Passaic County Technical Institute

Wayne, NJ

Geophysical Science Curriculum

Course # 0071

Credits 5

August 2016

Geophysical Science Curriculum

August 2016

I. Course Description

Geophysical Science is a full year course designed as an introduction to the body of knowledge contained in the earth and physical sciences, including the process of the scientific investigation. Students will study matter, changes in matter, motion and energy, earth sciences, the origin of the universe, natural resources, and the impact of science and technology on the environment.

This course covers the basic concepts of Earth sciences including describing scientific processes, geological time, Earth's history, Earth's interior and surface, and the universe.

II. Course Objectives/Outline

Content Area:	Geophysical Science		Grade	9
Unit Plan Title:	1. Earth's History	Time Frame	Approx. 10 Weeks	

NJ Student Learning Standards

1. **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-ESS1-6**
2. **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-ESS1-5**
3. **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-ESS2-1**
4. **Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth. HS-ESS2-7**
5. **Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. HS-LS4-5**

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models (pp. 56-59) Students use, synthesize, and develop models to predict and show relationships among variables between systems and their components in the natural and designed worlds. • Develop a model based on evidence to illustrate the relationships between systems or between components	**ESS1.C: The History of Planet Earth** (pp. 177-179) • 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	**Patterns** (pp. 85-87) • Empirical evidence is needed to identify patterns. (HS-ESS1-5) **Stability and Change** (pp. 98-101) • Much of science deals with constructing explanations

of a system. (HS-ESS2-1)

Constructing Explanations and Designing Solutions (pp. 67-71)
Students construct explanations and design solutions 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 (pp. 71-74)
Students use 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), (HS-ESS2-7), (HS-LS4-5)

- -

Connections to Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. (HS-ESS1-6)
- Models, mechanisms, and explanations collectively serve as tools in the development of a scientific theory. (HS-ESS1-6)

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 (pp. 179-182)

- 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 (pp. 182-183)

- 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)

PS1.C: Nuclear Processes (pp. 111-113)

- Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials.(secondary to HS-ESS1-5),(secondary to HS-ESS1-6)

LS4.C: Adaptation (pp. 164-166)

- Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. (HS-LS4-5)
- Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost. (HS-LS4-5)

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 (pp. 87-89)

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

NJSLS
RST.11-12.1, RST.11-12.8, WHST.9-12.1, WHST.9-12.2, SL9-10.5 **SEE APPENDIX I**

Content Area:	Geophysical Science	Grade	9
Unit Plan Title:	2. Earth's Systems	Time Frame	Approx. 10 Weeks

NJ Student Learning Standards

1. **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-ESS2-2**

2. **Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection. HS-ESS2-3**

3. **Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. HS-ESS2-5**

4. **Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. HS-ESS2-6**

5. **Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth. HS-ESS2-7**

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models (pp. 56-59) Students use, synthesize, and develop 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** (pp.59-61) Students plan and carrying out 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** (pp. 61-63) Students analyze data using 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	**ESS2.A: Earth Materials and Systems** (pp. 179-182) • 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** (pp. 182-183) • 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**	**Energy and Matter** (pp. 94-96) • 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** (pp. 96-98) • 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** (pp. 98-101) • 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) - ***Connections to Engineering, Technology, and Applications of Science***

(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** (pp. 71-74) Students use 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) - ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** • Science knowledge is based on empirical evidence. (HS-ESS2-3) • Science disciplines share common rules of evidence used to evaluate explanations about natural systems. (HS-ESS2-3) • Science includes the process of coordinating patterns of evidence with current theory. (HS-ESS2-3)	**Processes** (pp. 184-186) • 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** (pp. 186-189) • 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) **ESS2.E Biogeology** (189-190) • The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it. (HS-ESS2-7)	**Interdependence of Science, Engineering, and Technology** • Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise. (HS-ESS2-3) **Influence of Engineering, Technology, and Science on Society and the Natural World** • New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. (HS-ESS2-2)

NJSLS

RST.11-12.1, **RST.11-12.2**, **WHST.9-12.1**, **WHST.9-12.7**
See APPENDIX I

Content Area:	Geophysical Science	Grade	9
Unit Plan Title:	3. Weather & Climate	Time Frame	Approx. 5 Weeks

NJ Student Learning Standards

1. **Construct scientific arguments using data to support claims that spatial and temporal patterns in weather and climate found around the Earth are created by complex global, regional, and local interactions involving sunlight, and all of the Earth's spheres. HS-ESS2-4**

2. **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-ESS2-4**

3. **Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere as it relates to our climate system. HS-ESS2-6**

4. 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. HS-ESS3-5

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models (pp. 56-59) Students use, 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) • Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-ESS2-6) **Analyzing and Interpreting Data** (pp. 61-63) Students use 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) • 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. (SLO-1) - ***Connections to Nature of Science*** **Scientific Investigations Use a Variety of Methods** • Science investigations use diverse methods and do not always use the same set of procedures to obtain data. (HS-ESS3-5) • New technologies advance scientific knowledge. (HS-ESS3-5) **Scientific Knowledge is Based on Empirical Evidence** • Science knowledge is based on empirical evidence. (HS-ESS3-5) • Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (HS-ESS2-4),(HS-ESS3-5)	**ESS1.B: Earth and the Solar System** (pp. 175-176) • 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** (pp. 179-182) • 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** (pp. 186-189) • 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) (SLO 1) • Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. (HS-ESS2-6) • Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-6),(HS-ESS2-4) **ESS3.D: Global Climate Change** (pp. 196-198) • 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) **ETS1.A: Defining and Delimiting an Engineering Problem** (pp. 204-206, NRC, 2012) • Criteria and constraints also include satisfying any	**Patterns** (pp. 85-87) • Empirical evidence is needed to identify patterns. (SLO-1) **Cause and Effect** (pp.87-89) • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS2-4) **Stability and Change** (pp. 98-101) • 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-ESS3-5)

	requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (secondary to HS-ESS3-5)	

NJSLS
RST.11-12.1, **RST.11-12.2**, **RST.11-12.7**, **SL.9-10.5** See **APPENDIX I**

Content Area:	Geophysical Science		Grade	9
Unit Plan Title:	4. Human Sustainability	Time Frame	Approx. 5 Weeks	

NJ Student Learning Standards

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-ESS3-1**

2. **Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios. HS-ESS3-2**

3. **Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. HS-ESS3-3**

4. **Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. HS-ESS3-4**

5. **Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity. HS-ESS3-6**

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Using Mathematics and Computational Thinking (pp. 64-67) Students use 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. (HS-ESS3-3) • Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-ESS3-6)	**ESS2.D: Weather and Climate** (pp. 186-189) • 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** (pp. 191-192) • 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	**Cause and Effect** (pp. 87-89) • 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** (pp. 91-94) • 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** (pp. 98-101) • 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

Constructing Explanations and Designing Solutions (pp. 67-71) Students construct explanations and design solutions 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** (pp. 71-74) Students use 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)	as benefits. New technologies and social regulations can change the balance of these factors. (HS-ESS3-2) **ESS3.B: Natural Hazards** (pp. 192-194) • 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** (pp. 194-196) • 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** (pp. 196-198) • 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** (pp. 206-208) • 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 HS-ESS3-4)	destabilize a system. (HS-ESS3-4) - ***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** • Modern civilization depends on major technological systems. (HS-ESS3-1),(HS-ESS3-3) • Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. (HS-ESS3-2),(HS-ESS3-4) • New technologies can have deep impacts on society and the environment, including some that were not anticipated. (HS-ESS3-3) • Analysis of costs and benefits is a critical aspect of decisions about technology. (HS-ESS3-2) - ***Connections to Nature of Science*** **Science is a Human Endeavor** • Science is a result of human endeavors, imagination, and creativity. (HS-ESS3-3) **Science Addresses Questions About the Natural and Material World** • Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions. (HS-ESS3-2) • Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge. (HS-ESS3-2) • Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues. (HS-ESS3-2)

NJSLS

RST.11-12.1, **RST.11-12.8**, **WHST.9-12.2**
See **APPENDIX I**

Content Area:	Geophysical Science		Grade	9
Unit Plan Title:	5. Space Systems & Electromagnetic Spectrum	Time Frame	Approx. 10 Weeks	

NJ Student Learning Standards

1. **Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy in the form of radiation. HS-ESS1-1**

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-ESS1-2**

3. **Communicate scientific ideas about the way stars, over their life cycle, produce elements. HS-ESS1-3**

4. **Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. HS-ESS1-4**

5. **Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.** *[Clarification Statement: Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object rolling down a ramp, or a moving object being pulled by a constant force.] [Assessment Boundary: Assessment is limited to one-dimensional motion and to macroscopic object is moving at non-relativistic speeds.]* HS-PS2-1

6. **Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.** *[Clarification Statement: Emphasis is on the quantitative conservation of momentum in interactions and the qualitative meaning of this principle.] [Assessment Boundary: Assessment is limited to systems of two macroscopic bodies moving in one dimension.]* HS-PS2-2

7. **Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision*** *[Clarification Statement: Examples of evaluation and refinement could include determining the success of the device at protecting an object from damage and modifying the design to improve it. Examples of a device could include a football helmet or a parachute.] [Assessment Boundary: Assessment is limited to qualitative evaluations and/or algebraic manipulations.]* HS-PS2-3

8. **Use mathematical representations of Newton's Law of Gravitation to describe and predict the gravitational forces between objects.** *[Clarification Statement: Emphasis is on both quantitative and conceptual descriptions of gravitational fields.] [Assessment Boundary: Assessment is limited to systems with two objects.]* HS-PS2-4

9. **Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).** *[Clarification Statement: Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the earth, and the energy stored between two electrically-charged plates. Examples of models could include diagrams, drawings, descriptions, and computer simulations.]* HS-PS3-2

10. **Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.** *[Clarification Statement: Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other.] [Assessment Boundary: Assessment is limited to systems containing two objects.]* HS-PS3-5

11. **Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.** *[Assessment Boundary: Assessment is limited to designing and conducting investigations with provides materials and tools.]* HS-PS2-5

12. **Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.** *[Clarification Statement: Examples of data could include electromagnetic radiation traveling in a vacuum and glass, sound waves traveling through air and water, and seismic waves traveling through the Earth.] [Assessment Boundary: Assessment is limited to algebraic relationships and escribing those relationships qualitatively.]* HS-PS4-1

13. **Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.** *[Clarification Statement: Emphasis is on the idea that photons associated with different frequencies of light have different energies, and the damage to living tissue from electromagnetic radiation depends on the energy of the radiation. Examples of published materials could include trade books, magazines, web resources, videos, and other passages that may reflect bias.] [Assessment Boundary: Assessment is limited to qualitative descriptions]* HS-PS4-4

14. **Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.** *[Clarification Statement: Emphasis is on how the experimental evidence supports the claim and how a theory is generally modified in light of new evidence. Examples of a phenomenon could include resonance, interference, diffraction, and photoelectric effect.] [Assessment Boundary: Assessment does not include using quantum theory calculations.]* HS-PS4-3

15. **Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.*** *[Clarification Statement: Examples of advantages could include that digital information is stable because it can be stored reliably in computer memory, transferred easily, and copied and shared rapidly. Disadvantages could include issues of easy deletion, security, and theft.]* HS-PS4-5

16. **Evaluate questions about the advantages of using a digital transmission and storage of information.** *[Clarification Statement: Examples of advantages could include that digital information is stable because it can be stored reliably in computer memory, transferred easily, and copies and shared rapidly. Disadvantages could include issues of easy deletion, security, and theft.]* HS-PS4-2

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models (pp. 56-59) Students develop 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-ESS1-1) **Using Mathematical and Computational Thinking** (pp.64-67) Students use 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** (pp. 67-71) Students construct 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	**ESS1.A: The Universe and Its Stars** (pp. 173-174) • The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. (HS-ESS1-1) • 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** (pp. 175-176) • 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)	**Scale, Proportion, and Quantity** (pp. 89-91) • 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** (pp. 94-96) • 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) - ***Connections to Engineering, Technology, and Applications of Science*** **Interdependence of Science, Engineering, and Technology** • Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers,

students' own investigations, 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 (pp. 74-77)
Students evaluate 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)

- -

Connections to Nature of Science

Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. (HS-ESS1-2)

Planning and Carrying out Investigations (pp. 59- 61, NRC, 2012)
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-PS2-1),(HSPS2-3)

PS3.D: Energy in Chemical Processes and Everyday Life (pp. 129-130)

- 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 (pp. 133-136)

- 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)*

PS2.A: Forces and Motion (pp. 114-116, NRC, 2012)

- Newton's second law accurately predicts changes in the motion of macroscopic objects. (SLO 1, 2 & 3),(HS-PS2-1)
- Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. (SLO 5),(HS-PS2-2)
- If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. (HS-PS2-2),(HS-PS2-3),(SLO 5)

ETS1.A: Defining and Delimiting an Engineering Problem (pp. 204-206, NRC, 2012)

- Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (secondary to HS-PS2-3)

ETS1.C: Optimizing the Design Solution (pp. 208- 210, NRC, 2012)
• Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (HS-PS2-3)

PS2.B: Types of Interactions

- Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and

and others with wide ranges of expertise. (HS-ESS1-2),(HS-ESS1-4)

- -

Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. (HS-ESS1-2)
- Science assumes the universe is a vast single system in which basic laws are consistent. (HS-ESS1-2)

Cause and Effect (pp. 87-89, NRC, 2012)

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS2-1)
- Systems can be designed to cause a desired effect. (HS-PS2-3)

Systems and System Models (pp. 91-94, NRC, 2012)

- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined. (HS-PS2-2)

- -

Connections to Nature of Science
Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena (pp. 96-101, Appendix H: NRC, 2013)

- Theories and laws provide explanations in science. (HS-PS2-1)

Laws are statements or descriptions of the relationships among observable phenomena. (HS-PS2-1)

Patterns

- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS2-4)

Connections to Nature of Science, Science Models, Laws, Mechanisms, and Theories Explain Natural

Analyzing and Interpreting Data (pp. 61-63, NRC, 2012) Analyzing data in 9–12 builds on K–8 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. (SLO 1, 2 & 3), (HS-PS2-1)

Using Mathematics and Computational Thinking (pp. 64-67, NRC, 2012) Mathematical and computational thinking at the 9– 12 level builds on K–8 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 representations of phenomena to describe explanations. (SLO 1, 2 & 4), (HS-PS2-2)

Constructing Explanations and Designing Solutions (pp. 67-71, NRC, 2012) 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 ideas to solve a design problem, taking into account possible unanticipated effects. (HS-PS2-3)

Using Mathematics and Computational Thinking
Mathematical and computational thinking at the 9– 12 level builds on K–8 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 representations of phenomena to describe explanations. (HS-PS2- 4) (HS-ESS1-4), (SLO

electrostatic forces between distant objects. (HS-PS2-4)

- Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2-4)

PS3.A: Definitions of Energy

- "Electrical energy" may mean energy stored in a battery or energy transmitted by electric currents. (secondary to HS-PS2-5)

PS3.C: Relationship Between Energy and Forces
When two objects interacting through a field change relative position, the energy stored in the field is changed. (HS-PS3-5)

PS3.D: Energy in Chemical Processes

- Solar cells are human-made devices that likewise capture the sun's energy and produce electrical energy. (secondary to HS-PS4-5)

PS4.A: Wave Properties

- The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. (HS-PS4-1)
- Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. (HS-PS4-2),(HS-PS4-5)
- [From the 3–5 grade band endpoints] Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.) (HS-PS4-3)

PS4.B: Electromagnetic Radiation

- Electromagnetic radiation (e.g., radio, microwaves,

Phenomena

- Theories and laws provide explanations in science. (HS-PS2-1), (HS-PS2-4) • Laws are statements or descriptions of the relationships among observable phenomena.

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HSPS2-5)
- Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. (HS-PS3-5)

Cause and Effect
• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HSPS4-1)
• Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. (HS-PS4-4)
• Systems can be designed to cause a desired effect. (HS-PS4-5) Systems and System Models • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. (HS-PS4-3)

- -

Connections to Engineering, Technology, and Applications of Science Interdependence of Science, Engineering, and Technology
• Science and engineering complement each other in the cycle known as research and development (R&D). (HS-PS4-5)

Influence of Engineering, Technology, and Science on Society and the Natural World
• Modern civilization depends on major technological systems. (HS-PS4-2),(HS-PS4-5)
• Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while

1, 2, 5 & 6)

Developing and Using Models
Modeling in 9–12 builds on K–8 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 worlds.

- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HSPS3-2)

Using Mathematics and Computational Thinking
Mathematical and computational thinking at the 9– 12 level builds on K–8 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. (HS-PS3-2)

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems 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-PS2-5)

Developing and Using Models
Modeling in 9–12 builds on K–8 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 worlds.
Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS3-5)

light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. (HS-PS4-3)

- When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells. (HS-PS4-4)
- Photoelectric materials emit electrons when they absorb light of a high-enough frequency. (HS-PS4-5)

PS4.C: Information Technologies and Instrumentation
Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, and scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. (HS-PS4-5)

decreasing costs and risks. (HS-PS4-2)

Connections to Nature of Science, Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. (HS-PS4- 3)

Asking Questions and Defining Problems Asking questions and defining problems in grades 9–12 builds from grades K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. • Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. (HSPS4-2**)** **Using Mathematics and Computational Thinking** Mathematical and computational thinking at the 9- 12 level builds on K-8 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 representations of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-PS4-1) **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 worlds. Arguments may also come from current scientific or historical episodes in science. • Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-PS4-3) **Obtaining, Evaluating, and Communicating Information** Obtaining, evaluating, and communicating information in 9–12 builds on K–8 and progresses to evaluating the validity and reliability of the claims, methods, and designs. • Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible. (HS-PS4-4) • Communicate technical information or 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-PS4-5)		
NJSLS		
RST.11-12.1, **WHST.9-12.2**, **SL.9-10.4** See **APPENDIX I**		

III. Methods of Student Evaluation

Assessment can be divided into two general categories: formal (graded) and informal/classroom-based (both graded and ungraded). The key to effectively assessing a student's mastery of skills is to match the assessment method to the learning objective.

<u>Formal Assessments</u>

- Evaluation
- Class participation
- Creative assignments
- Homework and classwork assignments
- Reports and presentations
- Research methodology
- Technological applications
- Unit tests
- Various speaking and listening assignments
- Multiple choice exams
- Quizzes (announced and unannounced)
- Essays
- Formal lab reports
- Scientific journal reviews
- Projects
- Short answer and problem solving tests
- Tests and quizzes on blackboard
- Case Study analysis

Informal Assessments

- Instructor’s observations of note-taking, and organization of notebooks and assignments
- Cooperative learning activities, including labs
- Creative project assignments
- Laboratory behavior
- Observing citizenship and appropriate social responses
- Instructor’s observations of time management skills

IV. Instructional Strategies Based on Instructional Goals

- Graphs and other visuals
- Engaging in discussions
- Reading silently and aloud
- Listening and speaking activities
- Watching and responding to media
- Brainstorming
- Listening
- Mapping
- Revising and editing
- Participating in small and large groups
- Researching to make connections to texts and classroom discussions
- Collaborative projects
- Answering questions (oral and written)
- Summarizing
- Debating
- Analyzing texts, discussions, etc.
- Peer teaching
- Competing in teams/debating
- Playing games
- Creating games
- Note taking and note making
- Writing

V. Textbooks:

a. Physical Science: Concepts In Action W/Earth And Space Science; 1st Edition; 2007; By: Wysession, Frank, Yancopoulos; Pearson School; 978-0-13-362816-6
b. Environmental Science: Your World, Your Turn; 1st Edition; 2010; By Withgott; Pearson School; 978-0-13-372475-2

VI. Scope and Sequence

Key: I – introduced D – developed in depth R – reinforced

	Skill to be Learned	Suggested Grade Level			
		9	**10**	**11**	**12**
1	Identify the core concepts and principles of science and use measurements and observation tools to assist in categorizing, representing, and interpreting the natural and designed world.	IDR			
2	Use the conceptual, mathematical, physical, and computational tools that need to be applied when constructing and evaluating claims.	IDR			
3	Recognize that scientific knowledge builds itself over time.	IDR			
4	Describe how the scientific knowledge involves critique and communication, which are social practices that are governed by a core set of values and norms.	IDR			
5	Explain how scientists organize geological time to help them communicate about Earth's history.	IDR			
6	Describe how fossils provide scientists with a record of the history of life on Earth.	IDR			
7	Describe how scientists date rocks and other objects using radioactive elements.	IDR			
8	Explain the classification of rock types according to their formation throughout the rock cycle.	IDR			
9	Identify how the theory of plate tectonics provides a framework for understanding the dynamic processes within and on Earth.	IDR			
10	Identify the internal and external sources of energy that drive Earth's systems.	IDR			
11	Explain the interaction between the atmosphere, geosphere, and hydrosphere and how they shape Earth's surface.	IDR			
12	Describe how the Earth's weather and climate systems are the result of complex interactions between land, ocean, ice, and atmosphere.	IDR			
13	Recognize that our universe has been expanding and evolving for approximately 13.8 billion years under	IDR			

	the influence of gravitational and nuclear forces.				
14	Explain how gravity governs the organizational patterns, and the movement of celestial bodies, nuclear forces within stars governs its evolution through the processes of stellar birth and death. Recognize how these same processes governed the formation of our solar system 4.6 billion years ago.	IDR			
15	Recognize from the time that the Earth formed from a nebula 4.6 billion years ago, it has been evolving as a result of geologic, biological, physical and chemical processes.	IDR			
16	Describe how Earth's composition is unique, is related to the origin of our solar system, and provides us with the raw resources needed to sustain life.	IDR			

VII. Pacing Chart

<u>Marking Period 1</u> –

- ***Unit 1: Earth's History***
  - **Basic Science Skills** *(Week 1-2)* Students will be provided with an introduction to the sciences. Students will learn the branches of sciences, units of measurement, and the process of scientific investigation.
  - **Rocks & Minerals** *(Week 3-5)* Students will study properties of rocks and minerals, formation and types of rocks, and the rock cycle.
  - **Geological Time Scale** *(Week 6-7)* Students will learn how the geological time scale is organized. Students will learn the different divisions, and important events that define the major divisions.
  - **Radiometric Dating** *(Week 8)* Students will learn about radiometric dating, including absolute-age dating, relative-age dating, parent-daughter relationships, and half-life. Students will learn how those methods are used by scientists to date fossils and other artifacts.
  - **Fossils** *(Week 9-10)* Students will study fossils and learn how different fossils provide scientists with different clues to Earth's history.

<u>Marking Period 2</u> –

- ***Unit 2: Earth's Systems***
  - **Layers of the Earth** *(Week 11-12)* Students will review the layers of the Earth and how they fuel plate tectonics, volcanism, and earthquakes.
  - **Plate Tectonics** *(Week 12-15)* Students will learn how the theory of plate tectonics explains continental drift, sea-floor spreading, subduction, and the formation of mountains, as well as the mechanisms of plate movement and stresses on Earth's crust.
  - **Earthquakes and Volcanoes** *(Week 16-17)* Students will learn about earthquakes, why and how they occur and how we can use earthquake data to study Earth's interior. Students will also learn about volcanoes, how they are formed, different types, typical locations, and their internal structure.
  - **The Earth's Surface** *(Week 18-20)* Students will study the various mechanisms that shape the surface as Earth, such as erosion, weathering, and deposition.

<u>Marking Period 3</u> –

- ***Unit 3: Weather & Climate***
  - **Weather and Climate** *(Week 21-23)* Students will be provided with a basic understanding of Earth's atmosphere and weather.
  - **Oceanography** *(Week 24-25)* Students will gather an understanding of properties of the oceans, including the change with depth, ocean movement, and how waves and currents can shape the Earth.
- ***Unit 4: Human Sustainability***

- **Natural Resources & Natural Hazards** *(Week 26-27)* Students will gather an understanding of nonrenewable and renewable resources and the hazards in collecting them.
- **Human Impact on Earth's Systems** *(Week 28)* Students will learn of the sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources.
- **Global Climate Change** *(Week 29)* Students will gain an understanding of important discoveries that are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities.
- **Developing Possible Solutions** *(Week 30)* Students will learn the importance to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.

Marking Period 4 –

- ***Unit 5: Space Systems***
  - **Early Astronomy & Technology** *(Week 31)* Provides students with an understanding of how early astronomers studied outer space and how the advancement of technology expanded how much we can see and how it changed our beliefs of the universe.
  - **The Sun-Earth-Moon System** *(Week 32-33)* Students will learn the movement of the Sun, Earth and moon and how it causes phenomena such as seasons, tides, and temperature changes throughout the different latitudes.
  - **The Solar System** *(Week 34-36)* Students will learn the origin of the Solar System and the objects within it, including the characteristics of the sun, planets, comets, and asteroids.
  - **Stars & Galaxies** *(Week 37-38)* Students will study properties, such as color and temperature, magnitude, and distance of stars and galaxies, and how they are classified.
  - **Origin of the Universe** *(Week 39-40)* Students will be provided with an understanding of the beginning of the universe according to the Big Bang Theory and Hubble's Shift.

VIII. Student Handout

Passaic County Technical Institute
Student Proficiencies
<u>Geophysical Science</u>

I. Course Overview

This course is an introduction to the body of knowledge contained in the earth and physical sciences, including the processes of scientific investigation. Students will study matter, forces and motion, earth sciences, the origin of the universe and solar system, the impact of science and technology on the environment.

Successful completion of this course will prepare the student for other sciences such as Biology, Chemistry, and Environmental Science.

II. Proficiencies

Upon successful completion of the requirements for this course, students will be able to:

1. Identify the core concepts and principles of science and use measurements and observation tools to assist in categorizing, representing, and interpreting the natural and designed world.
2. Use the conceptual, mathematical, physical, and computational tools that need to be applied when constructing and evaluating claims.
3. Recognize that scientific knowledge builds itself over time.
4. Describe how the scientific knowledge involves critique and communication, which are social practices that are governed by a core set of values and norms.
5. Explain how scientists organize geological time to help them communicate about Earth's history.
6. Describe how fossils provide scientists with a record of the history of life on Earth.
7. Describe how scientists date rocks and other objects using radioactive elements.
8. Explain the classification of rock types according to their formation throughout the rock cycle.
9. Identify how the theory of plate tectonics provides a framework for understanding the dynamic processes within and on Earth.
10. Identify the internal and external sources of energy that drive Earth's systems.
11. Explain the interaction between the atmosphere, geosphere, and hydrosphere and how they shape Earth's surface.
12. Describe how the Earth's weather and climate systems are the result of complex interactions between land, ocean, ice, and atmosphere.
13. Recognize that our universe has been expanding and evolving for approximately 13.8 billion years under the influence of gravitational and nuclear forces.

14. Explain how gravity governs the organizational patterns, and the movement of celestial bodies, nuclear forces within stars governs its evolution through the processes of stellar birth and death. Recognize how these same processes governed the formation of our solar system 4.6 billion years ago.
15. Recognize from the time that the Earth formed from a nebula 4.6 billion years ago, it has been evolving as a result of geologic, biological, physical and chemical processes.
16. Describe how Earth's composition is unique, is related to the origin of our solar system, and provides us with the raw resources needed to sustain life.

APPENDIX I

RST.11-12.1. Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.

RST.11-12.2. Determine the central ideas, themes, or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

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.

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.

WHST.9-10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.

A. Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence.
B. Develop claim(s) and counterclaims using sound reasoning, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns.
C. Use transitions (e.g. words, phrases, clauses) to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
D. Establish and maintain a style and tone appropriate to the audience and purpose (e.g. formal and objective for academic writing) while attending to the norms and conventions of the discipline in which they are writing.
E. Provide a concluding paragraph or section that supports the argument presented.

WHST.11-12.1. Write arguments focused on *discipline-specific content.*

A. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence.
B. Develop claim(s) and counterclaims using sound reasoning and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases.
C. Use transitions (e.g. words, phrases, clauses) to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
D. Establish and maintain a style and tone appropriate to the audience and purpose (e.g. formal and objective for academic writing) while attending to the norms and conventions of the discipline in which they are writing.
E. Provide a concluding paragraph or section that supports the argument presented.

WHST.9-10.2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

A. Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
B. Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
C. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts.
D. Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.
E. Establish and maintain a style and tone appropriate to the audience and purpose (e.g. formal and objective for academic writing) while attending to the norms and conventions of the discipline in which they are writing.
F. Provide a concluding paragraph or section that supports the argument presented.

WHST.11-12.2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

A. Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
B. Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
C. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.
D. Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.
E. Provide a concluding paragraph or section that supports the argument presented.

WHST.9-10.7. 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.

WHST.11-12.7. 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.

SL.9-10.4. Present information, findings, and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.

SL.9-10.5. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance findings, reasoning, and evidence and to add interest.