Fair Lawn

Public Schools

Fair Lawn, NJ

GeoScience CP

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GeoScience is a CP high school science class developed by the Fair Lawn Schools high school science faculty and aligned to the Next Generation Science Standards and correlated to the Common Core State Standards for Literacy & Math.

Science Department

Fair Lawn School District

Committee Credits

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Geoscience

I. Course Synopsis

GeoScience is a laboratory based elective course that will introduce students to the Earth Sciences. The course will explore the processes and forces that created and continually shape the planet Earth. This course investigates the Earth beginning as a planet in space from its solid composition, to its liquid oceans, and gaseous atmosphere. The course presents each component as a part of a dynamic interrelated system. Emphasis is placed on the flow of matter and energy throughout all earth systems. Thus, students will study Astronomy, Geology, Oceanography, and Meteorology. Finally, the course emphasizes how each field of study relates to people and their survival on the planet. Students will explore topics via online research, group work, lecture and video shorts with a focus on following the scientific process. Reading, writing, lab work, data analysis, and graph interpretation are all important components to this course.

II. Philosophy & Rationale

The earth sciences impact humans in every facet of existence. Human Survival is dependent upon an understanding of the vast yet fragile nature of our planet. This course will enable students to understand earth's place in space and the interactions among the land, oceans, and air. Understanding scientific processes that are common to all earth systems allows people to accurately and objectively view their world. With an understanding of earth systems, people can make responsible choices throughout their lives while seeking to live in a productive and sustainable society.

This course has been aligned to and developed with the Next Generation Science Standards (NGSS) as its focus. Efforts have been made to integrate aspects of other science standards, particularly the earth and space science standards into this course to assure that students are provided an opportunity to form connections.

All NGSS aligned courses in the Fair Lawn Schools demonstrate a commitment preparing students to become college and career ready as well as the other guiding assumptions of the Frameworks for Science Education (NRC, 2011) and the NGSS including

- Students are born investigators;
- Science instruction should focus on core ideas and practices;
- An understanding of science develops over time;
- Science and engineering require both knowledge and practice;
- Science education must connect to students' interests and experiences; and
- Promoting equity for all students must be a focus of science education.

Additionally, all NGSS aligned courses in the Fair Law Schools integrate the three dimensions discussed in the Frameworks for Science Education and the NGSS, including

- Science & Engineering Practices which describe behaviors that scientists engage in as they investigate and build models and theories about the natural world and the key set of engineering practices that engineers use as they design and build models and systems; (NGSS PDF)
- Cross Cutting Concepts which link all domains of science and provide an organizational schema for interrelating knowledge from various science fields into a coherent and scientifically-based view of the world; (NGSS PDF) and
- Disciplinary Core Ideas which focus and unite K-12 science, have a broad importance across multiple sciences or engineering disciplines or are a key organizing concept within a single discipline; provide a key tool for understanding or investigating more complex ideas and solving problems; relate to the interests and life experiences of students; are connected to societal or personal concerns that require scientific or technological knowledge; and are teachable and learnable over multiple grades at increasing depth and sophistication. (NGSS PDF)

Since coherence is a main dimension of the NGSS, consider reviewing the "story line" for the middle school physical science, life science, earth and space science, and engineering, technology and applications of science, as well as the high school physical science, life science, earth and space science, and engineering, technology and application of science for a full picture of the NGSS philosophy. For a full picture of how these programs are implemented in the Fair Lawn Schools, visit the district curriculum website.

As described in the NGSS, technical writing and reading non-fiction is also a focus of our 6-12 science curricula as required by the CCSS. Students are expected to think critically about data they collect or read about and then express their thoughts through text-based narratives, journal entries, short-constructed response, argument-based writing, and/or in-class discussion.

Differentiated instruction for students at different levels of achievement and specific learning needs (e.g. special education, English Language Learners (ELL), at-risk, and Gifted & Talented) is embedded in targeted scaffolding based on knowledge of each student's interests, needs, and assessment data, including, but not limited to, in class formative and summative assessments.

When deemed appropriate, department teachers will engage students in purposeful paired discussions to share information more effectively, such as the "turn and talk" (Harvey & Daniels, 2009). "Text annotation" could be used, for example to optimize reading comprehension (Daniels & Steineke, 2010).

III. Scope & Sequence

Unit 1: Astronomy <Sept-Nov>

1. Tools of Astronomy
2. The Moon
3. Earth Moon system
4. The Sun

Unit 2: Geology <Nov-Feb>

1. Weathering & Erosion
2. Minerals and Rocks
3. Plate Tectonics
4. Volcanoes
5. Earthquakes

Unit 3: Oceans <Feb-Apr>

1. Ocean Chemistry
2. Ocean Geology
3. Ocean Physics
4. Ocean Biology

Unit 4: Weather and Climate <Apr-Jun>

1. Atmosphere
2. Meteorology
3. Severe Weather

IV. Unit Descriptions

Unit 1: ASTRONOMY

Enduring Understanding

1. The Earth's surface, atmosphere, and life have changed immensely throughout time and will continue to change.
2. Knowledge of the Earth's creation and how its systems work have been achieved by the investigation of astronomers.
3. Analyzing the ways in which energy is transferred from stars to planets broadens our understanding of habitable worlds.
4. Understanding the scale of our solar system and our place in the galaxy help us imagine the enormity of the universe?

Essential Question(s)

1. How does energy move through a dynamic system?
2. What is the impact that energy has on these systems?
3. How has technology helped us understand the universe?
4. How might the findings of astronomers be confirmed?
5. What can be observed/discovered by looking into the night Sky?
6. How can current scientific observations allow us to recreate past events?
7. What limits our understanding of how the Solar System formed?
8. How would the earth be different if there were no moon?
9. Why is it important for us to monitor the sun?
10. How has the Earth evolved over time?
11. How has this continuous change impacted Earth and how will it continue to impact Earth?

Learning Objectives

1. Compare and contrast the electromagnetic spectrum
2. Differentiate between refracting, reflecting and radio telescopes.
3. Investigate the technologies, tools, and measurements used to observe the solar system and beyond. (For example: Rockets, probes, rovers, satellites, space shuttle, space station, Hubble & other telescopes, astronomical unit, light year, etc.)
4. Identify the properties of the lunar surface.
5. Evaluate the current theories on the formation of the moon.
6. Describe the role of gravity in the formation, organization, and continuous motion of the solar system.
7. Identify the relative positions and motions of the earth, sun and moon.
8. Create a scale model of the earth-sun-moon system
9. Describe how ancient observations of the sky reflect current understanding of our solar system.
10. Understand how to model, analyze, and explain the effects of gravitational force in the solar system.
11. Determine the cause and effect of various patterns that occur within the solar system; for example, orbits of the planets around stars (sun), orbits of moons around planets, seasons, moon phases, hours of daylight, eclipses, tides.

12. Compare and contrast the properties of the planets.
13. Explain how eclipses have contributed to our understanding of the solar system.
14. Assess the risks and benefits of electromagnetic energy produced by the sun, and its impact on Earth
15. Explain the technologies that enable us to know the structure of the sun
16. Compare and contrast parts of the sun.
17. Describe how solar activity impacts life on earth.
18. Compare and contrast the sun as a star with other objects in the milky way

Suggested Activities & Suggested Modifications for Special Education Students, ELL Students, Students at Risk, and Gifted Students:

1. Students with special needs and ELL learners may be provided with key vocabulary terms prior to the unit beginning.
2. ELL students may be provided with additional visual aids. For additional modifications, refer to Classroom Instruction that Works for ELL Learners *or the* SIOP protocol.
3. Gifted students may be challenged by asking them to form additional connections between biology, chemistry, and physics.

Demonstrations

1. Solar Collector - (pop the popcorn)
2. Prism → Rainbow
3. Insolation (flashlight angle activity)
4. Eclipse Demo - Spheres with Light source
5. Fireworks Demo - Burning Salts in flame (or use with mineral ID?)

Labs

1. Intro to Data Collection (Vernier #1)
2. Seasons and Angle of InSolAtion (Vernier #29)
3. Scale Model Eclipses
4. Moon Crater activity
5. Spectroscopy
6. Sun Spot Observation (long term)
7. Gizmo's - Seasons, Tides, Eclipses

Assessment

1. Pretest (formative)
2. Vocabulary Quizzes (formative)
3. Online Self Check Quizzes (formative)
4. Chapter Tests (summative)
5. Lab Reports (summative)
6. Research / Projects (summative)

Other

1. Earth Moon Scale Activity - (NASA - with Meter sticks, beads, and Ping pong balls)

Next Generation Science Standards

HS-ESS1-1

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 that eventually reaches Earth in the form of radiation. [Clarification Statement: Emphasis is on the energy transfer mechanisms that allow energy from nuclear fusion in the sun's core to reach Earth. Examples of evidence for the model include observations of the masses and lifetimes of other stars, as well as the ways that the sun's radiation varies due to sudden solar flares ("space weather"), the 11-year sunspot cycle, and non-cyclic variations over centuries.] [*Assessment Boundary: Assessment does not include details of the atomic and sub-atomic processes involved with the sun's nuclear fusion.]*

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. [Clarification Statement: Emphasis is on the astronomical evidence of the red shift of light from galaxies as an indication that the universe is currently expanding, the cosmic microwave background as the remnant radiation from the Big Bang, and the observed composition of ordinary matter of the universe, primarily found in stars and interstellar gases (from the spectra of electromagnetic radiation from stars), which matches that predicted by the Big Bang theory (3/4 hydrogen and 1/4 helium).]

HS-ESS1-3

Communicate scientific ideas about the way stars, over their life cycle, produce elements. [Clarification Statement: Emphasis is on the way nucleosynthesis, and therefore the different elements created, varies as a function of the mass of a star and the stage of its lifetime.] [*Assessment Boundary: Details of the many different nucleosynthesis pathways for stars of differing masses are not assessed.*]

HS-ESS1-4

Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.[Clarification Statement: Emphasis is on Newtonian gravitational laws governing orbital motions, which apply to human-made satellites as well as planets and moons.] [*Assessment Boundary: Mathematical representations for the gravitational attraction of bodies and Kepler's Laws of orbital motions should not deal with more than two bodies, nor involve calculus.*]

HS-ESS-1-6

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. [Clarification Statement: Emphasis is on using available evidence within the solar system to reconstruct the early history of Earth, which formed along with the rest of the solar system 4.6 billion years ago. Examples of evidence include the absolute ages of ancient materials (obtained by radiometric dating of meteorites, moon rocks, and Earth's oldest minerals), the sizes and compositions of solar system objects, and the impact cratering record of planetary surfaces.]

Interdisciplinary Connections

HS-PS-3-4

Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics). [Clarification Statement: Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the energy changes both quantitatively and conceptually. Examples of investigations could include mixing liquids at different initial temperatures or adding objects at different temperatures to water.] [*Assessment Boundary: Assessment is limited to investigations based on materials and tools provided to students.*]

HS-PS-3-5

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.*]

Unit 2: GEOLOGY

Enduring Understanding

1. The shape and geology of the continents suggests that they were once part of single, larger continent.
2. Life on Earth is affected by plate tectonics and continental drift.
3. Seismic waves can be used to understand the internal structure of Earth, as well as to measure and analyze the strength and location of earthquakes.
4. Forces involved in tectonic plate movement are thought to be caused by convection currents deep within the Earth.
5. The rock record reveals that life has become more complex over time.
6. The geologic time scale was developed using sedimentary rocks and the principle of superposition.
7. Scientists organize geologic time to help them communicate about Earth's history.
8. The radioactive decay of certain elements found in rocks helps scientists determine the age of those rocks and therefore the fossils they contain.
9. The creation, deformation, and destruction of rocks are the result of the continuous process known as the rock cycle.
10. The rock cycle has an impact on the physical characteristics of the Earth.

Essential Question(s)

1. How are the rock cycle and plate tectonics interrelated systems?
2. How are earthquakes related to plate tectonics?
3. How do scientists use technology to measure ocean floor topography, sea-floor spreading, and earthquakes?
4. To what degree do plate tectonics affect life on Earth?
5. How do rocks constantly change from one type of rock to another?
6. To what extent are geologic principles and techniques used by scientists to learn the sequence in which geologic events occurred?
7. How do scientists use the dating of rocks to determine the order of events in the geologic time scale?
8. To what extent do humans influence the rock cycle?

Learning Objectives

1. Map earthquakes and volcanoes in real-time by understanding latitude and longitude.
2. Describe the energy within Earth that causes the continents to shift.
3. Discuss the effects of changing plate position on living things.
4. Explain how factors such as heat, pressure, time, weathering, and erosion influence the rock cycle.
5. Determine the age of a rock or fossil sample when given the number of half-lives and the length of one half-life.
6. Model the rock cycle and describe the steps involved in the process.
7. Compare and contrast the rock cycle to other natural cycles. (water cycle and life cycle)
8. Explain how weathering and erosion impact our daily lives.
9. Utilize the properties of rocks, such as composition, grain size, texture, color, and presence of fossils, to classify them according to rock type.
10. Differentiate the Earth's interior layers using characteristics that describe each.
11. Evaluate the properties of rocks to determine how they can be used in everyday life.
12. Justify how information about the Earth's past can be attained from rocks contain fossils.
13. Describe and distinguish the Earth's four main layers.
14. Explain how pressure and temperature are affected as depth below the surface increases.
15. Describe how Earth's surface is constantly changed by dynamic forces.
16. Differentiate the two forms of weathering.
17. Apply the knowledge of erosion and weathering to real life situations

18. Describe the physical effects of volcanic eruptions.
19. Describe the four principal types of volcanoes.
20. Demonstrate an understanding of the process by which magma is formed.
21. Explain the relationship between plate boundaries and zones of volcanism.
22. Correlate plate boundaries with active volcanism, mountain ranges and island chains.
23. Relate volcanic activity with the driving forces beneath the Earth.
24. Compare the positive and negative effects of volcanic eruptions.
25. Discuss options for predicting volcanic eruptions.

Suggested Activities & Suggested Modifications for Special Education Students, ELL Students, Students at Risk, and Gifted Students:

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2. ELL students may be provided with additional visual aids. For additional modifications, refer to Classroom Instruction that Works for ELL Learners *or the* SIOP protocol.
3. Gifted students may be challenged by asking them to form additional connections between biology, chemistry, and physics.

Demonstrations

1. Rock Saw
2. Pyrite hit with steel (sparks)
3. Flame Tests / Fireworks Demo
4. Acid on Marble / Coral
5. Stream Table

Labs

1. Mineral ID Lab
2. Rock Density Comparison Lab
3. Mechanical/Physical Weathering Lab
4. Chemical Weathering
5. Sea Floor Spreading (paleomagnetism)(Vernier # 5)
6. Gizmo - Density, Building Pangaea, Plate Tectonics, Rock Cycle

Assessment

1. Pretest (formative)
2. Vocabulary Quizzes (formative)
3. Online Self Check Quizzes (formative)
4. Chapter Tests (summative)
5. Lab Reports (summative)
6. Research / Projects (summative)

Next Generation Science Standards

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. [Clarification Statement: Emphasis is on how the appearance of land features (such as mountains, valleys, and plateaus) and sea-floor features (such as trenches, ridges, and seamounts) are a result of both constructive forces (such as volcanism, tectonic uplift, and orogeny) and destructive mechanisms (such as weathering, mass wasting, and coastal erosion).] [*Assessment Boundary: Assessment does not include memorization of the details of the formation of specific geographic features of Earth's surface.*]

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. [Clarification Statement: Examples should include climate feedbacks, such as how an increase in greenhouse gases causes a rise in global temperatures that melts glacial ice, which reduces the amount of sunlight reflected from Earth's surface, increasing surface temperatures and further reducing the amount of ice. Examples could also be taken from other system interactions, such as how the loss of ground vegetation causes an increase in water runoff and soil erosion; how dammed rivers increase groundwater recharge, decrease sediment transport, and increase coastal erosion; or how the loss of wetlands causes a decrease in local humidity that further reduces the wetland extent.]

HS-ESS2-3.
Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.[Clarification Statement: Emphasis is on both a one-dimensional model of Earth, with radial layers determined by density, and a three-dimensional model, which is controlled by mantle convection and the resulting plate tectonics. Examples of evidence include maps of Earth's three-dimensional structure obtained from seismic waves, records of the rate of change of Earth's magnetic field (as constraints on convection in the outer core), and identification of the composition of Earth's layers from high-pressure laboratory experiments.]

HS-ESS2-7.
Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.[Clarification Statement: Emphasis is on the dynamic causes, effects, and feedbacks between the biosphere and Earth's other systems, whereby geoscience factors control the evolution of life, which in turn continuously alters Earth's surface. Examples of include how photosynthetic life altered the atmosphere through the production of oxygen, which in turn increased weathering rates and allowed for the evolution of animal life; how microbial life on land increased the formation of soil, which in turn allowed for the evolution of land plants; or how the evolution of corals created reefs that altered patterns of erosion and deposition along coastlines and provided habitats for the evolution of new life forms.] [*Assessment Boundary: Assessment does not include a comprehensive understanding of the mechanisms of how the biosphere interacts with all of Earth's other systems.*]

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. [Clarification Statement: Emphasis is on the ability of plate tectonics to explain the ages of crustal rocks. Examples include evidence of the ages oceanic crust increasing with distance from mid-ocean ridges (a result of plate spreading) and the ages of North American continental crust decreasing with distance away from a central ancient core (a result of past plate interactions).]

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. [Clarification Statement: Emphasis is on using available evidence within the solar system to reconstruct the early history of Earth, which formed along with the rest of the solar system 4.6 billion years ago. Examples of evidence include the absolute ages of ancient materials (obtained by radiometric dating of meteorites, moon rocks, and Earth's oldest minerals), the sizes and compositions of solar system objects, and the impact cratering record of planetary surfaces.]

HS-ESS3-2.
E**valuate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.*** [Clarification Statement: Emphasis is on the conservation, recycling, and reuse of resources (such as minerals and metals) where possible, and on minimizing impacts where it is not. Examples include developing best practices for agricultural soil use, mining (for coal, tar sands, and oil shales), and pumping (for petroleum and natural gas). Science knowledge indicates what can happen in natural systems—not what should happen.]

HS-ESS3-3.
Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. [Clarification Statement: Examples of factors that affect the management of natural resources include costs of resource extraction and waste management, per-capita consumption, and the development of new technologies. Examples of factors that affect human sustainability include agricultural efficiency, levels of conservation, and urban planning.] [*Assessment Boundary: Assessment for computational simulations is limited to using provided multi-parameter programs or constructing simplified spreadsheet calculations.*]

HS-ESS3-6.
Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity. [Clarification Statement: Examples of Earth systems to be considered are the hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere. An example of the far-reaching impacts from a human activity is how an increase in atmospheric carbon dioxide results in an increase in photosynthetic biomass on land and an increase in ocean acidification, with resulting impacts on sea organism health and marine populations.] [*Assessment Boundary: Assessment does not include running computational representations but is limited to using the published results of scientific computational models.*]

Unit 3: OCEANOGRAPHY

Enduring Understanding

1. Many factors influence variations in seawater chemistry which has profound implications for the organisms that call the oceans home.
2. The water in the oceans is organized into layers based on density.
3. The Sun-Earth-Moon system drives the movement of fluids on the Earth.
4. The ocean is home to a diversity of life, all of which is affected by human activity.
5. The salt content of ocean water is critical to the all organisms that the oceans home.
6. The movement of ocean water is driven by interactions with the atmosphere, which is driven by the unequal heating of the Earth by the Sun.
7. Scientists research and communicate information through a universally accepted process known as the scientific method.
8. Ocean scientists are relying more and more on technology such as satellites, drifters, buoys, and submersibles to explore and gather information about the oceans.
9. Ocean exploration is interdisciplinary, requiring collaboration among biologists, chemists, climatologists, computer programmers, engineers, geologists, meteorologists, and physicists.

Essential Question(s)

1. How do the properties and characteristics of seawater change from one location to another throughout the oceans?
2. How does seawater chemistry vary between surface regions and regions of great depth?
3. What is the role of the oceans within the Earth system?
4. What are the techniques used to navigate in ocean waters?
5. How have historical oceanographic achievements influenced the development of human society?
6. How do the oceans impact the climate of the Earth?
7. How would the weather on Earth be different if we did not have a moon?
8. How has plate tectonics molded the oceans and ocean bathymetry?
9. What are the similarities and differences between the major marine environments?
10. What is the importance of marine sediments as natural resources?
11. How do coastal marine environments differ from open ocean environments?
12. How do humans and modern society impact coastal environments and beach processes with stabilization practices?
13. What is the nature of the interaction between the world's oceans and the Earth's atmosphere?
14. How do the world's oceans circulate water at the surface and with depth? How does this pattern of movement affect life on Earth?
15. How do waves in the ocean form and what are the similarities and differences between different wave types?
16. What causes tides and why do monthly tidal cycles differ from place to place?
17. Science attempts to classify objects both living and nonliving as a means to better understand the world around us. How is marine life classified?
18. What adaptations do marine organisms use in order to survive?
19. What is primary productivity and how does it transfer energy through marine ecosystems?
20. What is the difference between benthic and pelagic organisms and how do they interact within marine ecosystems?
21. How is satellite technology used to study ocean processes?

Learning Objectives

1. Understand the field of oceanography and its role in understanding Earth as a
2. system.
3. Explain the role of historical oceanographic achievements on human society.
4. Understand and be able to use marine charts in navigation.
5. Understand the role of the world's oceans on the climate of the Earth, both currently and in the future.
6. Explain the nature and properties of seawater.
7. Understand the factors that influence seawater chemistry and explain their relationship to one another.
8. Describe the natural patterns of variation in seawater chemistry at the surface and with depth.
9. Explain the role of plate tectonics in the formation of the world's oceans and their bathymetry.
10. Compare and contrast different marine environments within the ocean system.
11. Evaluate marine sediments in the context of their importance as a natural resource.
12. Understand the differences between coastal marine environments.
13. Explain the impacts of humans and coastal stabilization on natural beach processes.
14. Explain the interaction between the world's oceans and Earth's atmosphere.
15. Explain how and why water circulates throughout the world's oceans, on the surface and with depth.
16. Describe the formation of ocean waves.
17. Compare and contrast the different kinds of ocean waves.
18. Explain why tides occur and the impact of different monthly tidal cycles.
19. Understand the classification of marine life.
20. Identify and explain the adaptations of marine organisms as it relates to their survival.
21. Understand the transfer of energy through primary productivity and its impact on marine ecosystems.
22. Know the difference between benthic and pelagic organisms.
23. Understand the particular environments in which benthic and pelagic organisms exist.
24. Describe the layers of ocean water in relation to density, salinity, pressure and temperature.
25. Distinguish between the motion of water in tides, waves and currents.
26. Describe how water moves within the atmosphere and hydrosphere.
27. Define the different parts of a wave.
28. Distinguish between different types of waves.
29. Describe the causes of waves.
30. Describe how waves transfer energy.
31. Elaborate on how different types of water motion affect human life.
32. Describe the concepts of density in terms of stable and unstable density-stratified systems.
33. Identify the major ocean and sea masses on the globe.
34. Explain the characteristics and causes of ocean currents.
35. Explain the role of the Coriolis Effect on ocean currents.
36. Compare and explain the types of forces of tidal motion.
37. Students will be able to:
38. Interpret thermocline, halocline and pycnocline graphs.
39. Label the major ocean currents on a map.
40. Use a hygrometer to measure the density of salt and fresh water.

Suggested Activities & Suggested Modifications for Special Education Students, ELL Students, Students at Risk, and Gifted Students:

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3. Gifted students may be challenged by asking them to form additional connections between biology, chemistry, and physics.

Demonstrations

1. Floating / Sinking Egg Density (salt and fresh water comparison)
2. Density Chimney (flask of hot water in battery jar)
3. Density Bottles (warm / cold water then invert)
4. Slinky Waves
5. Coriolis Effect Demonstrator

Labs

1. Freezing Temperature of Ocean Water (Vernier experiment #17)
2. Mapping the Ocean Floor (Vernier #19)
3. Sea Floor Mapping (hands-on Lab w/ probes / topo models in the box)
4. Gizmo - Tides
5. Problem Solving Lab (pg.401) Analyzing a Tidal Record
6. GeoLab - Modeling Water Masses

Assessment

1. Pretest (formative)
2. Vocabulary Quizzes (formative)
3. Online Self Check Quizzes (formative)
4. Chapter Tests (summative)
5. Lab Reports (summative)
6. Research / Projects (summative)

Next Generation Science Standards

HS-ESS2-5.

Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. [Clarification Statement: Emphasis is on mechanical and chemical investigations with water and a variety of solid materials to provide the evidence for connections between the hydrologic cycle and system interactions commonly known as the rock cycle. Examples of mechanical investigations include stream transportation and deposition using a stream table, erosion using variations in soil moisture content, or frost wedging by the expansion of water as it freezes. Examples of chemical investigations include chemical weathering and recrystallization (by testing the solubility of different materials) or melt generation (by examining how water lowers the melting temperature of most solids).]

HS-ESS2-6.

Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. [Clarification Statement: Emphasis is on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.]

Interdisciplinary Connections

HS-PS-1-1

Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. [Clarification Statement: Examples of properties that could be predicted from patterns could include reactivity of metals, types of bonds formed, numbers of bonds formed, and reactions with oxygen.] [*Assessment Boundary: Assessment is limited to main group elements. Assessment does not include quantitative understanding of ionization energy beyond relative trends.*]

HS-PS-1-2

Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. [Clarification Statement: Examples of chemical reactions could include the reaction of sodium and chlorine, of carbon and oxygen, or of carbon and hydrogen.] [*Assessment Boundary: Assessment is limited to chemical reactions involving main group elements and combustion reactions.*]

HS-PS-4-1

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 describing those relationships qualitatively.*]
http://www.nextgenscience.org/sites/ngss/files/HS%20ESS%20DCI%20combined%206.13.13.pdf

Unit 4: WEATHER AND CLIMATE

Enduring Understandings

1. Life on earth is impacted by weather and climate
2. The sun plays an important role in earth systems
3. Scientific measurement is important in order for us to understand how systems work
4. Without oceans on Earth the atmosphere and life as we know it would not exist
5. Energy is transferred throughout earth's atmosphere and oceans whic is the cause for variation in weather and climate
6. Climate varies over space and time through both natural and man-made processes.
7. Climate change will have consequences for the Earth system and human lives

Essential Question(s)

1. How do atmospheric properties, such as composition, temperature, air pressure, and humidity play a role in weather?
2. How does the atmosphere act as both a shield and a blanket for Earth?
3. How does the sun influence weather and climate
4. How can we predict the weather by looking at clouds?
5. In what ways does water and air move energy through earth systems?
6. How can monitoring properties of our air and oceans allow us to forecast the weather
7. How can models help scientists make predictions?
8. Why does weather and climate vary?
9. Is climate change good or bad for Earth?
10. What are current climate conditions dependent on?
11. How has climate changed in the past?
12. What natural and anthropogenic factors cause climate change?
13. Is our climate changing? How are extreme events, such as droughts, floods, wildfires, heat waves, and hurricanes related to climate variability and change?
14. What evidence do we have that global climate change has occurred?
15. What can we do to reduce our carbon imprint on the environment?
16. What impact do individuals throughout the world have on climate change?
17. How has climate changed over time on our planet?
18. How does the atmosphere impact life?
19. What effects do non-living things have on the atmosphere?
20. How does maintaining a healthy atmosphere affect the sustainability of life on Earth?

Learning Objectives

Students will be able to:

1. Identify the composition of the atmosphere
2. Design methods to determine the percent oxygen of the atmosphere
3. Compare the different layers of the atmosphere
4. Explain what happens to sunlight as it passes through the atmosphere
5. Compare means of heat transfer through the atmosphere
6. Distinguish between the concepts of temperature and heat
7. Describe the role dew point plays in condensation

8. Describe the relationship between air pressure-temperature and density.
9. Explain how a temperature inversion occurs
10. Explain how wind forms
11. Compare humidity with relative humidity
12. Explain how clouds are formed
13. Diagram the water cycle
14. Classify air masses and the conditions under which they originate
15. Model the Coriolis effect and its impact on global wind patterns
16. Compare and contrast high and low pressure systems
17. Identify the types of data meteorologists collect throughout the atmosphere
18. Explain how a thermometer works .
19. Explain how a barometer works.
20. Interpret data on a weather map
21. Distinguish between different weather fronts on weather maps
22. Evaluate data to predict a weather outcome
23. Describe the nature of storms and severe weather
24. Differentiate between climate and weather.
25. Relate the effects of climate change to the presence of and increase in greenhouse gases.
26. Explain how carbon cycles through the biosphere, geosphere, and hydrosphere.
27. Interpret climate proxy data to predict long-term climate patterns.
28. Evaluate scientific evidence to determine how human activities are impacting climate system.
29. Calculate their personal carbon footprint and compare it to average carbon footprints from other countries.
30. Articulate ways to decrease their own personal carbon emissions.

Suggested Activities & Suggested Modifications for Special Education Students, ELL Students, Students at Risk, and Gifted Students:

1. Students with special needs and ELL learners may be provided with key vocabulary terms prior to the unit beginning.
2. ELL students may be provided with additional visual aids. For additional modifications, refer to Classroom Instruction that Works for ELL Learners *or the* SIOP protocol.
3. Gifted students may be challenged by asking them to form additional connections between biology, chemistry, and physics.

Demonstrations

1. % Determination of o2 in Air (candle, cylinder, bowl, water)
2. Conduction of heat through metals (bb's with wax on conductometer)
3. Convection Chiminy (candle, touch paper, convection box)
4. Melting Ice Cube (ice, 2 surfaces metal/plastic)
5. Cloud Chamber demo

Labs

1. Temperature Profile of the Atmosphere (graphing Lab)
2. Relection and Absorption of Light (Vernier #23)
3. Relative Humidity (Vernier Earth Science #26) Also See page 283 of text
4. Dew Point (Vernier # 27)
5. Wind Chill (Vernier # 28)
6. Charles Law (vernier # ?)
7. Boyles Law (vernier #?)
8. Barometric Pressure ???
9. Problem Solving Lab Interpreting Scientific Illustrations ISOBARS p. 318
10. GeoLab - Interpreting a Weather Map p.322
11. The Greenhouse Effect (Vernier Earth Science #24)
12. Gizmo - Heat Transfer by Conduction, Hurricane Motion, Land and Sea Breezes,

Assessment

1. Pretest (formative)
2. Vocabulary Quizzes (formative)
3. Online Self Check Quizzes (formative)
4. Chapter Tests (summative)
5. Lab Reports (summative)
6. Research / Projects (summative)

Other

New Jersey Core Curriculum Content Standards

5.1, 5.2, 5.3B, 5.4, 8.1, 8.2, 9.1, 9.4
http://www.state.nj.us/education/cccs/standards/5/5-1.htm
http://www.state.nj.us/education/cccs/standards/8/8-1.htm
http://www.state.nj.us/education/cccs/standards/9/9-1.htm

Next Generation Science Standards

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. [Clarification Statement: Examples of the causes of climate change differ by timescale, over 1-10 years: large volcanic eruption, ocean circulation; 10-100s of years: changes in human activity, ocean circulation, solar output; 10-100s of thousands of years: changes to Earth's orbit and the orientation of its axis; and 10-100s of millions of years: long-term changes in atmospheric composition.] [*Assessment Boundary: Assessment of the results of changes in climate is limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution.*]

HS-ESS2-6.
Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. [Clarification Statement: Emphasis is on modeling biogeochemical cycles that include the cycling of carbon through the ocean, atmosphere, soil, and biosphere (including humans), providing the foundation for living organisms.]

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. [Clarification Statement: Examples of evidence, for both data and climate model outputs, are for climate changes (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition).] [*Assessment Boundary: Assessment is limited to one example of a climate change and its associated impacts.*]

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. [Clarification Statement: Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather (such as hurricanes, floods, and droughts). Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.]

HS-ESS3-4.
Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.* [Clarification Statement: Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).]
http://www.nextgenscience.org/sites/ngss/files/HS%20ESS%20DCI%20combined%206.13.13.pdf

Interdisciplinary Connections

HS-PS-3-4
Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics). [Clarification Statement: Emphasis is on analyzing data from student investigations and using mathematical thinking to describe the energy changes both quantitatively and conceptually. Examples of investigations could include mixing liquids at different initial temperatures or adding objects at different temperatures to water.] [*Assessment Boundary: Assessment is limited to investigations based on materials and tools provided to students.*]

V. Course Materials

Include the course textbook citation, including the year it was adopted by the Fair Lawn Board of Education. Include any additional materials which are used during the course.

1. Earth Science: Geology, the Environment, and the Universe
   Adopted: 2005

   Hess, Frances Scelsi., and National Geographic Society. *Earth Science: Geology, the Environment, and the Universe*. New York, NY: Glencoe/McGraw-Hill, 2005. Print.

2. Glencoe Online Textbook and Course Resources
3. Interactive Simulations - http://phet.colorado.edu/
4. Vernier Labquest Data Collection Devices and probeware
5. Laptop Cart / Computer Labs
6. Gizmo's - Explorelearning.com
7. Google Apps for Education
8. Video Clips (from file / youtube.com)
9. Teacher websites

Overall Suggested Activities & Suggested Modifications for Special Education Students, ELL Students, Students at Risk, and Gifted Students:

- **ELL/Special Education Students:**
  - Provide ELL students with short lists of essential academic vocabulary terms to assist with language development such as word walls;
  - Provide ELL students with opportunities for peer to peer interactions;
  - Explicitly teach ELL students academic language and link to main ideas;
  - Support ELL students through the use of graphic organizers, modeling, and visual aides.
  - Support special education students through the use of physical activity, modeling, role-play, dialogue, reading assignments based on ability, etc.
- **Gifted Students**

  Gifted students may be challenged by asking them to form additional connections between biology, chemistry, and physics.

VI. Assessments

Each unit will have a variety of tests, quizzes, labs, projects, written homework assignments, presentations and class activities. These assessments will be geared toward the main learning objectives for each unit. In addition there will be a Midterm exam, Final exam, and Final project. Additional resources related to assessments for the NGSS may be located at the NGSS website.

VII. Cross Curricular Aspects

Science teachers will work with Algebra 1 teachers to enhance student understanding of graphing, equation calculations, and basic statistical analysis.

CCCS Literacy: Click on the link to the High School Evidence Statements to see expectations related to literacy for this unit. In addition, a focus of the course will be on the development of the LAL standards for science & technical subjects.

CCCS Math: Students will be expected to perform measurement, modeling, apply algebra, and geometry and statistics.

Interdisciplinary Connections and Alignment to Technology standards

Science classes in the Fair Lawn Public schools promote career-readiness skills related to Personal Financial Literacy (9.1) and Career Awareness, Exploration, and Presentation (9.2). Some course concepts from the Career and Technical Education Standards (9.3), but these are not directly correlated since our district is not a CTE program.

The Fair Lawn Public Schools District fosters an environment that promotes career-readiness skills in all content areas. Whereas Career Ready Practices are explored consistently, specific alignment to Personal Finance Literacy (9.1) and Career Awareness, Exploration, and Presentation Standards (9.2) are included in the district level document (below). When appropriate, the Career and Technical Education Standards (9.3) have been reviewed and aligned as well.

Examples: 9.2B: Career exploration in each unit of study.

In addition, every effort is made to integrate technology and engineering into our science classes. Educational Technology (8.1) and Technology Education, Engineering, Design, and Computational Thinking – Programming (8.2) standards are cross connected throughout our science programs.

Examples:

8.1A:	Use spreadsheets to analyze & interpret data from laboratories, 6-12.
	Use the internet to increase productivity and efficiency, 9-12.
8.1B,C:	Use data to solve real-world problems, 6-12.
	Use online platforms to collaborate & address global issues, 9-12.
8.1F:	Collect and analyze data using internet and data simulations, 6-12.
8.2A:	Become aware of the invention process, 3-5.
8.2B:	Become aware of the global impacts on technology, 6-12.
8.2C:	Apply the design process to pushes & pulls, K-2.
8.2D:	Use tools to reduce work, K-2.

For additional detail on how these standards are integrated throughout the Fair Lawn Schools curriculum, review the Fair Lawn Public Schools District Alignment to Technology & Career Readiness & 21st Century Skills Standards Curriculum Appendix.