiper Belt is located. · Compare meteoroids, meteorites, and meteors. · Explain the relationship between the Oort cloud and comets. · Explain how the sun converts matter into energy in its core. · Compare the radiative and convective zones of the sun. · Describe the three layers of the sun's atmosphere. · Explain how sunspots are related to powerful magnetic fields on the sun. · Compare prominences, solar flares, and coronal mass ejections. · Describe how the solar wind can cause auroras on Earth. · Describe how astronomers determine the composition and temperature of stars. · Explain why stars appear to move in the sky. · Describe one way astronomers measure the distances to stars. · Explain the difference between absolute magnitude and apparent magnitude. · Describe how a protostar becomes a star. · Explain how a main-sequence star generates energy. · Describe the evolution of a star after its main-sequence stage. · Describe the characteristics that identify a constellation. · Describe the three main types of galaxies.

convective zones of the sun. · The three layers of the sun’s atmosphere. · How sunspots are related to powerful magnetic fields on the sun. · The similarities between prominences, solar flares, and coronal mass ejections. · How the solar wind can cause auroras on Earth. · How astronomers determine the composition and temperature of stars. · Why stars appear to move in the sky. · One way astronomers measure the distances to stars. · The difference between absolute magnitude and apparent magnitude. · How a protostar becomes a star. · How a main-sequence star generates energy. · The evolution of a star after its main-sequence stage. · The characteristics that identify a constellation. · Three main types of galaxies. · How a quasar differs from a typical galaxy. · How Hubble’s discoveries led to an understanding that the universe is expanding. · Evidence for the big bang theory.	· Explain how a quasar differs from a typical galaxy. · Explain how Hubble's discoveries led to an understanding that the universe is expanding. · Summarize the big bang theory. · List evidence for the big bang theory.

OCEAN COUNTY SCIENCE CURRICULUM
Evidence of Learning

Formative Assessments	**Benchmark**
-Observation -Homework -Class participation -Venn Diagrams/Graphic Organizers -WebQuests -Do Now -Laboratories/Lab Reports -Notebook -Writing Assignments -Foldables	- New Jersey Student Learning Assessment; Science (NJSLA) - Quarterly Exams - Unit Tests - Performance Assessments
Summative Assessments	**Alternative**
-Writing Assignments - Laboratory Practical -Unit Projects -Midterm/Endterm Exams	- Oral Presentation - Video Recording - Virtual Lab

Modifications (ELLs, Special Education, 504, Gifted and Talented)

Special Education

-Follow all IEP modifications/504 plan
-Oral instructions
-Record lessons instead of taking notes
-Outlines of lessons
-Study Guides with answers
-Word processor to type notes
-Frequent breaks
-Teacher tutoring
-Peer tutoring
-Cooperative learning group
-Modified assignments (ex. Fewer items per page)
-Follow all IEP modifications

504:
- Utilize graphic organizers to help provide a purpose for reading and increase comprehension
- Assign peer tutor
- Provide clear and specific directions
- Provide class notes ahead of time to allow students to preview material and increase comprehension
- Provide extended time
- Simplify written and verbal instructions

Gifted and Talented

-Peer tutoring

-Cooperative learning groups

-Differentiated instruction

ELL

-Audio books, Movies, and other digital media in lieu of print versions

-Native language texts and native language to English Dictionary

Students at Risk of School Failure:
- Extended Time
- Flexible Grouping
- Small Group Instruction
- Peer Buddies
- Tiered Activities
- Manipulatives
- Graphic Organizers

Curriculum Development Resources/Instructional Materials/Equipment Needed

Teacher Resources:

· Textbook

· Laboratory manuals and equipment

· NJ DOE Model Curriculum Resources:

Solar Fusion: Students develop a model to identify and describe the hydrogen as the Sun's fuel source, helium and energy as the products of nuclear fusion, and the life span of the Sun.

Expansion of the Universe & Four Pillars of Cosmology: Student analyzes informational text, animations and videos on the Doppler effect and the observed redshift in the universe. Students apply their learning of the Doppler effect to justify the Big Bang Theory and support their reasoning with evidence from multiple sources.

Extensions:

· Sonic Boom Link: http://www.ck12.org/physics/Doppler-Effect/rwa/Sonic-Boom/

· Echolocation Link: http://www.ck12.org/physics/Doppler-Effect/rwa/Echolocation/

Universe Evolution & CMB Analyzer: Students analyze several NASA concept animations to develop an explanation for the existence of background radiation and the redshift to defend the argument that the universe is expanding.

Life Cycle of a Star - Students analyze multiple sources of information text and diagrams on the life cycle of a star. Students use the text to determine the relationship between the stars' mass, life cycle and ability to fuse elements and ability to go spread the elements through the universe.

Emission Spectrum of the Sun - Students analyze informational text and a video on how scientists know the composition of the sun. Students use the information to develop a written argument on how scientists can use this method to determine the composition of distant stars.

Interactive HR Diagram - Students manipulate the variables of the HR diagram to determine the relationship between the mass, lifespan, color and size of a star. Students generate conclusions between the mass and the lifespan of the star supported with data from the activity.

Supernova - Students analyze informational text regarding supernova to determine where a supernova takes place, the cause of supernovas and the role of supernovas in the evolution of the universe.

***resources will vary for each district**

Teacher Notes: