Washington Township School District

The mission of the Washington Township Public Schools *is to provide a safe, positive, and progressive educational environment that provides opportunity for all students to attain the knowledge and skills specified in the NJ Learning Standards at all grade levels, so as to ensure their full participation in an ever-changing world as responsible, self-directed and civic-minded citizens.*

Course Title:	**Advanced Science**
Grade Level(s):	**8th**

Duration:	*Full Year:*	**X**	*Semester:*		*Marking Period:*	
Course Description:	**The Washington Township School District eighth grade science curriculum uses an integrated approach to general science that focuses with units on physical, life, and earth science. By using this approach, teachers are able to meets the needs of all students while aligning with the New Jersey Model Curriculum and the Next Generation Science Standards. Hands on activities are stressed and include student discovery, laboratory experiments, problem solving, model building, cooperative learning, computer usage, classroom discussion, teacher demonstrations, and writing opportunities for research and self-expression. Interdisciplinary subject areas are incorporated whenever possible. Students are introduced to the use of scientific tools and methods used for investigations.**					
Grading Procedures:	Tests/ Labs/Projects - 50% Quizzes – 35% Homework/Class work – 15%					
Primary Resources:	Next Generation Science Standards NGSS, New Jersey Student Learning Standards NJSLS, New Jersey Model Curriculum Grade 8 Pearson Realize 21st Century Learner Framework					

Washington Township Principles for Effective Teaching and Learning

- Implementing a standards-based curriculum
- Facilitating a learner-centered environment
- Using academic target language and providing comprehensible instruction
- Adapting and using age-appropriate authentic materials
- Providing performance-based assessment experiences
- Infusing 21st century skills for College and Career Readiness in a global society

Designed by:	Joann Braker and Susan Flaherty

Under the Direction of:	Dr. Patricia Hughes

Written: _____

Revised: _____

BOE Approval: _____

Unit Title: Science Skills

Unit Description: Students will be reinforce skills required to be successful in the science classroom. In the first part, students will review the scientific method with emphasis on data collection, analysis, and drawing and supporting conclusions. In the second part students will work on scientific measurement and graphing using mathematical skills.

Unit Duration: about six weeks

Desired Results

Standard(s):

Part 1 - Using Scientific Inquiry – MS-ETS1-1, MS-ESS3-5

Part 2 - Mathematics and Models in Science – MS-ETS1-1

Indicators:

Part 1 - ETS1.B Developing Possible Solutions, ETS1.C Optimizing the Design Solution, ESS3.C Human Impacts on Earth Systems, ESS3.D Global Climate Change

Part 2 - ETS1.C Optimizing the Design Solution

Understandings:

Students will…

Part one

Lesson one

- Gather and synthesize information to identify skilled scientists use to learn about the world

Lesson two

- Gather and synthesize information to explain what scientific investigations involve
- Compare and contrast scientific thinking and nonscientific thanking
- Apply scientific principles to explain it characterizes science and its methods

Lesson three

- Apply scientific principles to explain what scientific inquiry is and how involves posing questions and developing hypotheses
- Design and construct an experiment that uses sound scientific principles
- Gather and synthesize information to compare how scientific explanation that developed an experimental sciences and historical sciences

Lesson four

- Construct a scientific explanation based on evidence for what scientific illiteracy is and why it is important
- Develop and use models to explain how to analyze scientific claims using scientific reasoning
- Gather and synthesize information to describe how to conduct background research on a scientific question and evaluate sources of information

Part two

Lesson one

Essential Questions:

Part 1 – Using Scientific Inquiry

- How do science and society affect each other?

Part 2 - Mathematics and Models in Science

- How do scientists use and measurement and mathematics?

- Apply scientific principles to explain why scientists use a standard measurement system
- Use mathematical representations to identify the SI units of measure for length, mass, volume, density, time, and temperature

Lesson two

- Gather and synthesize information to describe what math skills scientists use and collecting data in making measurements
- Apply scientific principles to identify the math tools scientists used to analyze data

Lesson three

- Use graphical displays to explain what kinds of data goal line grants can display

Lesson four

- Gather and synthesize information to explain how models are used in science
- Apply scientific principles to describe different types of systems and identify characteristics that all systems share
- Apply scientific principles to examine models of natural systems and compare the model to the system itself

Lesson five

- Apply scientific principles to explain why preparation is important in carrying out investigations in the lab and in the field
- Gather and synthesize information to describe what to do if an accident occurs

Assessment Evidence

Performance Tasks:

- Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
- Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system
- Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
- Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer
- Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.
- Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.
- Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.
- Integrate qualitative scientific and technical information to support the claim that digitized signals (sent as

Other Evidence:

Lesson quizzes, Chapter Tests, Labs

Performance Assessments
Part 1 Lab: Become a Learning Detective
Part 2 Lab: Selecting Models

wave pulses) are a more reliable way to encode and transmit information than analog signals.	

Benchmarks: To be determined

Learning Plan

Learning Activities:

Part 1: Using Scientific Inquiry

- **Introduce the Big Q** and students will answer question
- Watch Untamed Science video “DNA Crop Dusters"
- Preview vocabulary
- Complete Scenario Investigation **Casting a Vote That Makes Sense**

Lesson 1: How Scientists Work

- Introduce Vocabulary
- Read **My Planet Diary**
- Students will do the **Inquiry Warm-Up activity** and complete the **After the Inquiry Warm-Up** Worksheet
- Review the terms qualitative and quantitative observation
- Help students understand that scientists use specific skills when conducting an investigation into the natural world such as observing, classifying, making models, inferring, predicting, and analyzing
- Discuss how scientists use the skills as they form and test their ideas through scientific investigation
- Discuss inferring and predicting and help students distinguish between the two
- **Quick Lab:** Scientific Skills
- Practice calculations involving piclitaxel in the **Do The Math** activity
- **Support the Big Q** to emphasize how science and society affect each other
- Review Key Concepts and administer lesson quiz

Lesson 2: The Characteristics of Scientific Knowledge

- Introduce Vocabulary
- Read **My Planet Diary**
- Students will do the **Inquiry Warm-Up** activity and complete the **After the Inquiry Warm-Up** Worksheet
- Explain that scientific investigations involve collecting evidence and using that evidence to make inferences and draw conclusions
- **Support the Big Q** by using animal research to discuss how science affect society, and vice versa
- Clearly differentiate science and pseudoscience
- Point out that science and its methods are characterized by an ordered approach to learning about the world
- Explain that this approach relies on objective analysis of data
- **Quick Labs:** Activities of Science, Science and Its Method, and/or Science Thinking
- **Apply it** A**ctivity**
- Review Key Concepts and administer lesson quiz

Lesson 3: Designing an Experiment

- Introduce Vocabulary
- Read **My Planet Diary**
- Students will do the **Inquiry Warm-Up activity** and complete the **After the Inquiry Warm-Up** Worksheet
- Explain the scientific inquiry process
- Discuss how observations lead to a strong hypothesis
- Explain the role of hypotheses and experimental design
- Discuss possible sources of error and experimental design
- Review graphing, reading graphs, and using graphs to make predictions in the **Do the Math** activity
- **Open Inquiry:** Becoming a Learning Detective
- **Apply it Activity**: analyze experimental results and identify experimental bias

- **Support the Big Q** to discuss a scientific results affect society
- Discuss scientific explanations
- **Quick Labs:** How Can You Explain It? And/or Starts With a Question
- Review Key Concepts and administer lesson quiz

Lesson 4: Scientific Literacy

- Introduce Vocabulary
- Read **My Planet Diary**
- Students will do the **Inquiry Warm-Up** activity and complete the **After the Inquiry Warm-Up** Worksheet
- Explain that scientific literacy is knowing where to find scientific information how to evaluate and apply it to everyday life
- Discuss the difference between evidence and opinions
- Explain that when students encounter a scientific claim, they can use scientific reasoning to analyze and make sense of it
- **Apply it Activity**
- Explain that to make decisions and design experiments effectively, they need to do research to grab gather relevant, reliable background information
- **Explore the Big Q**: use figure four to discuss the interaction of science and society using the plastic bottle as an example
- **Answer the Big Q**: discuss how science and society affect each other
- **Quick Labs:** Analyzing Claims, Scientific Literacy Survey, and/or Source of Information
- Review Key Concepts and administer lesson quiz

Part 2: Mathematics and Models in Science

Introduce the Big Q and students will answer question

- Watch Untamed Science video “Meters and Liters and Grams, Oh My!"
- Preview vocabulary
- Complete STEM Activity **Flipping the Switch**

Lesson 1: Scientific Measurement

- Introduce Vocabulary
- Read **My Planet Diary**
- Students will do the **Inquiry Warm-Up** activity and complete the **After the Inquiry Warm-Up** Worksheet
- Review the prefixes used in SI and how each prefix relates to the number 10
- Help students understand the advantages of a standard system of measurement
- Explain a standard measurement system helps scientists compare data and share results
- **Do the math** activity to emphasize how the SI measurements increase or decrease based on powers of 10
- Introduced SI unit for length
- Define mass in weight and identify the SI unit for each
- Discuss the difference between mass and weight
- The fine volume and identify the SI units used to measure volume
- Discuss how to measure the volume of your regular solids
- Introducing defined density and identify the SI units used to measure density
- **Apply it activity**
- Introduce the SI unit for time and temperature
- **Quick Labs**: A Unit of SI and/or Measuring With SI
- Review Key Concepts and administer lesson quiz

Lesson 2: Mathematics and Scientific Thinking

- Introduce Vocabulary
- Read **My Planet Diary**
- Students will do the **Inquiry Warm-Up** activity and complete the **After the Inquiry Warm-Up** Worksheet
- Discuss when using estimates are useful
- Use figure 1 to give students practice in estimating
- Use figure 2 so students can gain practice distinguishing between accuracy and precision
- Make an analogy for accuracy and precision by comparing a drill team and a marching band
- Discuss how precision is influenced by the equipment used to measure
- Explain significant figures using figure 3
- Explain how math tools allow you to analyze data see you can draw conclusions
- Use figure 4 to teach mean, medium, mode, and range
- Discuss the importance of these math tools, anomalous data, and percent error

- **Explore the Big Q** by evaluating the precision of density calculations
- **Quick Labs**: Is It Accurate and/or Math Tools in Science
- Review key concepts and administer lesson quiz

Lesson 3: Using Graphs in Science

- Introduce Vocabulary
- Read **My Planet Diary**
- Students will do the **Inquiry Warm-Up** activity and complete the **After the Inquiry Warm-Up** Worksheet
- Explain the grass illustrate different types of data
- Discuss the difference between linear and non-linear graphs
- Explain how outliers on a graph indicate anomalous data
- **Apply it activity**: practice plotting a non-linear graphs and using the graphs to recognize anomalous data
- **Support the Big Q** to review the ways in which graphs are in mathematical tool for scientists
- **Quick Lab:** Recognizing Trends (using Vernier Probes)
- Review key concepts and administer lesson quiz

Lesson 4: Models and Systems

- Introduce Vocabulary
- Read **My Planet Diary**
- Students will do the **Inquiry Warm-Up** activity and complete the **After the Inquiry Warm-Up** Worksheet
- Explain that scientists use models to observe things they cannot see directly
- Defined system and point out the three components (input, process, and output) that every system has
- Explain how models are helpful and understanding systems
- **Apply it Activity**
- **Support the Big Q** by discussing how measurement and mathematics can be used to make models
- Discuss how assumptions are made and checked in science as in daily life
- **Open Inquiry**: Selecting Models
- **Quick Labs**: Characteristics of Systems and/or Working With Models
- Review Key Concepts and administer lesson quiz

Lesson 5: Safety in the Science Laboratory

- Introduce Vocabulary
- Read **My Planet Diary**
- Students will do the **Inquiry Warm-Up** activity and complete the **After the Inquiry Warm-Up** Worksheet
- Discuss two things students should do before beginning any scientific investigation
- Observe the photo of students working in the field
- Use figure 1 to lead a thorough discussion of laboratory safety procedures
- **Support the Big Q** by asking students why scientists follow safety precautions
- Use figure 2 to discuss proper care of animals
- Explain proper procedures to follow in case of an accident
- Use figure 3 to discuss safety equipment
- **Quick Labs:** Be Prepared to Be Safe in the Field and/or How Would You Respond to These Emergencies?
- Review Key Concepts and administer lesson quiz

Resources:

Interactive Science Program

Vernier Lab Pro™ Equipment (Thermometers)

Unit Learning Goal and Scale *(Level 2.0 reflects a minimal level of proficiency)*	
Standard(s): MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.	
4.0	**Students will be able to:** • In addition to score 3.0 performance, the student demonstrates in-depth inferences and applications that go beyond what was taught.
3.0	**Students will be able to:** • Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
2.0	**Students will be able to:** • Recognize and recall specific vocabulary (with 80% success): science, observing, quantitative observation, qualitative observation, classifying, inferring, predicting, analyzing, skepticism, data, empirical evidence, objective reasoning, subjective reasoning, pseudoscience, scientific inquiry, hypothesis, independent variable, dependent variable, controlled experiment, bias, repeated trial, replication, scientific explanation, scientific literacy, evidence, opinion, metric system, International System of Units (SI), mass, weight, volume, meniscus, density, estimate, accuracy, precision, significant figures, mean, median, mode, range, anomalous data, percent error, graph, linear graph, nonlinear graph, outlier, model, system, input, process, output, feedback, field
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Standard(s): MS – ESS 3-5: Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.	
4.0	**Students will be able to:** • In addition to score 3.0 performance, the student demonstrates in-depth inferences and applications that go beyond what was taught.
3.0	**Students will be able to:** • Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.
2.0	**Students will be able to:** • Recognize and recall specific vocabulary (with 80% success): reflection, refraction, diffraction, interference, constructive interference, destructive interference, standing wave, node, antinode, resonance, density, music, fundamental tone, overtone, ear canal, eardrum, cochlea, echolocation, ultrasound, sonar, sonogram, transparent, translucent, opaque, primary color, secondary color, complementary color, pigment, ray, regular reflection, image, diffuse reflection, plane mirror, virtual image, concave mirror, optical axis, focal point, real image, convex mirror, index of refraction, mirage, lens, concave lens, convex lens, cornea, pupil, iris, retina, rods, cones, optic nerve, nearsighted, farsighted, camera, telescope, refracting telescope, objective, eyepiece, reflecting telescope, microscope • Describe the reflection, absorption, and transmission of waves.
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Unit Modifications for Special Population Students	
Advanced Learners	Enrichment Worksheets and Scenario Investigations

Struggling Learners	Use L1 Differentiated Instruction Activities
English Language Learners	Use ELL Support Activities from lesson as needed. http://www.state.nj.us/education/modelcurriculum/ela/ELLSupport.pdf
Special Needs Learners	Follow IEP modifications and work with special education teacher to make modifications and use L1 Differentiated Instruction Activities. http://www.nj.gov/education/udl/

Interdisciplinary Connections

Indicators:

ELA:

- Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
- Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
- Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.

MATH:

- Use mathematical representations to identify the SI units of measure for length, mass, volume, density, time, and temperature
- Write, interpret, and explain statements of order for rational numbers in real-world contexts
- Summarize numerical data sets in relation to their context.
- Model with mathematics.

Integration of 21st Century Skills

Indicators:

To function in the 21st Century work place a variety of skills need to be developed and strengthened some of those would be:

• Developing and Using Models
• Planning and Carrying Out Investigations [supported in the science lab setting but useful in many aspects of life]
• Constructing Explanations and Designing Solutions [supporting explanations with research and experimentation]
• Engaging in Argument from Evidence
• Analyzing and Interpreting Data [collected during labs or proposed scenarios]
• Creativity and Innovation [brainstorm, collaborate and incorporate group ideas]
• Critical Thinking and Problem Solving [Follow the steps of the scientific method.]
• Communication and Collaboration [All types of communication are needed - oral, written and nonverbal communication in a variety of forms and contexts. It is also importanat to be able to listen effectively to decipher meaning, including knowledge, values, attitudes and intentions.]
• Flexibility and Adaptability [Adapt to varied roles, jobs and responsibilities, schedules and contexts.]
• Initiative and Self-Direction [Set goals, balance short-term and long-term goals. Utilize time and manage workload efficiently. Monitor, define, prioritize, and complete tasks without direct oversight. Demonstrate commitment to learning as a lifelong process. Reflect critically on past experiences to continue to improve.]
• Social and Cross-Cultural Skills [Know when it is appropriate to listen and when to speak. Conduct themselves in a respectable manner. Learn and respect cultural differences and work effectively with people from a range of social and cultural backgrounds. Respond open-mindedly to different ideas and values.]
• Productivity and Accountability Set and meet goals, even in the face of obstacles.]
• Leadership and Responsibility [Use interpersonal and problem-solving skills to influence and guide others toward a goal. Inspire others to reach their very best via example and selflessness. Demonstrate integrity and ethical behavior in using influence and power. Act responsibly with the interests of the larger community in mind.]

Unit Title: Life Science

Unit Description: Students will be introduced to major theme concepts of biology. Students will learn about Darwin's theory of Natural Selection, how species change over time and evidence of biological change.

Unit Duration: about three weeks

Desired Results

Standard(s):

Change over Time- MS-LS4-4

Indicators:

LS4.A Evidence of Common Ancestry and Diversity, LS4.B Natural Selection, LS4.C Adaptation

Understandings:

Students will…

Chapter 1

Lesson 1

- Apply scientific principles to describe how Darwin's observations helped him to develop his hypothesis.
- Use scientific principles to explain how natural selection leads to evolution.

Lesson 2

- Construct an explanation based on evidence that supports the theory of evolution.

Lesson 3

- Gather and synthesize information to explain how new species form.
- Apply scientific principles to identify the two patterns that describe the rate of evolution.

Essential Questions:

Chapter 1 – Change over Time

How do life forms change over time?

Assessment Evidence

Performance Tasks:

- Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on earth under the assumption that natural laws operate today as in the past.
- Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.
- Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.
- Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.
- Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.

Other Evidence:

Lesson quizzes, Chapter Tests, Labs

Performance Assessments:

Chapter 1 Lab: Nature at Work or

Chapter 1 Scenario Investigation: Worms Under Attack

• Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.	

Benchmarks: To be determined

Learning Plan

Learning Activities:

Chapter 1: Changes over time

- To teach this lesson with an emphasis on inquiry, begin by **Introducing the Big Q** and students will answer question
- Watch Untamed Science video "Why Would a Fish Have Red Lips?"; students will discuss what they know about how organisms adapt to their environments
- Preview vocabulary
- Complete Scenario Investigation **Worms Under Attack**

Lesson 1: Darwin's Theory

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up activity**. Students will observe variation in sunflower seeds. The After the Inquiry Warm-Up worksheet sets up a discussion about how sunflower seeds are alike and different. Have volunteers share their answers to question 4 by giving their conclusions about how sunflower seeds are alike and different.
- Focus on the Inquiry Skill for the lesson. Remind students that a hypothesis is not a guess. Scientists base their hypotheses on observations and previous knowledge. Develop a hypothesis about the differences in sunflower seeds observed in the **Inquiry Warm-Up Activity**? (Sample: The seeds were different because they came from different plants that had been grown in different climates.)
- Build Inquiry to give students the opportunity to interpret scientific drawings.
- Before beginning the **Apply It Activity**, help student recall the different traits that Darwin observed in tortoises and finches, and his explanation for the differences.
- Have students do the Quick Lab to explore adaptations in birds.
- Explore the Big Q by using Figure 5 to discuss natural selection.
- Build Inquiry by having students identify and record adaptations that allow plants and animals to better survive in their environments.
- Do the Lab Investigation by having students make a model to simulate natural selection in mice.
- Answer the Big Q by leading a class discussion about how living things change over time.
- Have students take the Lesson Quiz.

Lesson 2: Evidence of Evolution

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up activity**. Students will classify different objects to model classification of species. The After the Inquiry Warm-Up worksheet sets up a discussion about classifying objects by traits. Have volunteers share their answers to question 4 by reading their statements relating birds that have brown feathers and live in pine trees to the survival of all birds in this forest.
- Focus on the Inquiry Skill for the lesson. Remind students that while communication between friends may be loose and casual, communication among scientists must be detailed and precise. Why was it important to carefully count the number of pens in each group in the **Inquiry Warm-Up Activity**? (If the counts were not correct, the conclusion might have been wrong.)
- Support the Big Q by discussing why homologous structures evolved differently.
- Do the Build Inquiry to allow students to identify similar, important features of the body plan and internal functions of vertebrates.
- Before beginning the **Apply It Activity**, have students practice interpreting the table.
- Have students do the Quick Lab exploring fossil formation by modeling molds and casts.
- Have students take the Lesson Quiz.

Lesson 3: Rate of Change

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up activity**. Students will place biological events on a timeline of Earth's history. The After the Inquiry Warm-Up worksheet sets up a discussion about a timeline showing the development of life on Earth. Have volunteers share their answers to question 4 about how long dinosaurs lived on Earth.
- Focus on the Inquiry Skill for the lesson. Remind students that there are many types of models, including drawings, diagrams, and computer images. Point out that making models helps people understand things that they cannot see directly. What type of model was used in the **Inquiry Warm-Up Activity**? (A timeline)

- Have students do the Quick Lab by looking at a map of Pangaea and speculating on how Australia's breaking away could have led to the formation of new species.
- Support the Big Q by discussing how the two theories of evolution could both be accurate.
- Before beginning the **Apply It Activity**, review the theory of punctuated equilibrium. Stress that in punctuated equilibrium, long periods of little or no change separate short periods of rapid change.
- Have students do the Quick Lab by exploring gradualism and punctuated equilibrium as they observe the evolution of imaginary species.
- Have students take the Lesson Quiz.
- Have students take the chapter assessment

Resources:
Interactive Science Program
Vernier Lab Pro™ Equipment (Thermometers)

Unit Learning Goal and Scale *(Level 2.0 reflects a minimal level of proficiency)*	
Standard(s): MS-LS4-4 Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.	
4.0	**Students will be able to:** • In addition to score 3.0 performance, the student demonstrates in-depth inferences and applications that go beyond what was taught.
3.0	**Students will be able to:** • Use simple probability statements and proportional reasoning to defend the claim that genetic variation of traits in a population increase some individuals' probability of surviving and reproducing.
2.0	**Students will be able to:** • Recognize and recall specific vocabulary (with 80% success): species, fossil, adaptation, evolution, scientific theory, natural selection, variation, homologous structures, gradualism, punctuated equilibrium • Describe how genetic variation of traits in a population increase some individuals' probability of surviving and reproducing
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Unit Modifications for Special Population Students	
Advanced Learners	Enrichment Worksheets and Scenario Investigations
Struggling Learners	Use L1 Differentiated Instruction Activities
English Language Learners	Use ELL Support Activities from lesson as needed. http://www.state.nj.us/education/modelcurriculum/ela/ELLSupport.pdf
Special Needs Learners	Follow IEP modifications and work with special education teacher to make modifications and use L1 Differentiated Instruction Activities. http://www.nj.gov/education/udl/

Interdisciplinary Connections

Indicators:

ELA:

- Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions
- Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
- Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
- Draw evidence from informational texts to support analysis, reflection, and research.
- Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.
- Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.

- Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.
- Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources.

MATH:

- Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.
- Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.
- Summarize numerical data sets in relation to their context.
- Recognize and represent proportional relationships between quantities.

Integration of 21st Century Skills

Indicators:

To function in the 21st Century work place a variety of skills need to be developed and strengthened some of those would be:

• Developing and Using Models
• Planning and Carrying Out Investigations [supported in the science lab setting but useful in many aspects of life]
• Constructing Explanations and Designing Solutions [supporting explanations with research and experimentation]
• Engaging in Argument from Evidence
• Analyzing and Interpreting Data [collected during labs or proposed scenarios]
• Creativity and Innovation [brainstorm, collaborate and incorporate group ideas]
• Critical Thinking and Problem Solving [Follow the steps of the scientific method.]
• Communication and Collaboration [All types of communication are needed - oral, written and nonverbal communication in a variety of forms and contexts. It is also importanat to be able to listen effectively to decipher meaning, including knowledge, values, attitudes and intentions.]
• Information Literacy [Use information accurately and creatively for the issue or problem at hand.]
• Media Literacy [Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of media.]
• ICT (Information, Communications and Technology) Literacy [Use technology as a tool to research, organize, evaluate and communicate information.]
• Flexibility and Adaptability [Adapt to varied roles, jobs and responsibilities, schedules and contexts.]
• Initiative and Self-Direction [Set goals, balance short-term and long-term goals. Utilize time and manage workload efficiently. Monitor, define, prioritize, and complete tasks without direct oversight. Demonstrate commitment to learning as a lifelong process. Reflect critically on past experiences to continue to improve.]
• Social and Cross-Cultural Skills [Know when it is appropriate to listen and when to speak. Conduct themselves in a respectable manner. Learn and respect cultural differences and work effectively with people from a range of social and cultural backgrounds. Respond open-mindedly to different ideas and values.]
• Productivity and Accountability Set and meet goals, even in the face of obstacles.]
• Leadership and Responsibility [Use interpersonal and problem-solving skills to influence and guide others toward a goal. Inspire others to reach their very best via example and selflessness. Demonstrate integrity and ethical behavior in using influence and power. Act responsibly with the interests of the larger community in mind.]

Unit Title: Earth Science

Unit Description: Students will be introduced to earth science concepts. The students will learn what causes climate, global climate regions, and changes in climate, and how human activity affects it. Students will learn about fossil fuels, renewable energy and conservation. Students will be introduced to environmental issues, natural resources, and population issues and propose and analyze potential solutions.

Unit Duration: about twelve weeks

Desired Results

Standard(s):

Climate and Climate Change – MS-ESS3-3; MS -ESS3-5; MS-ESS2-6

Energy Resources – MS -ESS3-3; MS-ESS3-4; MS-ESS3-1

Land, Air and Water Resources – MS-ESS3-3

Indicators:

ESS3.D Global Climate Change; ESS3.C Human Impact on Earth Systems; ESS2.D Weather and Climate

ESS3.C Human Impact on Earth Systems; ESS3.B Natural Hazards; ESS3.A Natural Resources

ESS3.C Human Impact on Earth Systems; ESS3.B Natural Hazards; ESS3.A Natural Resources

Understandings:

Students will…

Chapter 2

Lesson 1

- Apply scientific principles to identify factors that influence temperature.
- Construct a scientific explanation based on evidence to identify factors that influence precipitation.

Lesson 2

- Analyze and interpret data to identify factors used to define climates.
- Apply scientific principles to describe the six main climate regions.

Lesson 3

- Construct a scientific explanation based on evidence to explain the principle scientists follow in studying ancient climates.
- Apply scientific principles to identify natural factors that can cause climate change.

Lesson 4

- Apply scientific principles to explain how human activities are affecting the temperature of the atmosphere.

Chapter 3

Lesson 1

- Gather and synthesize information about the three major fossil fuels.
- Apply scientific principles to explain why fossil fuels are considered nonrenewable resources.

Lesson 2

- Gather and synthesize information about renewable sources of energy.
- Interpret information to explain how a nuclear power plant produces electricity.

Lesson 3

Essential Questions:

Chapter 2 – Climate and Climate Change
What factors affect Earth's climate?

Chapter 3 – Energy Resources
What are some of Earth's Energy Resources?

Chapter 4 – Land, Air and Water Resources
What can people do to use resources wisely?

- Gather and synthesize information to explain how human energy use has changed over time.
- Apply scientific ideas to describe ways to ensure that there will be enough energy for the future.

Chapter 4
Lesson 1
- Gather and synthesize information to identify the general categories of environmental issues.
- Explore how decision makers evaluate and balance opposing needs and concerns when establishing environmental policy.

Lesson 2
- Gather and synthesize information to explain what natural resources are and distinguish between renewable and nonrenewable resources.
- Apply scientific principles to explain why natural resources are important.

Lesson 3
- Gather and synthesize information to describe how people use land.
- Develop and use models to explain why soil management is important.

Lesson 4
- Use graphical displays to identify three methods of solid waste disposal.
- Apply scientific principles to identify ways people can help control the solid waste problem.
- Gather and synthesize information to describe proper disposal of hazardous wastes.

Lesson 5
- Gather and synthesize information to identify the causes of indoor and outdoor air pollution.
- Develop and use models to explain the importance of the ozone layer and how it has been damaged.
- Construct a scientific explanation based on evidence to explain the key to reducing air pollution

Lesson 6
- Construct a scientific explanation based on evidence to explain why fresh water is a limited resource.
- Use graphical displays to identify the major sources of water pollution.
- Apply scientific principles to suggest possible solutions for reducing water pollution.

Assessment Evidence

Performance Tasks:

- Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.
- Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact earth's systems.

Other Evidence:

Lesson quizzes, Chapter Tests, Labs

Performance Assessments

Chapter 2 Lab: Sun Rays and Angles or

Chapter 2 Scenario Investigation: What Causes our Climate?

• Apply scientific principles to design a method for monitoring and minimizing human impact on the environment. • Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. • Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.	Chapter 3 Lab: Design and Build a Solar Cooker or Chapter 3 Scenario Investigation: Light bulbs Can't Use Much Energy. Chapter 4 Lab: Recycling Paper and Waste, Away! Or Chapter 4 Stem Activity: It's All Water Under the Dam

Benchmarks: To be determined

Learning Plan

Learning Activities:

Chapter 2: Climate and Climate Change

- To teach this lesson with an emphasis on inquiry, begin by **Introducing the Big Q** and students will answer question
- Watch Untamed Science video "Searching for the Perfect Climate."
- Preview vocabulary
- Complete Scenario Investigation **What Causes our Climate?**

Lesson 1: What Causes Climate?

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up activity**. Students will use a paper tube and flashlight to examine how the sunlight falls on Earth at various latitudes. Discuss the variables and potential sources of error in this activity. Have students do the After the Inquiry Warm-Up worksheet. Talk about what latitudes receive the most direct and least direct light rays from the sun. Have volunteers share their answers to number 4 about why the climates differ.
- Focus on the Inquiry Skill for the lesson. Point out that when you infer, you use data, observations, and knowledge to draw logical conclusions. What can be inferred about the climate of a location near the equator based on the **Inquiry Warm-Up activity**? (Places nearer to the equator get more sunlight and have warmer climates than those that are further away.)
- Use Support the Big Q to identify how latitude affects the temperature of locations.
- Do the Teacher Demo to model differences in air temperature based on altitude. Have students compare the temperatures of water and soil by doing the Build Inquiry activity.
- Review the factors that affect temperature before beginning the **Apply It Activity**. Ask volunteers to share their inferences.
- During the Lab Investigation, students will investigate how the surface temperature is affected by the angle of a light source.
- Have students do the Quick Lab to better understand the amount of precipitation received by different regions in the United States. Have them share their predictions.
- Have students take the Lesson Quiz.

Lesson 2: Climate Regions

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up activity**. Students will investigate weather characteristics of land areas around the world. Discuss how students organized the pictures into climate categories. Have students do the After the Inquiry Warm-Up worksheet. Talk about the landscape, weather, animals, and plants in each region. Have volunteers share their answers to number 4 about the plants and animals in their climate.
- Focus on the Inquiry Skill for the lesson. Point out that when you communicate, you share what you know with others, in an organized manner. What information can be communicated about one of the climate categories from the **Inquiry Warm-Up activity**? (Sample: I can communicate about the weather, plants, and animals that exist in a climate.)

- Have students do the Quick Lab to practice classifying climates by comparing precipitation data.
- During the Build Inquiry activity students will research and describe one specific climate region in a travel brochure.
- To Support the Big Q, compare and contrast rainy and dry climates.
- The second Build Inquiry activity allows students to investigate plant adaptations specific to climate regions.
- Review the six climographs before beginning the **Apply It Activity**. Ask volunteers to share their letters to the Olympic committee.
- Assign the Quick Lab to reinforce understanding of how to make and interpret a climograph.
- Have students take the Lesson Quiz.

Lesson 3: Changes in Climate

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up activity**. Students will investigate the rings of a tree in a photograph. Discuss the information that can be gathered from the tree rings. Have students do the After the Inquiry Warm-Up worksheet. Talk about the variations in the rings of the tree. Have volunteers share their answers to number 4 about the climate changes the tree endured throughout the course of its life.
- Focus on the Inquiry Skill for the lesson. Point out that when you interpret data, you analyze information in order to look for trends and patterns. What data could students interpret in the **Inquiry Warm-Up activity**? (Thickness of tree rings)
- Have students do the Quick Lab to explore clues about the climate from a tree's rings.
- Support the Big Q by discussing causes of climate changes that could occur during a student's lifetime.
- Do the Quick Lab to reinforce understanding of how movement of the Earth can affect the solar energy that reaches Earth.
- Have students take the Lesson Quiz.

Lesson 4: Human Activity and Climate Change

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up activity**. Students will create a greenhouse. Discuss how heat is trapped in a greenhouse. Have students do the After the Inquiry Warm-Up worksheet. Talk about how Earth's atmosphere is comparable to a greenhouse. Have volunteers share their answers to number 4 about what could happen if the greenhouse effect makes Earth too hot.
- Focus on the Inquiry Skill for the lesson. Point out that when you make a model, you replicate something to better understand it. What was modeled in the **Inquiry Warm-Up activity**? (The greenhouse effect)
- Review the information about "Efficient Energy" before beginning the **Apply It Activity**. Ask volunteers to share their models of energy efficient household items.
- Explore the Big Q by observing the image of the polar bear and discussing how global warming has affected its habitat.
- Do the Quick Lab to investigate how bubbles, trapped in ice, provide information about ancient climates.
- Ask students to identify the factors that affect Earth's climate to Answer the Big Q.
- Have students take the Lesson Quiz.
- Have students take chapter assessment

Chapter 3: Energy Resources

- To teach this lesson with an emphasis on inquiry, begin by **Introducing the Big Q** and students will answer question
- Watch Untamed Science video "Farming the Wind"
- Preview vocabulary
- Complete Scenario Investigation **Light Bulbs Can't Use Much Energy**

Lesson 1: Fossil Fuels

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up activity**. Students will examine a piece of coal. Discuss any evidence of organic remains found in the coal sample. Have students do the After the Inquiry Warm-Up worksheet. Talk about the various stages of coal formation that occur over the course of millions of years. Have volunteers share their answers to number 4 about the layers in the coal samples.
- Focus on the Inquiry Skill for the lesson. Explain that when you communicate, you share information, with others, in an organized format. What information did you communicate about fossil fuels in the Inquiry Warm-Up? (There is evidence of organic remains in coal.)
- Use the Support the Big Q to explain how fossil fuels are important sources of energy.
- The Build Inquiry Activity allows students to replicate coal formation using everyday materials. During the second Build Inquiry activity students classify coal samples from different stages of the formation process. Use Figure 4 and 5 to review how oil is formed and mined before beginning the **Apply It Activity**. Ask volunteers to share their letters to the editor. The third Build Inquiry activity helps students to calculate and ponder the magnitude of the gas pipelines in the United States.

- Give students the chance to observe the consistency of crude oil by doing the Quick Lab.
- Do the Lab Investigation to reinforce understanding of fossil fuels as nonrenewable resources.
- Have students take the Lesson Quiz.

Lesson 2: Renewable Source of Energy

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up activity**. Students will learn how solar energy is captured using a water-filled bag. Discuss how the location of the bag impacts the temperature of the water. Have students do the After the Inquiry Warm-Up worksheet. Talk about the temperature changes they recorded and where they captured the most solar energy. Have volunteers share their answers to number 4 about the impact of leaving the water in direct sunlight for a long duration of time.
- Focus on the Inquiry Skill for the lesson. Point out that when you infer, you use evidence or logical thinking to draw a conclusion. Build Inquiry with students to observe how heat is trapped inside a passive solar object.
- Review the term biomass and how to read a line graph before beginning the **Apply It Activity**. Ask volunteers to share their answers.
- Explore the Big Q by identifying energy sources represented in the illustrations.
- Have students work on the Quick Lab to reinforce understanding of how solar energy can warm food.
- Have students identify Earth's energy sources to Answer the Big Q.
- Build Inquiry to help students understand the potential disadvantages of nuclear power.
- Have students complete the Quick Lab to understand how electricity is produced.
- Have students take the Lesson Quiz.

Lesson 3: Energy Use and Conservation

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up activity**. Students will investigate incandescent and fluorescent light bulbs. Discuss the differences in efficiency between the two bulbs. Have students do the After the Inquiry Warm-Up worksheet. Talk about why it is more efficient to use a fluorescent light bulb. Have volunteers share their answers to number 4 comparing the brightness of the two types of light bulbs.
- Focus on the Inquiry Skill for the lesson. Point out that when you observe, you carefully watch something.
- Support the Big Q by using the timeline to identify various sources of energy used over the course of time.
- Have students do the Quick Lab to understand human energy use in the 20th century and then share their results.
- Use the Real World Inquiry to identify ways that energy can be conserved in a home. Build Inquiry by discussing energy conservation and efficiency in relation to the real world.
- Review transportation and energy conservation before beginning the **Apply It Activity**. Ask volunteers to share their posters and responses.
- Have students do the Quick Lab to learn how to increase efficiency of energy use and conserve energy.
- Have students take the Lesson Quiz.
- Have students take the chapter assessment

Chapter 4: Land, Air, and Water Resources

- To teach this lesson with an emphasis on inquiry, begin by **Introducing the Big Q** and students will answer question
- Watch Untamed Science video "Manatee Survival"
- Preview vocabulary
- Complete STEM Activity **It's All Water Under the Dam**

Lesson 1: Fossil Fuels

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up Activity**. Students will discuss decisions about important environmental issues and their impact. Discuss environmental issue decision-making. Have students do the After the Inquiry Warm-Up Worksheet. Talk about each question and the student or group response. Have volunteers share and compare their answers to number 4 about whether personal interest plays an important role in making decisions about the environment.
- Focus on the Inquiry Skill for the lesson. Point out that when you draw conclusions, you use information you already know to reach a decision.
- Have students do the Quick Lab to explore environmental issues and then share their results.
- Review costs and benefits before beginning the **Apply It Activity**.
- Use the Support the Big Q to discuss how population growth may affect natural resources.
- Have students do the second Quick Lab to compare more costs and benefits about environmental issues.
- Have students take the Lesson Quiz.

Lesson 2: Introduction to Natural Resources

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up Activity**. Students will investigate natural resources they use in a typical day. Discuss the types of resources mentioned. Have students

do the After the Inquiry Warm-Up Worksheet. Talk about the most important and most used resources. Have volunteers share their answers to number 4 about steps that can be taken to use less electricity daily.

- Focus on the Inquiry Skill for the lesson. Point out that when you calculate, you often find new information from existing information.
- Have students do the Quick Lab to further investigate natural resources and then share their results.
- Use the Support the Big Q to help students distinguish between essential and nonessential natural resources.
- Review ecological footprints before beginning the **Apply It Activity**. Ask volunteers to write another problem using the data in the table.
- Have students do the Lab Investigation to reinforce understanding of recycling paper.
- Have students take the Lesson Quiz.

Lesson 3: Conserving Land and Soil

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up activity**. Students will investigate how mining affects the land and what can be done to minimize its impact on the land. Discuss what happens to the land as mining is underway. Have the students do the After the Inquiry Warm-Up worksheet. Talk about what must be done to restore the land. Have volunteers share their answers to number 4 about effects on soil from digging.
- Focus on the Inquiry Skill for the lesson. Point out that when you infer, you combine the evidence that you observe with your prior experience or knowledge to draw a conclusion. What conclusion can be drawn from the results in the **Inquiry Warm-Up activity**? (Knowing where the minerals are located before beginning to mine for them lessens the impact of mining on the land.)
- Have students do the Quick Lab and then share their results.
- Conduct the Teacher Demo. Have students identify the various layers and compare them using the terms from Figure 2.
- Use the Support the Big Q to discuss the role that land reclamation plays in using our resources wisely.
- Review desertification before beginning the **Apply It Activity**. Ask volunteers to share their findings.
- Have students do the Quick Lab to learn about erosion and how to prevent it.
- Have students take the Lesson Quiz.

Lesson 4: Waste Disposal and Recycling

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up activity**. Students will classify trash to determine the most common types. Have students do the After the Inquiry Warm-Up worksheet. Talk about the most common materials in household trash and the possibilities for recycling. Have volunteers share their answers to number 4 about how recycling would cut down on the amount of household trash.
- Focus on the Inquiry Skill for the lesson. Point out that a graph can be used to compare pieces of information. Explain that the graph compares usage of three methods of municipal waste disposal. What conclusions can students make from categorizing trash in the **Inquiry Warm-Up activity**? (There are two common types of household waste.)
- Review incineration, sanitary landfill, and recycling before beginning the **Apply It Activity**.
- Use the Support the Big Q activity to discuss how reuse and recycling are alike and different.
- Review the term leachate before doing the Teacher Demo to show how chemicals in discarded materials in landfills can pollute groundwater.
- Have students do the Lab Investigation to reinforce students' understandings of the importance of properly designed landfills.
- Review the term biodegradable before doing the Build Inquiry. Have students predict which items are biodegradable.
- The next Build Inquiry activity allows students to determine how many trees would be required to produce a year's worth of a daily newspaper.
- Have the students do the Quick Lab and then share their findings about the recycling numbers of plastic products.
- Have students do the last Quick Lab and share their findings about the decay of radioactive materials.
- Have students take the Lesson Quiz.

Lesson 5: Air Pollution and Solutions

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up activity**. Students will try to detect a scent and then describe the way in which the scent spreads throughout the room. Have students do the After the Inquiry Warm-Up worksheet. Discuss their prediction about what would happen if certain variables of the activity were changed. Have volunteers share their answers to number 4 about designing a new experiment to compare the direction and speed at which other scents spread.
- Focus on the Inquiry Skill for the lesson. Point out that when you communicate, you are share ideas with others through writing and speaking. What role did communication play in the **Inquiry Warm-Up Activity**? (The accuracy of communicating the arrival of the scent determined the outcome of the experiment)
- Assign the Build Inquiry activity. Ask students to predict the effects of air pollutants on the nylon fabric.

- Review the cause, forms, and effects of acid rain and have students do the **Apply It Activity**.
- Build Inquiry to help students identify indoor pollutants.
- Assign the Quick Lab activity and then have students share their results about the levels of acid rain in your area.
- Continue to Build Inquiry by challenging students to create a model of the ozone cycle. Have students present their models to the class.
- Assign the Quick Lab on creating models of oxygen and ozone molecules.
- Use the Support the Big Q activity to help students understand how they can make changes in their everyday activities and reduce air pollution.
- Assign the Quick Lab and the ask students to discuss the solid particles they found in indoor air and outdoor air.
- Have students take the Lesson Quiz.

Lesson 6: Water Pollution and Solutions

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up activity**. Students will investigate how pollutants change water by observing how water changes when milk is added to it. Have students do the After the Inquiry Warm-Up worksheet. Talk about the effects of pollutants on water. Have volunteers share their answers to number 4 about the distribution of pollutants in water.
- Focus on the Inquiry Skill for the lesson. Remind students that when they design experiments, they seek to test a hypothesis. Have students state a hypothesis for the experiment in the Inquiry Warmup activity. (Sample: By adding milk to water the mixture will become cloudy and reduce the clarity of the water.)
- Have students do the first Quick Lab to model distribution of Earth's water and then share their results.
- Assign the next Quick Lab on cleaning up oil spills. Students will model the difficult process of removing oil from water.
- Review the term groundwater before beginning the **Apply It Activity**. Ask volunteers to share their pros and cons of using bacteria to clean up oil spills.
- Use the aerial photograph in Figure 4 to Explore the Big Q. Have students identify the potential sources of air pollution and water pollution.
- Do the Teacher Demo to model an oil spill clean-up. Discuss the implications of a much larger spill.
- Have students do the Quick Lab to model the way fresh water is purified in the water cycle.
- Answer the Big Q by leading a discussion about how people can use resources wisely.
- Have students take the Lesson Quiz.
- Have students take the Chapter Assessment.

Resources:
Interactive Science Program
Vernier Lab Pro™ Equipment (Thermometers, pH sensors)

Unit Learning Goal and Scale *(Level 2.0 reflects a minimal level of proficiency)*	
Standard(s): ESS2-6 Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates	
4.0	**Students will be able to:** • In addition to score 3.0 performance, the student demonstrates in-depth inferences and applications that go beyond what was taught.
3.0	**Students will be able to:** • Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates
2.0	**Students will be able to:** • Recognize and recall specific vocabulary (with 80% success): climate, tropical zone, polar zone, temperate zone, marine climate, continental climate, windward, leeward, monsoon,rain forest, savanna, steppe, desert, humid subtropical, tundra, permafrost, ice age, aerosol, sunspot, greenhouse gas, fossil fuel, global warming
1.0	**With help, partical success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Standard(s): MS – ESS 3-1: Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.	
4.0	**Students will be able to:** • In addition to score 3.0 performance, the student demonstrates in-depth inferences and applications that go beyond what was taught.
3.0	**Students will be able to:** • Explain how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.
2.0	**Students will be able to:** • Recognize and recall specific vocabulary (with 80% success): Fuel, fossil fuel, hydrocarbon, petroleum, refinery, petrochemical, solar enery hydroelectric power, biomass fuel, gasohol, geothermal energy, nuclear fission, reactor vessel, fuel rod, natural resource, renewable resource, nonrenewable resource, topsoil, groundwater • Describe the relationship between mineral resources and geoscience processes • Describe how the distribution of various resources occurs.
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Standard(s): MS – ESS 3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.	
4.0	**Students will be able to:** • In addition to score 3.0 performance, the student demonstrates in-depth inferences and applications that go beyond what was taught.
3.0	**Students will be able to:** • Design a method for monitoring and minimizing a human impact on the environment.
2.0	**Students will be able to:** • Recognize and recall specific vocabulary (with 80% success): Efficiency, insulation, energy conservation, litter, pollutant, point source, nonpoint source, sustainable use, conservation, pesticide, sewage, sediment • Describe how humans have impacted the environment

	• Describe how possible solutions mitigate human impacts
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Standard(s): MS – ESS 3-4: Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.	
4.0	**Students will be able to:** • In addition to score 3.0 performance, the student demonstrates in-depth inferences and applications that go beyond what was taught.
3.0	**Students will be able to:** • Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.
2.0	**Students will be able to:** • Recognize and recall specific vocabulary (with 80% success): municipal solid waste, incineration, pollutant, leachate, sanitary landfill, recycling, biodegradable, hazardous waste • Describe impacts of the increasing human population and consumption of natural resources.
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Standard(s): MS – ESS 3-5: Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.	
4.0	**Students will be able to:** • In addition to score 3.0 performance, the student demonstrates in-depth inferences and applications that go beyond what was taught.
3.0	**Students will be able to:** • Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.
2.0	**Students will be able to:** • Recognize and recall specific vocabulary (with 80% success): environmental science, ecological footprint, desertification, drought, emissions • Describe the different factors that have caused the rise in global temperature.
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Unit Modifications for Special Population Students	
Advanced Learners	Enrichment Worksheets and Scenario Investigations
Struggling Learners	Use L1 Differentiated Instruction Activities
English Language Learners	Use ELL Support Activities from lesson as needed. http://www.state.nj.us/education/modelcurriculum/ela/ELLSupport.pdf
Special Needs Learners	Follow IEP modifications and work with special education teacher to make modifications and use L1 Differentiated Instruction Activities. http://www.nj.gov/education/udl/

Interdisciplinary Connections

Indicators:

ELA:

- Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
- Write arguments focused on discipline content.
- Draw evidence from informational texts to support analysis, reflection, and research.
- Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
- Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
- Gather relevant information from multiple print and digital sources; assess the credibility of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and providing basic bibliographic information for sources.

Math:

- Model with mathematics.
- Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.
- Summarize numerical data sets in relation to their context.
- Recognize and represent proportional relationships between quantities.
- Reason abstractly and quantitatively.
- Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.
- Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

Integration of 21st Century Skills

Indicators:

To function in the 21st Century work place a variety of skills need to be developed and strengthened some of those would be:

• Developing and Using Models
• Planning and Carrying Out Investigations [supported in the science lab setting but useful in many aspects of life]
• Constructing Explanations and Designing Solutions [supporting explanations with research and experimentation]
• Engaging in Argument from Evidence
• Analyzing and Interpreting Data [collected during labs or proposed scenarios]
• Creativity and Innovation [brainstorm, collaborate and incorporate group ideas]
• Critical Thinking and Problem Solving [Follow the steps of the scientific method.]
• Communication and Collaboration [All types of communication are needed - oral, written and nonverbal communication in a variety of forms and contexts. It is also importanat to be able to listen effectively to decipher meaning, including knowledge, values, attitudes and intentions.]
• Information Literacy [Use information accurately and creatively for the issue or problem at hand.]
• Media Literacy [Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of media.]
• ICT (Information, Communications and Technology) Literacy [Use technology as a tool to research, organize, evaluate and communicate information.]
• Flexibility and Adaptability [Adapt to varied roles, jobs and responsibilities, schedules and contexts.]
• Initiative and Self-Direction [Set goals, balance short-term and long-term goals. Utilize time and manage workload efficiently. Monitor, define, prioritize, and complete tasks without direct oversight. Demonstrate commitment to learning as a lifelong process. Reflect critically on past experiences to continue to improve.]
• Social and Cross-Cultural Skills [Know when it is appropriate to listen and when to speak. Conduct themselves in a respectable manner. Learn and respect cultural differences and work effectively with people from a range of social and cultural backgrounds. Respond open-mindedly to different ideas and values.]
• Productivity and Accountability Set and meet goals, even in the face of obstacles.]

• Leadership and Responsibility [Use interpersonal and problem-solving skills to influence and guide others toward a goal. Inspire others to reach their very best via example and selflessness. Demonstrate integrity and ethical behavior in using influence and power. Act responsibly with the interests of the larger community in mind.]

Unit Title: Physical Science

Unit Description: Students will be introduced to physical science concepts. The students will learn about the forms of energy. Then, a concentration on thermal energy and heat, followed by an introduction to waves, including properties and interactions of waves. The unit continues with an exploration of the nature of sound. The students will learn about the electromagnetic waves including the electromagnetic (EM) spectrum. The unit concludes with an exploration of the properties of light and color.

Unit Duration: about nineteen weeks

Desired Results

Standard(s):

Energy – MS-PS3-1

Thermal Energy and Heat – MS-PS3-3

Characteristics of Waves – MS-PS4-1

Sound – MS-PS4-1

Electromagnetic Waves – MS-PS4-2

Light MS-PS4-2

Indicators:

PS3.A Definitions of Energy; PS3.C Relationship Between Energy and Force

PS3.A Definitions of Energy; PS3.D Energy in Chemical Processes

PS4.A Wave Properties

PS4.A Wave Properties

PS4.A Wave Properties; PS4.B Electromagnetic Radiation

PS4.A Wave Properties; PS4.B Electromagnetic Radiation

Understandings:

Students will…

Chapter 5

Lesson 1

- Use mathematical representations to explain how energy, work, and power are related.
- Develop and use models to describe the two basic types of energy.

Lesson 2

- Use mathematical representations to explain how to determine an object's mechanical energy.
- Gather and synthesize information to compare and contrast other forms of energy.

Essential Questions:

Chapter 5 – Energy
How is energy conserved in a transformation?
Chapter 6 – Thermal Energy and Heat
How does heat flow from one object to another?
Chapter 7 – Characteristics of Waves
What are the properties of waves?
Chapter 8 – Sound
What determines the pitch and loudness of sound?
Chapter 9 – Electromagnetic Waves
What kinds of waves make up the electromagnetic spectrum?
Chapter 10 – Light
How does light interact with matter?

Lesson 3 • Construct a scientific explanation based on evidence to describe how different forms of energy are related. • Apply scientific ideas to explain the law of conservation of energy. *Chapter 6* *Lesson 1* • Gather and synthesize information to explain what temperature is and how it is measured. • Apply scientific ideas to explain how heat is related to temperature and thermal energy. *Lesson 2* • Apply scientific principles to compare and contrast the three forms of heat transfer. *Lesson 3* • Conduct an investigation using heat conductors and insulators to examine how materials respond to heat. *Chapter 7* *Lesson 1* • Apply scientific principles to explain what causes mechanical waves. • Develop and use models to describe three types of mechanical waves. *Lesson 2* • Apply scientific principles to describe the basic properties of waves. • Use mathematical representations to explain how a wave's speed is related to its wavelength and frequency. *Lesson 3* • Develop and use a model to describe how reflection, refraction, and diffraction change a wave's direction. • Develop and use a model to describe different types of interference. • Gather and synthesize information to explain how standing waves form. *Chapter 8* *Lesson 1* • Apply scientific principles to define sound. • Use mathematical representations to identify factors that affect the speed of sound. *Lesson 2* • Apply scientific principles to identify dependent factors in the pitch of a sound. • Gather and synthesize information to identify factors that affect the loudness of a sound. • Construct an explanation for what causes the Doppler effect. *Lesson 3* • Gather and synthesize information to identify what determines the sound quality of a musical instrument. *Lesson 4* • Apply scientific principles to describe the function of the human ear. *Lesson 5* • Gather and synthesize information to describe how animals and people use sound.	

Chapter 9
Lesson 1
- Gather and make sense of information about electromagnetic waves.
- Students will use models to explain the behavior of electromagnetic waves.

Lesson 2
- Apply scientific principles to explain how electromagnetic waves are alike and how they are different.
- Develop and use models to describe the waves that make up the electromagnetic spectrum.

Lesson 3
- Integrate qualitative scientific and technical information to explain how radio waves transmit information.
- Gather and synthesize information to explain how cell phones work.
- Apply scientific ideas to explain how communications satellites work.

Chapter 10
Lesson 1
- Apply scientific principles to describe what determines the color of an opaque, transparent, or translucent object.
- Construct an explanation for how mixing pigments is different from mixing light.

Lesson 2
- Apply scientific principles to identify the kinds of reflection.
- Develop and use a model to describe the types of images produced by plane, concave, and convex mirrors.

Lesson 3
- Use scientific principles to explain why light rays bend when they enter a medium at an angle.
- Construct an explanation for what determines the types of images formed by convex and concave lenses.

Lesson 4
- Apply scientific principles to explain how one sees objects.

Lesson 5
- Gather and synthesize information to explain how cameras, telescopes, and microscopes work U

Assessment Evidence

Performance Tasks:

- Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
- Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.

Other Evidence:

Lesson quizzes, Chapter Tests, Labs

Performance Assessments

Chapter 5 Lab: Can You Feel the Power or

Chapter 5 Scenario Investigation: Stuck at the Top

Chapter 6 Lab: Build Your Own Thermometer or

Chapter 6 Scenario Investigation: Where is the Battery?

• Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. • Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. • Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. • Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. • Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. • Integrate qualitative scientific and technical information to support the claim that digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information than analog signals.	Chapter 7 Lab: Making Waves Chapter 7 Scenario Investigation: Rogue Wave Chapter 8 Lab: Changing Pitch or Chapter 8 Scenario Investigation: Seeing with Your Ears Chapter 9 Lab: Build a Crystal Radio or Chapter 9 Scenario Investigation: Catching the Waves Chapter 10 Lab: Changing Colors or Chapter 10 Stem Activity: Optical Security

Benchmarks: To be determined

Learning Plan

Learning Activities:

Chapter 5: Energy

- To teach this lesson with an emphasis on inquiry, begin by **Introducing the Big Q** and students will answer the question
- Watch **Untamed Science Video** "The Potential for Fun"
- Preview vocabulary
- Complete scenario investigation stuck at that top

Lesson 1: What is Energy?

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up Activity**. Students will bounce a ball to explore kinetic energy. Discuss how students will graph the information they collected about the ball bounces. Have students do the After the Inquiry Warm-Up Worksheet. Talk about why the ball does not bounce as high as the original dropping point. Have volunteers share their predictions to question 4 about what they would see if they watched the dropped ball until it came to a rest.
- Focus on the Inquiry Skill for the lesson. Point out that when you calculate, you use mathematical equations to solve problems. What calculation could be made using the information in the graph from the **Inquiry Warm-Up activity**? (Calculations that the height from which the ball was dropped to the height to which it bounced.)
- Have students calculate work, gravitational potential energy, and power by doing the Lab Investigation. Have students share their results.
- Support the Big Q to reinforce understanding that an object does not have to be moving to have energy—it can have potential energy based on its shape or position.
- Do the Quick Lab to reinforce understanding of the relationship between mass, velocity, and kinetic energy .
- Have students take the Lesson Quiz.

Lesson 2: Forms of Energy

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up Activity**. Students will explore how energy changes from one form to another. Discuss how the energy in a flashlight travels. Have students do the After the Inquiry WarmUp Worksheet. Talk about the energy efficiency of a flashlight. Have volunteers share their answers to question 4 about the energy produced by the light and heat of the flashlight.

- Focus on the Inquiry Skill for the lesson. Point out that when you classify, you categorize objects or information based on similarities. How are the types of energy produced by the flashlight in the **Inquiry Warm-Up Activity** classified? (Light and heat from the flashlight can both be classified as electromagnetic radiation.)
- Have students do the Quick Lab to determine how mechanical energy and work are related. Ask volunteers to share their results.
- Review the relationship between work and energy before beginning the **Apply It Activity**. Ask volunteers to describe how the bowling ball does work on the pins.
- Support the Big Q by eliciting examples of common instances in which energy changes form.
- Do the Teacher Demo to model how as chemical bonds are broken, energy is given off.
- Do the Quick Lab to reinforce understanding of how energy can change forms.
- Have students take the Lesson Quiz.

Lesson 3: Energy Transformations and Conservation

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up Activity**. Students will observe what makes an index card jump. Discuss the forms of energy used to move the card. Have students do the After the Inquiry Warm-Up Worksheet. Talk about the types of energy they labeled in their diagrams. Have volunteers share their answers to question 4 about the energy applied to the rubber band.
- Focus on the Inquiry Skill for the lesson. Point out that when you infer, you use information and evidence to conclude something. What can be inferred about the potential energy in a rubber band? (The potential energy comes from the energy applied to stretch it.)
- Review forms of energy associated with particles before beginning the **Apply It Activity**. Ask volunteers to share what forms of energy they identified in the transformations.
- Build Inquiry to model energy transformations.
- Have students do the Quick Lab to explore how potential energy is transformed to kinetic energy and then share their results.
- Explore the Big Q to show that energy is conserved during a transformation.
- Do the Quick Lab to reinforce understanding of the law of conservation of energy. Ask students to share their responses to the Answer the Big Q in the student edition.
- Have students take the Lesson Quiz.
- Have students take the chapter assessment

Chapter 6: Thermal Energy and Heat

- To teach this lesson with an emphasis on inquiry, begin by **Introducing the Big Q** and students will answer question
- Watch **Untamed Science Video** “Why is this Inner Tube So Hot?"
- Preview vocabulary
- Complete Scenario Investigation **Where is the Battery?**

Lesson 1: Fossil Fuels

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up activity**. Students will compare the sensations they get from water at different temperatures. Discuss how their hands felt when they moved them from the hot and cold water to the warm water. Have students do the After the Inquiry WarmUp Worksheet. Talk about how their hands might have felt in other scenarios with warm, hot, and cold water. Have volunteers share their answers to question 4 about how the water would feel on each hand.
- Focus on the Inquiry Skill for the lesson. Point out that when you communicate, you share ideas and information with others using various formats. What information were students communicating in the **Inquiry Warm-Up Activity**? (The way the water felt in different scenarios.)
- Have students build their own thermometer in the Lab Investigation.
- Review the two factors that thermal energy depends on before beginning the **Apply It Activity**. Ask volunteers to share their drawings of pies with greater thermal energy than the shown pie.
- Support the Big Q by discussing how thermal energy is transferred between two objects.
- Have students do the Quick Lab to see how temperature is related to the rate of transfer.
- Have students take the Lesson Quiz.

Lesson 2: The Transfer of Heat

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up Activity**. Students will investigate how different materials transfer heat. Discuss the different rates at which heat is transferred by the materials. Have students do the After the Inquiry Warm-Up worksheet. Talk about situations when, because of their rate of heat transfer, it is better to use specific materials. Have volunteers share their answers to question 4 about why it was important not to let the materials touch one another in the activity.
- Focus on the Inquiry Skill for the lesson. Point out that when you infer, you are analyzing an observation, not stating a fact. Use the Build Inquiry activity to explore how heat flows from a lamp. Discuss how heat is transferred by conduction, radiation, and convection to Explore the Big Q.

- Review the three types of heat transfer before beginning the **Apply It Activity**. Ask volunteers to share their inferences about the shape of cooking pots.
- Have students do the Quick Lab to explore convection using colored liquids and then share their results. Have students Answer the Big Q and then share their responses.
- Have students take the Lesson Quiz.

Lesson 3: Thermal Properties

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up Activity**. Students will explore thermal properties. Discuss how they can graph the temperature changes for each test tube. Have students do the After the Inquiry Warm-Up worksheet. Talk about the conclusions students were able to draw from their observations. Have volunteers share their answers to question 4 about why the thermometers should not touch the bottom or side of the test tubes.
- Focus on the Inquiry Skill for the lesson. Point out that when you calculate, you use mathematical reasoning to describe a situation. What calculations were made in the **Inquiry Warm-Up activity**? (The temperature changes of each test tube.)
- Support the Big Q by explaining that a coat is an insulator.
- Have students do the Quick Lab to see how a balloon's volume changes as its temperature decreases and then share their results.
- Have students take the Lesson Quiz.
- Have students take the chapter assessment

Chapter 7: Characteristics of Waves

- To teach this lesson with an emphasis on inquiry, begin by **Introducing the Big Q** and students will answer the question
- Watch untamed science video Extreme Wave Science
- Preview vocabulary
- Complete scenario investigation Rogue wave

Lesson 1: What are Waves?

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up Activity**. Students will explore waves that travel along a rope. The After the Inquiry Warm-Up worksheet sets up a discussion about waves. Have volunteers share their answers to question 4 about how a wave in water works.
- Focus on the Inquiry Skill for the lesson. Remind students that predicting involves making an inference about a future event based on current evidence. What inferences could be made in Step 2 of the **Inquiry Warm-Up Activity**? (Sample: Only the wave moves, not the actual rope.)
- Do the Teacher Demo to allow students to explore how a mechanical wave moves its medium.
- Have students do the Quick Lab to explore how vibrations start waves.
- Support the Big Idea by discussing the motion in a transverse wave.
- Use the Teacher Demo to help students visualize the movement of transverse waves.
- Review the sentences containing the highlighted terms compression and rarefaction before assigning the **Apply It Activity**.
- Have students share their predictions. Have students do the Quick Lab investigating transverse and longitudinal waves.
- Have students take the Lesson Quiz.

Lesson 2: Properties of Waves

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up activity**. Students will model waves and identify wave properties. The After the Inquiry Warm-Up worksheet sets up a discussion about an operational definition of a wave. Have volunteers share their answers to question 4 about the relationship between the height of a wave's crest and its amplitude.
- Focus on the Inquiry Skill for the lesson. Remind students that before calculating they should make sure they understand what a problem is asking. Encourage students to use units as part of their calculations. What information could students calculate in the **Inquiry Warm-Up Activity**? (Volume using length and width of pan and depth of water to find cubic centimeters of water)
- Do the Teacher Demo to allow students to observe that a change in the medium will change the speed of a wave traveling through that medium.
- Have students do the Quick Lab to investigate the affect of changing the frequency of waves on a spring toy.
- Explore the Big Q by using Figure 3 to explore the four basic properties of waves.
- Have students do the Quick Lab to determine what affects the speed of a wave.
- Answer the Big Q by leading a class discussion about the properties of waves.
- Have students take the Lesson Quiz.

Lesson 3: Interactions of Waves

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up Activity**. Students will observe the angles that a ball makes as it strikes a wall and bounces off. The After the Inquiry Warm-Up worksheet sets up a discussion about angles of reflection. Have volunteers share their answers to question 4 about the angle of reflection that occurs when a wave hits a surface at an angle of 45º.
- Focus on the Inquiry Skill for the lesson. Remind students that an observation is something they can see, hear, smell, taste, or feel. What could be observed in Step 1 of the **Inquiry Warm-Up Activity**? (Sample: The ball bounces back from a wall at the same angle it hits the wall) Build Inquiry by allowing students to observe how light can reflect around a barrier.
- Review the terms reflection, refraction, and diffraction before beginning the **Apply It Activity**. Have students tell how reflection, refraction, and diffraction are similar.
- Have students do the Lab Investigation to observe the behavior of water waves.
- Support the Big Q by discussing the changes in amplitude caused by constructive interference and destructive interference.
- Do the Teacher Demo to allow students to observe how interference affects the amplitude of waves.
- Have students do the Quick Lab to explore constructive and destructive interference.
- Do the Teacher Demo to allow students to observe resonance.
- Have students do the Quick Lab using ropes to create different standing waves and explain how they are formed.
- Have students take the Lesson Quiz
- Have students take the chapter assessment

Chapter 8: Sound

- To teach this lesson with an emphasis on inquiry, begin by **Introducing the Big Q** and students will answer question
- Watch Untamed Science video “Was That a Whale I Heard?"
- Preview vocabulary
- Complete Scenario Investigation **Seeing With Your Ears**

Lesson 1: The Nature of Sound

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up activity**. Students will use a tuning fork to explore sound waves. The After the Inquiry Warm-Up worksheet sets up a discussion about sound waves. Have volunteers share their answers to question 4 about how to make the tuning fork vibrate for a longer period of time.
- Focus on the Inquiry Skill for the lesson. Remind students that a graph can be used to see whether a relationship exists between two variables, such as the speed of a sound and the temperature of the medium through which the sound travels. How could students have used a graph in the **Inquiry Warm-Up Activity**? (Accept all reasonable answers.)
- Do the Teacher Demo to show that air rushing through a narrow tube creates compressions that travel through the air as a sound wave.
- Have students do the Quick Lab to help them understand how sound travels.
- Support the Big Q by discussing that the speed of sound is determined by measuring how fast a wave moves from one place to another.
- Do the Teacher Demo to show how the stiffness of the medium sound waves travel through affects the speed of the sound waves.
- Do the next Teacher Demo to demonstrate density.
- Have students do the Quick Lab to observe how sound travels.
- Have students take the Lesson Quiz.

Lesson 2: Properties of Sound

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up Activity**. Students will investigate the relationship between loudness and amplitude. The After the Inquiry Warm-Up worksheet sets up a discussion about the relationship between amplitude and loudness. Have volunteers share their answers to question 4 about why the sound did not change when the string was pulled in the opposite direction.
- Focus on the Inquiry Skill for the lesson. Help students understand that there are many types of models, including drawings, diagrams, and computer images. Point out that making models helps people understand things that they cannot see directly. What model did students use in the **Inquiry Warm-Up Activity**? (A string was used to model sound waves.)
- Do the Lab Investigation giving students the opportunity to explore pitch.
- Build Inquiry to model sound intensity.
- Before beginning the **Apply It Activity**, read each question aloud and discuss what information students may find in the table and/or what calculations they must make to answer it. Remind students that calculations are arithmetical operations that are used to analyze data. In this activity, students will work with multiples of ten.
- Have students do the Quick Lab to explore how different media affect the loudness of sound.

- Use the Teacher Demo to model the Doppler effect.
- Explore the Big Q by discussing the three kinds of energy used in headphones: electrical, magnetic, and sound.
- Have students do the Quick Lab to explore the Doppler effect.
- Answer the Big Q by leading a class discussion about the factors that determine the pitch and loudness of a sound.
- Have students take the Lesson Quiz.

Lesson 3: Music

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up activity**. Students will explore variations in frequency of sounds made by straws. The After the Inquiry Warm-Up worksheet sets up a discussion about the musical notes produced in one particular family of instruments. Have volunteers share their answers to question 4 about the similarities in the way stringed, wind, and percussion instruments produce sound.
- Focus on the Inquiry Skill for the lesson. Help students understand that predicting involves making an inference about a future event based on current evidence. What prediction did students make in Step 2 of the **Inquiry Warm-Up Activity**? (Sample: Each straw in the panpipe would produce the exact same note.)
- Before beginning the **Apply It Activity**, remind students that the first overtone has a frequency that is twice the frequency of the fundamental tone and the second overtone has a frequency that is three times the frequency of the fundamental tone. This will help them answer question 1.
- Support the Big Q by explaining how pitch is adjusted on a slide trombone and contrasting that instrument with a clarinet.
- Have students do the Quick Lab to explore pitch by investigating vibrations on stretched rubber bands.
- Have students take the Lesson Quiz.

Lesson 4: Hearing Sound

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up Activity**. Students will explore how sound makes a membrane vibrate. The After the Inquiry Warm-Up Worksheet sets up a discussion about how the eardrum works. Have volunteers share their answers to question 4 predicting what would happen if they changed the variables.
- Focus on the Inquiry Skill for the lesson. Remind students that an observation is something they can hear, see, smell, taste, or feel. Which senses did students use to make observations in the **Inquiry Warm-Up Activity**? (Sight and hearing)
- Before beginning the **Apply It Activity**, have students close their eyes and visualize sound waves entering their ears from in front of them, behind them, and to the left and right. Assign the activity and have students share their results.
- Support the Big Q by discussing how pitch and volume affect the eardrum.
- Have students do the Quick Lab explore materials for soundproofing.
- Have students take the Lesson Quiz

Lesson 5: Using Sound

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up Activity**. Students will explore the relationship between the distance a rebounding object travels and the elapsed time. The After the Inquiry Warm-Up Worksheet sets up a discussion about how to use time to measure distance. Have volunteers share their answers to question 4 about designing an experiment that uses the formula for distance.
- Focus on the Inquiry Skill for the lesson. Remind students that, before calculating, they should make sure they understand what a problem is asking. What information did students need in order to do the calculation in number 3 of the **Inquiry Warm-Up Activity**? (The average time of all three trials and the distance the ball traveled)
- Support the Big Q by discussing ultrasound and comparing the frequency of the sounds a bat can hear with the frequencies a human can hear.
- Before beginning the **Apply It Activity**, write on the board the equation for finding the total distance that sound travels, Distance = Speed of sound in water x Time. Have students complete the activity and share their results.
- Have students do the Quick Lab to explore how sound reflects off different materials.
- Have students take the Lesson Quiz.
- Have students take the chapter assessment

Chapter 9: Electromagnetic Waves

- To teach this lesson with an emphasis on inquiry, begin by **Introducing the Big Q** and students will answer the question
- Watch **Untamed Science Video** “The Day the Waves Died”
- Preview vocabulary
- Complete scenario investigation Catching the Waves

Lesson 1: The Nature of Electromagnetic Waves

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up activity**. Students will investigate the speed of electromagnetic waves. Discuss the data they collected in Steps 5 and 6 of the

investigation. Have students do the After the Inquiry Warm-Up Worksheet. Talk about the average speed in each of the trials. Have volunteers share their answers to question 4 about whether the naked eye can accurately measure the speed of light.

- Focus on the Inquiry Skill for the lesson. Point out that when you calculate, you use mathematical equations to analyze information or answer questions. What did students calculate in the Inquiry WarmUp Activity? (The average speed of each trial)
- Ask students to identify the seven types of electromagnetic waves to Support the Big Q.
- Have students do the Quick Lab to investigate the effect of light waves on matter and then share their results.
- To Build Inquiry, have students explore how filters polarize light.
- Review Figure 2 before beginning the **Apply It Activity**. Ask volunteers to share their diagrams.
- Do the Quick Lab to differentiate between waves and particles.
- Have students take the Lesson Quiz.

Lesson 2: Waves of the Electromagnetic Spectrum

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up Activity**. Students will observe the colors that make up white light. Discuss the colors students saw when white light passed through the prism. Have students do the After the Inquiry Warm-Up Worksheet. Talk about how the colors in the prism compare to the colors in a rainbows. Have volunteers share their answers to question 4 about why rainbows appear under certain circumstances.
- Focus on the Inquiry Skill for the lesson. Point out that when you communicate, you share information with others. How did students communicate what happened when white light passed through the prism in the **Inquiry Warm-Up activity**? (With a diagram)
- Have students do the Quick Lab to look at different types of electromagnetic waves.
- To Build Inquiry, have students design an experiment to see which materials absorbed the most energy from the microwave.
- Review how to write numbers in scientific notation before beginning the **Apply It Activity**. Ask volunteers to share their interpretations.
- Continue to Build Inquiry by experimenting with infrared rays. Build Inquiry by modeling X-rays and other electromagnetic waves.
- To Explore the Big Q, have students complete the activities and share their responses.
- Do the Quick Lab and have students share what they discovered.
- Have students identify the kinds of waves that make up the electromagnetic spectrum to Answer the Big Q.
- Have students take the Lesson Quiz.

Lesson 3: Wireless Communication

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up activity**. Students will investigate how waves change. Discuss what occurs when one characteristic of a wave changes. Have students do the After the Inquiry Warm-Up worksheet. Talk about how the measurements vary when they are stretched horizontally and vertically. Have volunteers share the data tables they created for number 4.
- Focus on the Inquiry Skill for the lesson. Point out that when you interpret data, you analyze trends to gather information about a situation. What type of data did students interpret in the **Inquiry Warm-Up activity**? (How the amplitude, frequency, and wavelength of the waves changed as they were stretched horizontally and vertically)
- To Support the Big Q discuss how the electromagnetic waves used in radio broadcasting differ from the other waves in the electromagnetic spectrum.
- In the Lab Investigation students will build a radio using a crystal diode.
- Do the Teacher Demo to model how messages are transmitted from cell to cell in a cell phone network.
- Do the Quick Lab to model how cell phones work.
- Complete the Teacher Demo to model how a communications satellite works.
- Have students do the Quick Lab to reinforce understanding of how a GPS uses triangulation to find a location.
- Have students take the Lesson Quiz.
- Have students take the chapter assessment

Chapter 10: Light

- To teach this lesson with an emphasis on inquiry, begin by **Introducing the Big Q** and students will answer question
- Watch Untamed Science video “Why is the Ocean Blue?"
- Preview vocabulary
- Complete STEM Activity **Optical Security**

Lesson 1: Light and Color

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up activity**. Students will investigate how colors mix. Discuss how the colors appeared to change as the disk spun at different speeds.

Have students do the After the Inquiry Warm-Up worksheet. Talk about what colors make up white light. Have volunteers share their answers to question 4 about how spinning to mix colors is different from mixing colors when painting.

- Focus on the Inquiry Skill for the lesson. Point out that when you predict, you use current evidence or past experiences to make an inference about a situation. Based on the **Inquiry Warm-Up activity**, what do students predict would happen if they mixed unequal amounts of primary colors on a spinning disk? (You would not see a grayish white color.)
- Use Figure 2 to Support the Big Q and illustrate how the color of an opaque object depends on the color of light that strikes it.
- Do the Teacher Demo to show students that objects appear to change color if you view them in other colors of light besides white.
- Do the second Teacher Demo to reinforce understanding of the color of light transmitted by transparent and translucent materials.
- Review Figure 2 before beginning the **Apply It Activity**. Ask volunteers to share their predictions.
- Do the Quick Lab to reinforce understanding of how to develop a hypothesis.
- Have students do the Lab Investigation to observe how color filters affect the appearance of objects in white light.
- Have students take the Lesson Quiz.

Lesson 2: Reflection and Mirrors

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up activity**. Students will examine how the reflection produced by plane mirror is seen. Discuss what they saw when they looked in a single plane mirror and winked at their reflections. Have students do the After the Inquiry Warm-Up worksheet. Talk about what they saw in the single plane mirror versus the plane mirrors at right angles. Have volunteers share their answers to question 4 about the importance of the mirrors being positioned at a 90° angle.
- Focus on the Inquiry Skill for the lesson. Point out that when you classify, you group items by similarities. How could students classify the mirrors used in the **Inquiry Warm-Up activity**? (Plane mirrors)
- Have students do the Quick Lab to observe regular and diffuse reflection and then share their results.
- Support the Big Q by directing students' attention to Figure 3. Discuss how parallel rays are reflected by the concave surface of a mirror and identify the focal point.
- Do a Teacher Demo to model how light is reflected from a concave mirror.
- To Build Inquiry have students find the focal point.
- Review the table in Figure 4 before beginning the **Apply It Activity**. Ask volunteers to share how they classified the mirrors.
- Do the Quick Lab to reinforce understanding of the images produced by different mirrors.
- Have students take the Lesson Quiz.

Lesson 3: Refraction and Lenses

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up activity**. Students will make an image appear using a convex lens. Discuss what they saw when they looked through the lens and moved it farther away from the eye and toward the window. Have students do the After the Inquiry Warm-Up worksheet. Talk about how they could tell that the image they saw on the paper was a real image. Have volunteers share their answers to question 4 about how your result would be different on black paper.
- Focus on the Inquiry Skill for the lesson. Point out that when you interpret data, you look for patterns. What could students interpret about the image based on the diagram they drew for number 3 on the **Inquiry Warm-Up activity** worksheet? (The image was a real image.)
- Do the Teacher Demo to show students how refracted light can help you to see an object.
- To Build Inquiry, have students observe what happens when only one color passes through a second prism.
- To Explore the Big Q discuss what causes light to refract and reflect as a rainbow forms.
- Do the Quick Lab and then ask students to share their explanations.
- Have students Answer the Big Q and then share their response.
- Do the Teacher Demo to show students how light rays enter the lens parallel to the optical axis in order to form an image at the focal point.
- Review the types of mirrors and how they reflect light before beginning the **Apply It Activity**. Ask volunteers to share their responses.
- Do the Quick Lab to reinforce understanding of how the distance between an image and a convex lens affects the image formed.
- Have students take the Lesson Quiz.

Lesson 4: Seeing Light

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up activity**. Students will investigate whether they lose some vision when using only one eye. Discuss what they saw on the paper before and after moving it while one eye was closed. Have students do the After the Inquiry Warm-Up worksheet. Talk

about why it is important to repeat an inquiry. Have volunteers share their answers to question 4 about how their vision would be affected by an eye patch.

- Focus on the Inquiry Skill for the lesson. Point out that when you observe, you use your senses to gather information about an object or situation. What did students observe about their ability to see with one eye in the **Inquiry Warm-up activity**? (You cannot see everything with one eye.)
- Review how the pupil functions in different amounts of light before beginning the **Apply It Activity**. Ask volunteers to share their observations.
- Have students do the Quick Lab to investigate how the cones in their eyes work and then share their results.
- Have students take the Lesson Quiz.

Lesson 5: Using Light

- To teach this lesson with an emphasis on inquiry, begin with the **Inquiry Warm-Up activity**. Students will explore how a pinhole camera works. Discuss what students saw when they looked through the pinhole camera. Have students do the After the Inquiry WarmUp worksheet. Talk about how and why a real image was formed. Have volunteers share their answers to question 4 about how this investigation would be affected if done in a brightly lit room.
- Focus on the Inquiry Skill for the lesson. Point out that when you infer, you relate new information to prior information in order to draw a conclusion. Based on the **Inquiry Warm-Up Activity** what could students infer about the type of image formed using a pinhole camera? (I inferred that it was a real image because it was upside down.)
- Review how a convex lens produces an image before beginning the **Apply It Activity**. Ask volunteers to share their inferences.
- Have students do the Quick Lab to model how a refracting telescope forms an image and then share their results.
- Have students take the Lesson Quiz.
- Have students take the chapter assessment

Resources:

Interactive Science Program

Vernier Lab Pro™Equipment (Thermometers)

Unit Learning Goal and Scale *(Level 2.0 reflects a minimal level of proficiency)*	
Standard(s): MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object	
4.0	**Students will be able to:** • In addition to score 3.0 performance, the student demonstrates in-depth inferences and applications that go beyond what was taught.
3.0	**Students will be able to:** • Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object
2.0	**Students will be able to:** • Recognize and recall specific vocabulary (with 80% success): energy, kinetic energy, potential energy, gravitational potential energy, elastic potential energy, mechanical energy, nuclear energy, thermal energy, electrical energy, electromagnetic energy, chemical energy, energy transformation, law of conservation of energy • Organize data in a way that facilitates analysis and interpretation. • Identify relationships using a graphical display • Compare linear and non-linear relationships
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Standard(s): MS-PS-3-3 Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.	
4.0	**Students will be able to:** • In addition to score 3.0 performance, the student demonstrates in-depth inferences and applications that go beyond what was taught.
3.0	**Students will be able to:** • **Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.**
2.0	**Students will be able to:** • Recognize and recall specific vocabulary (with 80% success): temperature, Fahrenheit scale, Celsius scale, Kelvin scale, absolute zero, heat, convection, convection current, radiation, conduction, conductor, insulator, specific heat, thermal expansion • Describe thermal energy transfer.
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Standard(s): MS-PS-4-1 Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.	
4.0	**Students will be able to:** • In addition to score 3.0 performance, the student demonstrates in-depth inferences and applications that go beyond what was taught.
3.0	**Students will be able to:** • Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.
2.0	**Students will be able to:** • Recognize and recall specific vocabulary (with 80% success); wave, energy, medium, mechanical wave, vibration, transverse wave, crest, trough, longitudinal wave, compression, rarefaction, amplitude, wavelength, frequency, hertz, pitch, loudness, intensity,

	decibel, Doppler effect, electromagnetic wave, electromagnetic radiation, polarized light, photoelectric effect, photon, electromagnetic spectrum, radio waves, microwaves, radar, infrared rays, thermogram, visible light, ultraviolet rays, X-rays, gamma rays, amplitude modulation, frequency modulation • Describe the relationship between the amplitude and energy of a wave.
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Standard(s): MS-PS4-2 Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.	
4.0	**Students will be able to:** • In addition to score 3.0 performance, the student demonstrates in-depth inferences and applications that go beyond what was taught.
3.0	**Students will be able to:** • Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.
2.0	**Students will be able to:** • Recognize and recall specific vocabulary (with 80% success): environmental science, ecological footprint, desertification, drought, emissions • Describe the different factors that have caused the rise in global temperature.
1.0	**With help, partial success at level 2.0 content and level 3.0 content:**
0.0	**Even with help, no success**

Unit Modifications for Special Population Students

Advanced Learners	Enrichment Worksheets and Scenario Investigations
Struggling Learners	Use L1 Differentiated Instruction Activities
English Language Learners	Use ELL Support Activities from lesson as needed. http://www.state.nj.us/education/modelcurriculum/ela/ELLSupport.pdf
Special Needs Learners	Follow IEP modifications and work with special education teacher to make modifications and use L1 Differentiated Instruction Activities. http://www.nj.gov/education/udl/

Interdisciplinary Connections

Indicators:

ELA:

- Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
- Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
- Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.
- Write arguments focused on discipline content.
- Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
- Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
- Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
- Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.
- Draw evidence from informational texts to support analysis, reflection, and research.

MATH:

- Reason abstractly and quantitatively.
- Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities.
- Understand the concept of a unit rate a/b associated with a ratio a:b with b≠0, and use rate language in the context of a ratio relationship.
- Recognize and represent proportional relationships between quantities.
- Know and apply the properties of integer exponents to generate equivalent numerical expressions.
- Use square root and cube root symbols to represent solutions to equations of the form x2=p and x3=p, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that √2 is irrational.
- Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.
- Interpret statements of inequality as statements about the relative position of two numbers on a number line diagram.
- Write, interpret, and explain statements of order for rational numbers in real-world contexts
- Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.
- Understand congruence and similarity using physical models, transparencies, or geometry software.
- Summarize numerical data sets in relation to their context.
- Model with mathematics.

Integration of 21st Century Skills

Indicators:

To function in the 21st Century work place a variety of skills need to be developed and strengthened some of those would be:

• Developing and Using Models
• Planning and Carrying Out Investigations [supported in the science lab setting but useful in many aspects of life]
• Constructing Explanations and Designing Solutions [supporting explanations with research and experimentation]
• Engaging in Argument from Evidence
• Analyzing and Interpreting Data [collected during labs or proposed scenarios]
• Creativity and Innovation [brainstorm, collaborate and incorporate group ideas]
• Critical Thinking and Problem Solving [Follow the steps of the scientific method.]
• Communication and Collaboration [All types of communication are needed - oral, written and nonverbal communication in a variety of forms and contexts. It is also important to be able to listen effectively to decipher meaning, including knowledge, values, attitudes and intentions.]
• Information Literacy [Use information accurately and creatively for the issue or problem at hand.]
• Media Literacy [Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of media.]
• ICT (Information, Communications and Technology) Literacy [Use technology as a tool to research, organize, evaluate and communicate information.]
• Flexibility and Adaptability [Adapt to varied roles, jobs and responsibilities, schedules and contexts.]
• Initiative and Self-Direction [Set goals, balance short-term and long-term goals. Utilize time and manage workload efficiently. Monitor, define, prioritize, and complete tasks without direct oversight. Demonstrate commitment to learning as a lifelong process. Reflect critically on past experiences to continue to improve.]
• Social and Cross-Cultural Skills [Know when it is appropriate to listen and when to speak. Conduct themselves in a respectable manner. Learn and respect cultural differences and work effectively with people from a range of social and cultural backgrounds. Respond open-mindedly to different ideas and values.]
• Productivity and Accountability Set and meet goals, even in the face of obstacles.]
• Leadership and Responsibility [Use interpersonal and problem-solving skills to influence and guide others toward a goal. Inspire others to reach their very best via example and selflessness. Demonstrate integrity and ethical behavior in using influence and power. Act responsibly with the interests of the larger community in mind.]