Science- Grade 8

Unit # 1	**Title:** Evidence of a Common Ancestry/Selection and Adaptation	**Pacing**: 35 days

Stage 1- Desired Results

Established Goals/NJSLS Standards

Next Generation Science Standards/NJSLS:

MS-LS4-1 Biological Evolution: Unity and Diversity

- 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. *[Clarification Statement: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.] [Assessment Boundary: Assessment does not include the names of individual species or geological eras in the fossil record.] (MS-LS4-1)*

MS-LS4-2 Biological Evolution: Unity and Diversity

- 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. *[Clarification Statement: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures.] (MS-LS4-2)*

MS-LS4-3 Biological Evolution: Unity and Diversity

- 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. *[Clarification Statement: Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.] [Assessment Boundary: Assessment of comparisons is limited to gross appearance of anatomical structures in embryological development.] (MS-LS4-3)*

MS-LS4-4 Biological Evolution: Unity and Diversity

- 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. *[Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations] (MS-LS4-4)*

MS-LS4-5 Biological Evolution: Unity and Diversity

- Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms. *[Clarification Statement: Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.] (MS-LS4-5)*

MS-LS4-6 Biological Evolution: Unity and Diversity

- Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. [Clarification Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.] [Assessment Boundary: Assessment does not include Hardy Weinberg calculations.] (MS-LS4-6)

English Language Arts Standards

- Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. (MS-LS4-1),(MSLS4-2),(MS-LS4-3) RST.6-8.1
- 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). (MS-LS4-1),(MS-LS4-3) RST.6-8.7
- Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-LS4-3) RST.6-8.9
- Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS4-2) WHST.6-8.2
- Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS4-2) WHST.6-8.9
- Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. (MS-LS4-2) SL.8.1
- 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. (MSLS4-2) SL.8.4
- Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. (MS-LS4-4),(MSLS4-5) RST.6-8.1
- Compare and contrast the information gained from experiments, simulations, videos, or multimedia sources with that gained from reading a text on the same topic. (MS-LS4-4) RST.6-8.9
- Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-LS4-4) WHST.6-8.2
- Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-LS4-5) WHST.6-8.8
- Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS4-4) WHST.6-8.9
- Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly. (MS-LS4-4) SL.8.1
- 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. (MSLS4-4) SL.8.4

Mathematics Standards

- 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. (MS-LS4-1),(MS-LS4-2) 6.EE.B.6
- Model with mathematics. (MS-LS4-6) MP.4
- Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-LS4-4),(MS-LS4-6) 6.RP.A.1
- Summarize numerical data sets in relation to their context. (MS-LS4-4),(MS-LS4- 6) 6.SP.B.5
- Recognize and represent proportional relationships between quantities. (MS-LS4- 4),(MS-LS4-6) 7.RP.A.2

Enduring Understandings (DCI) *Students will understand…*	**Essential Questions** *Students will consider...*
LS4.A: Evidence of Common Ancestry and Diversity ● The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. (MS-LS4-1) ● Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent. (MS-LS4-2) ● Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy. (MS-LS4-3) **LS4.B: Natural Selection** ● Natural selection leads to the predominance of certain traits in a population, and the suppression of others. (MS-LS4-4) ● In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed onto offspring. (MS-LS4-5) **LS4.C: Adaptation** ● Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. (MS-LS4-6)	● How do we know when an organism (fossil) was alive? ● How do we know that birds and dinosaurs are related? ● Other than bones and structures being similar, what other evidence is there that birds and dinosaurs are related? ● How can changes to the genetic code increase or decrease an individual's chances of survival? ● How can the environment affect natural selection? ● Are Genetically Modified Organisms (GMO) safe to eat?
Knowledge (Concepts) *Students will know…*	**Academic Vocabulary**
● The fossil record documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. ● The collection of fossils and their placement in chronological order as identified through the location of sedimentary layers in which they are found or through radioactive dating is known as the fossil record. ● Relative fossil dating is achieved by examining the fossil's relative position in sedimentary rock layers. ● Objects and events in the fossil record occur in consistent patterns that are understandable through measurement and observation. ● Patterns exist in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in rock layers. ● Patterns can occur within one species of organism or across many species.	● fossil ● diversity ● extinction ● anatomical ● organism ● pattern ● sedimentary rock ● evolution ● descent

Knowledge (Concepts) Continued ***Students will know…***	**Academic Vocabulary**
• Similarities and differences exist in the gross anatomical structures of modern organisms. • There are anatomical similarities and differences among modern organisms and between modern organisms and fossil organisms. • Similarities and differences exist in the gross anatomical structures of modern organisms and their fossil relatives. • Similarities and differences in the gross anatomical structures of modern organisms enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent. • Patterns and anatomical similarities in the fossil record can be used to identify cause-and-effect relationships. • Science assumes that objects and events in evolutionary history occur in consistent patterns that are understandable through measurement and observation. • Relationships between embryos of different species show similarities in their development. • General patterns of relatedness among embryos of different organisms can be inferred by comparing the macroscopic appearance of diagrams or pictures. • Pictorial data can be used to identify patterns of similarities in embryological development across multiple species. • Similarities in embryological development across multiple species show relationships that are not evident in the fully formed organisms. • Genetic variations of traits in a population increase or decrease some individuals' probability of surviving and reproducing in a specific environment. • Natural selection leads to the predominance of certain traits in a population and the suppression of others. • Natural selection may have more than one cause, and some cause-and effect relationships within natural selection can only be described using probability. • Natural selection, which over generations leads to adaptations, is one important process through which species change over time in response to changes in environmental conditions. • The distribution of traits in a population changes. • Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. • Natural selection may have more than one cause, and some cause-and effect relationships in natural selection can only be described using probability. • Mathematical representations can be used to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. • In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding.	• genetic variation • probability • natural selection • fossil record • traits • population • artificial selection • ancestors

• In artificial selection, humans choose desirable, genetically determined traits in to pass on to offspring.	

Knowledge (Concepts) Continued

Students will know…

- Phenomena, such as genetic outcomes in artificial selection, may have more than one cause, and some cause-and-effect relationships in systems can only be described using probability.
- Technologies have changed the way humans influence the inheritance of desired traits in organisms.
- Engineering advances have led to important discoveries in the field of selective breeding.
- Engineering advances in the field of selective breeding have led to the development of entire industries and engineered systems.
- Scientific discoveries have led to the development of entire industries and engineered systems.

Skills

Students will be able to…

- Use graphs, charts, and images to identify patterns within the fossil record.
- Analyze and interpret data within the fossil record to determine similarities and differences in findings.
- Make logical and conceptual connections between evidence in the fossil record and explanations about the existence, diversity, extinction, and change in many life forms throughout the history of life on Earth.
- Apply scientific ideas to construct explanations for evolutionary relationships.
- Apply the patterns in gross anatomical structures among modern organisms and between modern organisms and fossil organisms to construct explanations of evolutionary relationships.
- Apply scientific ideas about evolutionary history to construct an explanation for evolutionary relationships evidenced by similarities or differences in the gross appearance of anatomical structures.
- Use diagrams or pictures to identify patterns in embryological development across multiple species.
- Analyze displays of pictorial data to identify where the embryological development is related linearly and where that linear nature ends.
- Infer general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.
- Construct an explanation that includes probability statements regarding variables and proportional reasoning of how genetic variations of traits in a population increase some individuals' probability surviving and reproducing in a specific environment.
- Use probability to describe some cause-and-effect relationships that can be used to explain why some individuals survive and reproduce in a specific environment.
- Explain some causes of natural selection and the effect it has on the increase or decrease of specific traits in populations over time.
- Use mathematical representations to support conclusions about how natural selection may lead to increases and decreases of genetic traits in populations over time.
- Gather, read, and synthesize information about technologies that have changed the way humans influence the inheritance of desired traits in organisms (artificial selection) from multiple appropriate sources.
- Describe how information from publications about technologies and methods that have changed the way humans influence the inheritance of desired traits in organisms (artificial selection) used are supported or not supported by evidence.
- Assess the credibility, accuracy, and possible bias of publications and they methods they used when gathering information about technologies that have changed the way humans influence the inheritance of desired traits in organisms (artificial selection).

21ST Century/ Interdisciplinary Themes	21st Century Skills
Global Awareness Financial, Business, & Entrepreneurial Literacy Civic Literacy Environmental Literacy Health Literacy	**Creativity & Innovation** **Communication & Collaboration** **Media Literacy** **Critical Thinking & Problem Solving** **Information Literacy** **Information, Communication, & Technology** **Life & Career Skills**

Stage 2- Assessment Evidence
from the NJ Model Curriculum:

How do we know when an organism (fossil) was alive?
How do we know that birds and dinosaurs are related?

In this unit of study, students analyze graphical displays and gather evidence from multiple sources in order to develop an understanding of how fossil records and anatomical similarities of the relationships among organisms and species describe biological evolution. Students search for patterns in the evidence to support their understanding of the fossil record and how those patterns show relationships between modern organisms and their common ancestors. The crosscutting concepts of cause and effect, patterns, and structure and function are called out as organizing concepts for these disciplinary core ideas. Students use the practices of analyzing graphical displays and gathering, reading, and communicating information. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Are Genetically Modified Organisms (GMO) safe to eat?

Students construct explanations based on evidence to support fundamental understandings of natural selection and evolution. They will use ideas of genetic variation in a population to make sense of how organisms survive and reproduce, thus passing on the traits of the species. The crosscutting concepts of patterns and structure and function are called out as organizing concepts that students use to describe biological evolution. Students use the practices of constructing explanations, obtaining, evaluating, and communicating information, and using mathematical and computational thinking. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Summative Assessment 1

- ***Standard:*** MS-LS4-1, MS-LS4-2, MS-LS4-3
- ***Type:*** Lab
- ***Overview:*** Students will be able to create a model evolutionary tree using fossil records and morphology.
- ***Rubric:*** https://docs.google.com/a/linwoodschools.org/document/d/15ybWaljGXLgCVYR3OMNlegiydZb4xa8vdcSG1_d-_LA/edit?usp=sharing
- ***Resources:*** https://api.betterlesson.com/mtp/lesson/638053/print
  https://betterlesson.com/lesson/638053/fossil-record-experience

Summative Assessment 2

- ***Standard:*** MS-LS4-4, MS-LS4-5, MS-LS4-6
- ***Type:*** PBL (problem-based assessment)
- ***Overview:*** Is it the end of humanity? Students will use what they learned about adaptations, evolution and genetic technologies to develop a plan to manipulate the evolutionary process to save the human species. Students write a proposal that persuades the reader that their ideas are plausible and well thought out and supported with research
- ***Rubric:*** https://docs.google.com/a/linwoodschools.org/document/d/18Ab3iNMjGnJc4vDhsOLgtizLUMPTrSKhhl_WBX5dG84/edit?usp=sharing
- ***Resources:***
  - https://betterlesson.com/lesson/635476/introduction-of-pbl-is-it-the-end-of-humanity
  - https://api.betterlesson.com/mtp/lesson/635476/print

Formative Assessments	*Student Self-Assessment*	*Common Assessments*
• Pre-assessments • Labs • Quizzes • Project and problem-based learning activities • Graphic organizers • Short research projects • Collaborative learning projects • Formative checks (whiteboards, T/F, vote with your feet, thumbs up or thumbs down) • Summary Diagrams • Open ended responses • Short responses • Conferencing • Unit tests • Checklists	• Reflection activities (on the learning scale, on the daily target, on labs, on summative assessments, on collaborative work, on projects) • Responses to inquiry-based questions • Think-pair-share activities • Student revising knowledge throughout the unit	• Summative Assessments

Stage 3- Learning Plan

Suggested Learning Activities from the NJ DOE Model Curriculum

Evidence of Common Ancestry

Prior to middle school, students know that some living organisms resemble organisms that once lived on Earth. Fossils provide evidence about the types of organisms and environments that existed long ago. In this unit of study, students will build on this knowledge by examining how the fossil record documents the existence, diversity, extinction, and change of many life forms through Earth's history. The fossil record and comparisons of anatomical similarities between organisms and their embryos enable the inference of lines of evolutionary descent.

Students analyze images or data to identify patterns in the locations of fossils in layers of sedimentary rock. They can use their understanding of these patterns to place fossils in chronological order. Students may make connections between their studies of plate movement in grade 7 and the possible shifting of layers of sedimentary rock to explain inconsistencies in the relative chronological order of the fossil record as it is seen today.

Students can analyze data on the chronology of the fossil record based on radioactive dating. An explanation of radioactive dating can be provided to students along with data, but students are not expected to complete any calculations. Information can be provided in the form of data tables correlating fossil age with half-life. This information could also be presented in the form of a graph.

Students may analyze images from the fossil record to identify patterns of change in the complexity of the anatomical structures in organisms. For example, students can observe pictures of fossilized organisms with similar evolutionary histories in order to compare and contrast changes in their anatomical structures over time. Students may be placed in groups, with each group examining changes in anatomical structures over time within one evolutionary lineage (e.g., the whale, the horse, cycads). Once students have identified patterns of change within one evolutionary lineage, they can meet with students from other groups to discuss patterns of change across multiple evolutionary lineages. Students could then present their findings using a variety of media choices (PowerPoint, poster, short skit or play, comic strip, etc.). This activity would provide application of the real-world phenomenon that life on Earth changes over time.

Students could be provided with multimedia experiences in order to analyze visual displays of the embryological development of different species. They can analyze the linear and nonlinear relationships among the embryological developments of different species. For example, students can analyze data about embryological development to determine whether development across species shares a similar rate, similar size of embryos, or similar characteristics over a period of time. If these characteristics are consistent across species, a linear relationship can be inferred. At the point where the rate, size, or general characteristics of development diverge, the relationship can then be classified as nonlinear.

Students can integrate the patterns they identified in the fossil record by studying sedimentary rock images and radioactive dating data provided by the teacher and the relationships they discovered through their study of embryological development with evidence from informational texts to develop an explanation of changes in life forms throughout the history of life on Earth. This explanation could be presented in the form of a claim, with students required to cite evidence from their studies of diagrams, images, and texts to explain that life on Earth has changed over time.

Selection and Adaptation

In this unit of study, students will build on their prior knowledge by constructing explanations that describe how genetic variations increase some individuals' probability of surviving and reproducing. Mathematical representations will be used to support explanations of how natural selection leads to increases and decreases of specific traits in populations over time. Students will analyze numerical data sets that represent a proportional relationship between some change in the environment and corresponding changes in genetic variation over time. Students will summarize these numerical data sets and construct explanations for how the proportional relationship could impact the probability of some individuals surviving and reproducing in a specific environment.

Students will construct explanations based on evidence that describes how genetic variations can provide a survival and reproductive advantage over other traits. This evidence could be provided through activities that model these phenomena or by examining and analyzing data from informative texts. Based on their findings, students can write claims about how natural selection leads to a predominance of some traits in a population and the suppression of other traits. Students will pay attention to precise details in explanations from specific textual evidence and will cite this evidence to support their analysis and reflection on research that explains how genetic variation of traits in a population increases some individuals' probability of surviving and reproducing in a specific environment. Students will compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading these texts and write informative/explanatory texts on how natural selection leads to the predominance of some traits and the suppression of others in a population.

Students will engage effectively in a range of collaborative discussions where they will present their claims and findings. These discussions may be one-on-one between students, in small groups, or teacher-led large group discussions. In these discussions, students will build on others' ideas while expressing their own clearly. Claims must emphasize salient points in a focused, coherent manner, supported with relevant evidence, sound valid reasoning, and well-chosen details. Students must use appropriate eye contact, adequate volume, and clear pronunciation. There are multiple activities available that show students how one trait can provide a survival advantage over another in a specific environment. As part of these activities, students can analyze data and determine ratio relationships to provide evidence of cause-and-effect relationships. These ratios can be used to explain why some inherited traits result in individuals that have a survival advantage in a specific environment over time or why other traits in a population are suppressed. When an environment changes as a result of human influence and/or natural processes on Earth, traits that were present in populations of organisms and that led to a survival advantage in that environment before the change may no longer offer an advantage. Changes in environmental conditions can be the driving cause of the suppression of traits in populations.

Students will examine a variety of environmental factors that may influence the natural selection that is taking place in populations. Students will need to use simple probability statements and proportional reasoning to explain why each factor may or may not be responsible for the changes being observed. Students will compare and contrast the information gained from experiments, simulations, video, or multimedia sources with information gained from reading science and technical texts to support their explanations. After students have constructed their explanations, they will participate in collaborative discussions in small groups; in larger, teacherled groups, or in pair.

After students have developed a strong understanding of natural selection, they will need to begin gathering evidence from multiple sources, including print and digital, to support analysis of information about technologies that have changed how humans can influence the inheritance of desired traits in organisms (artificial selection). Students need to examine current technologies as well as the technologies that have led to these scientific discoveries. Students will cite the information they gathered and quote or paraphrase relevant data and conclusions from their resources to describe the impact that current technologies have on society. Some of the influences of humans on genetic outcomes in artificial selection that students can examine include genetic modifications, animal husbandry, and gene therapy

Students can be provided with multiple sources to determine the credibility, accuracy, and possible bias of the resources. In order to determine the best sources, students can investigate and describe how information in these resources is supported or not supported by evidence. Once students have determined appropriate sources, they can begin to synthesize information about the technologies that have changed how humans can influence the inheritance of desired traits in organisms (artificial selection). Students can quote or paraphrase the data and conclusions and provide basic bibliographic information. They can do this in a variety of ways (e.g., in writing, verbal discussion, debate, Socratic seminar, etc.).

Resources/Instructional Materials
(articles, novels, websites, books, magazines, art, media)

- http://www.pbslearningmedia.org/resource/evol07.sci.life.evo.genconnect/human-chromosome-2/
- http://ngss.nsta.org/Resource.aspx?ResourceID=56
- http://ngss.nsta.org/Resource.aspx?ResourceID=17
- http://ngss.nsta.org/Resource.aspx?ResourceID=55
- http://ngss.nsta.org/Resource.aspx?ResourceID=63
- http://ngss.nsta.org/Resource.aspx?ResourceID=378
- http://ngss.nsta.org/Resource.aspx?ResourceID=126

Technology Resources

- Google Classroom
- Socrative
- BrainPop
- Nasa website
- Google Apps
- Quizlet
- Science World
- Kahoot!
- Youtube
- Mystery Science
- Discovery
- PowerPoint
- Nova
- Scholastic

Accommodations & Modifications
for Spec. Ed., ELL, GT, & At Risk Students

- Allow oral responses
- Allow verbalization before writing
- Use audio materials when necessary
- Modify homework assignments
- Read tests aloud
- Provide math manipulatives as necessary
- Restate, reword, clarify directions
- Re-teach concepts using small groups
- Provide educational "breaks" as necessary
- Expanding time for free reading
- Chunking Content
- Calculator
- Use mnemonic devices
- Provide a cueing system
- Untimed and/or extended test taking time
- Shorten assignments to focus on mastery concept
- Leveled Reading Materials
- Acronyms
- Graphic Organizers
- Notes Provided
- Check agenda book for parent(s) communication
- Read directions aloud
- Assignment, Project, and Assessment Modification Based on Individual Student Needs
- Speech to Text/Text to Speech Features in Google Apps
- Technology assisted instruction
- Preferential seating utilized
- Redirect student(s) as necessary
- Student choice for project or approach to assignment
- Inquiry-Based Learning
- Genius Hour

Adapted from: Wiggins, Grant and J. McTighe. (1998). *Understanding by Design*, Association for Supervision and Curriculum Development and 5E NGSS Lesson Plan from www.lewiscenter.org and NJ Science Model Curriculum athttp://www.nj.gov/education/modelcurriculum/sci/7.shtml

Science Grade 8

Unit #2	**Title**: Stability and Change on Earth	**Pacing:** 30 days

Stage 1- Desired Results

Established Goals/NJSLS Standards

Next Generation Science Standards/NJSLS:

MS-ESS3-1 Earth and Human Activity

- 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. *[Clarification Statement: Emphasis is on how these resources are limited and typically nonrenewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).] (MS-ESS3-1)*

MS-ESS3-2 Earth and Human Activity

- Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. *[Clarification Statement: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornado-prone regions or reservoirs to mitigate droughts).] (MS-ESS3- 2)*

MS-ESS3-4 Earth and Human Activity

- Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. *[Clarification Statement: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.] (MS-ESS3-4)*

MS-LS4-5 Biological Evolution: Unity and Diversity

- Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. [Clarification Statement: Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures, atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.] (MS-ESS3-5)

English Language Arts Standards

- Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS3-1),(MS-ESS3-2) RST.6-8.1
- 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). (MS-ESS3-2) RST.6-8.7
- Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS3-1) WHST.6-8.2
- Draw evidence from informational texts to support analysis, reflection, and research. (MS-ESS3-1) WHST.6-8.9

Mathematics Standards

- Reason abstractly and quantitatively. (MS-ESS3-2) MP.2
- 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. (MS-ESS3-1),(MS-ESS3-2) 6.EE.B.6
- 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. (MS-ESS3-1),(MS-ESS3-2) 7.EE.B.4

Enduring Understandings (DCI) ***Students will understand…***	**Essential Questions** ***Students will consider...***
ESS3.A: Natural Resources ● **Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable o human lifetimes. These resources are distributed unevenly around t planet as a result of past geologic processes. (MS-ESS3-1)** **ESS3.B: Natural Hazards** ● **Mapping the history of natural hazards in a region, combined with understanding of related geologic forces can help forecast the locations and likelihoods of future events. (MS-ESS3-2)** **ESS3.C: Human Impacts on Earth Systems** ● **• Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unl the activities and technologies involved are engineered otherwise. (MS-ESS3-4)** **ESS3.D: Global Climate Change** ● **Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever clim changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5)**	● **Why aren't minerals and groundwater distributed evenly across th world?** ● **How can we predict and prepare for natural disasters?** ● **How can we predict and prepare for natural disasters?** ● **How can basic chemistry be used to explain the mechanisms that control the global temperature the atmosphere?**

Knowledge (Concepts) *Students will know…*	**Academic Vocabulary**
• **Humans depend on Earth's land, ocean, atmosphere, and biosphere for m different resources.** • **All human activities draw on Earth's land, ocean, atmosphere, and biosph resources and have both short and long-term consequences, positive as we as negative, for the health of people and the natural environment.** • **Minerals, fresh water, and biosphere resources are distributed unevenly around the planet as a result of past geologic processes.** • **Cause-and-effect relationships may be used to explain how uneven distributions of Earth's mineral, energy, and groundwater resources have resulted from past and current geosciences processes.** • **Resources that are unevenly distributed as a result of past processes inclu but are not limited to petroleum, metal ores, and soil.** • **Mineral, fresh water, ocean, biosphere, and atmosphere resources are limited, and many are not renewable or replaceable over human lifetimes.** • **The distribution of some of Earth's land, ocean, atmosphere, and biospher resources are changing significantly due to removal by humans.** • **Natural hazards can be the result of interior processes, surface processes, severe weather events.** • **Some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, suc as earthquakes, occur suddenly and with no notice, and thus are not yet predictable.** • **Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces, can help forecast the locations an likelihoods of future events.** • **Data on natural hazards can be used to forecast future catastrophic events and inform the development of technologies to mitigate their effects.** • **Data on natural hazards can include the locations, magnitudes, and frequencies of the natural hazards.** • **Graphs, charts, and images can be used to identify patterns of natural hazards in a region.** • **Graphs, charts, and images can be used to understand patterns of geologic forces that can help forecast the locations and likelihoods of future events.** • **Technologies that can be used to mitigate the effects of natural hazards ca be global or local.** • **Technologies used to mitigate the effects of natural hazards vary from reg to region and over time.** • **All human activity draws on natural resources and has both short and lon term consequences, positive as well as negative, for the health of people an the natural environment.** • **Increases in human population and per-capita consumption of natural resources impact Earth's systems.**	• **atmosphere** • **biosphere** • **resources** • **minerals** • **petroleum** • **metal ores** • **soil** • **renewable** • **non-renewable** • **natural hazards** • **natural resources** • **consumption** • **greenhouse gas** • **fossil fuels** • **catastrophic events**

Knowledge (Concepts) Continued

Students will know…

- **Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and techn involved are engineered otherwise.**
- **Cause and effect relationships may be used to predict how increases in human population and per-capita consumption of natural resources impact Earth's sy**
- **The consequences of increases in human populations and consumption of natural resources are described by science.**
- **Science does not make the decisions for the actions society takes.**
- **Scientific knowledge can describe the consequences of human population and per-capita consumption of natural resources impact Earth's systems but does n necessarily prescribe the decisions that society takes.**
- **Stability in Earth's surface temperature might be disturbed either by sudden events or gradual changes that accumulate over time.**
- **Human activities and natural processes are examples of factors that have caused the rise in global temperatures over the past century.**
- **Human activities play a major role in causing the rise in global temperatures.**
- **Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature warming).**
- **Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior, and on applying that knowledge wisely in decisions and ac**
- **Evidence that some factors have caused the rise in global temperature over the last century can include tables, graphs, and maps of global and regional tempe atmospheric levels of gases such as carbon dioxide and methane, and the rates of human activities.**

Skills

Students will be able to…

- **Construct a scientific explanation based on valid and reliable evidence of how the uneven distributions of Earth's mineral, energy, and groundwater resource result of past and current geosciences processes.**
- **Obtain evidence from sources, which must include the student's own experiments.**
- **Construct a scientific explanation based on the assumption that theories and laws that describe the current geosciences process operates today as they did in t and will continue to do so in the future.**
- **Analyze and interpret data on natural hazards to determine similarities and differences and to distinguish between correlation and causation.**
- **Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a pheno a solution to a problem.**
- **Ask questions to identify and clarify a variety of evidence for an argument about the factors that have caused the rise in global temperatures over the past ce**
- **Ask questions to clarify human activities and natural processes that are major factors in the current rise in Earth's mean surface temperature.**

21ST Century/ Interdisciplinary Themes	21st Century Skills
Global Awareness **Financial, Business, & Entrepreneurial Literacy** **Civic Literacy** **Environmental Literacy** **Health Literacy**	**Creativity & Innovation** **Communication & Collaboration** **Media Literacy** **Critical Thinking & Problem Solving** **Information Literacy** **Information, Communication, & Technology** **Life & Career Skills**

Stage 2- Assessment Evidence
from the NJ Model Curriculum:

Why aren't minerals and groundwater distributed evenly across the world?

Students construct an understanding of the ways that human activities affect Earth's systems. Students use practices to understand the significant and complex issues surrounding human uses of land, energy, mineral, and water resources and the resulting impacts on the development of these resources. Students also understand that the distribution of these resources is uneven due to past and current geosciences processes or removal by humans.
The crosscutting concepts of patterns, cause and effect, and stability and change are called out as organizing concepts for these disciplinary core ideas. In this unit of study students are expected to demonstrate proficiency in asking questions, analyzing and interpreting data, constructing explanations, and designing solutions. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Summative Assessment 1

- ***Standard:*** **MS-ESS3-1, MS-ESS3-2, MS-ESS3-4, MS-ESS3-5**
- ***Type:*** **Essay**
- ***Overview:*** Write informative/explanatory texts to examine the events leading up to global warming and climate change and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
- ***Rubric:*** **https://docs.google.com/a/linwoodschools.org/document/d/17JT_GMbHSIby2FHM1vgl3UU0cF9POkfSFDRbsIsL0cE/edit?usp=sharing**
- ***Resources:*** **https://betterlesson.com/lesson/632584/energy-history**

Formative Assessments	*Student Self-Assessment*	*Common Assessments*
• Pre-assessments • Labs • Quizzes • Project and problem-based learning activities • Graphic organizers • Short research projects • Collaborative learning projects • Formative checks (whiteboards, T/F, vote with your feet, thumbs up or thumbs down) • Summary Diagrams • Open ended responses • Short responses • Conferencing • Unit tests • Checklists	• Reflection activities (on the learning scale, on the daily target, on labs, on summative assessments, on collaborative work, on projects) • Responses to inquiry-based questions • Think-pair-share activities • Student revising knowledge throughout the unit	• Summative Assessments

Stage 3- Learning Plan

Suggested Learning Activities from the NJ DOE Model Curriculum

Stability and Change on Earth

Students will begin by building on their prior knowledge that human activities affect the Earth. Students will describe how human activities have positive as well as n impacts on land, ocean, atmosphere, and biosphere resources.

In this unit of study, students will build upon this knowledge by examining the causes of the uneven distribution of resources on Earth. Students can then write an inf text to explain the causes of uneven distributions of Earth's minerals, energy, and groundwater resources. These causes can include past and current geosciences proc well as human removal of resources. The written text needs to include specific evidence to support the student's explanation. Students will use variables to represent r and write expressions. They will convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

Students will perform investigations to gather data showing how natural processes can lead to the uneven distributions of Earth's mineral, energy, and groundwater r The resources considered should include but not be limited to petroleum, metal ores, and soil. An example of an investigation could include using models of different l of sediment that will show the uneven distribution of groundwater as it permeates through different types of soil and rock. A saturated mineral solution (i.e. salt) can poured over the sedimentary layers and then evaporated to leave behind a deposit. Students could then take core samples using straws to gather data from the model.

Emphasis is on how these resources, including land, ocean, atmosphere, biosphere, mineral, and fresh water, are limited and typically are nonrenewable, and how the distributions are significantly changing as a result of removal by humans. Students will use variables to represent quantities and construct simple equations and inequ solve problems by reasoning about the quantities.

Students may use maps showing the current global distribution of different resources along with maps showing past global distribution of the same resources to gathe Students could use these data to create mathematical expressions that could show the impact of current human consumption on possible future resource distribution (renewable and nonrenewable energy resources). In addition, students could use maps of different geosciences processes alongside other data to explain the uneven distributions of Earth's resources.

Students will continue to learn about Earth's systems as they consider how natural hazards can be the result of interior processes, surface processes, or severe weathe They will learn that some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Students will also look at how technology can be used to predict natural hazards to their impacts. Last, students will examine evidence of natural processes and human activities that have caused global climate change.

Students can analyze maps, charts, and images of natural hazards to look for patterns in past occurrences of catastrophic events. Data on natural hazards can include locations, magnitudes, and frequencies of the natural hazards. Students can use these data to make reliable predictions of future catastrophic events.

Students can also look at past occurrences of catastrophic events to determine how those events have influenced the development of technologies scientists use to predi future events. It might be useful to include local catastrophic events, since the technology used to predict and diminish effects of future events varies from region to re over time. Some of the data students might analyze could include locations, magnitudes, and frequencies of the natural hazards.

Students will continue their study of Earth's systems and processes by investigating the impact of sudden events or gradual changes that accumulate over time and aff stability of Earth's surface temperature.

Students will cite specific textual evidence to support an argument about the role of human activity and natural processes in the gradual increase in global temperatu the past century.

Suggested Learning Activities from the NJ DOE Model Curriculum Continued

Students can ask questions to clarify how human activities, such as the release of greenhouse gases from the burning of fossil fuels, play major roles in the rise in glob temperatures. Students can also ask questions about how natural events, such as volcanic activity, also contribute to the rise in global temperature. Students can look variety of sources for evidence, such as tables, graphs, and maps of global and regional temperatures; atmospheric levels of gases, such as carbon dioxide and methan rates of human activities, to support an argument that global temperatures have risen over the past century. Students can use these data to write mathematical expres show relationships between these variables.

Students will examine a variety of changes that humans have made to Earth's natural systems and determine whether these changes have positive impacts, negative i or some combination of positive and negative impacts. As part of this study, students will collect evidence to support arguments they develop about the impact of the modifications to Earth's systems. Students will consider how a variety of human actions can impact an ecosystem. Among the human actions considered will be huma population growth and the consumption of resources from the ecosystem. Students will prepare a report on the system and describe how the system is impacted. Evid must be recorded to support their arguments and must be presented in both an oral and a written format.

Students can cite specific textual evidence to develop an argument about the need to reduce the level of climate change due to human activity. The argument can inclu need for reduction in human vulnerability to whatever climate change occurs as a result of natural events. This unit of study will be will be leveraged in the Unit 4 engineering and design process.

Resources/Instructional Materials

(articles, novels, websites, books, magazines, art, media)

- **NJ DOE Model Curriculum - http://www.nj.gov/education/modelcurriculum/sci/8u3.pdf**
- **http://education.usgs.gov/secondary.html**
- **http://www.education.noaa.gov/**
- **https://kids.usa.gov/teens/science/environment/index.shtml**
- **https://www.education.com/activity/environmental-science/**

Technology Resources

- **Google Classroom**
- **Socrative**
- **BrainPop**
- **Nasa website**
- **Google Apps**
- **Quizlet**
- **Science World**
- **Kahoot!**
- **Youtube**
- **Mystery Science**
- **Discovery**
- **PowerPoint**
- **Nova**
- **Scholastic**

Accommodations & Modifications

for Spec. Ed., ELL, GT, & At Risk Students

- Allow oral responses
- Allow verbalization before writing
- Use audio materials when necessary
- Modify homework assignments
- Read tests aloud
- Provide math manipulatives as necessary
- Restate, reword, clarify directions
- Re-teach concepts using small groups
- Provide educational "breaks" as necessary
- Expanding time for free reading
- Chunking Content
- Calculator
- Use mnemonic devices
- Provide a cueing system
- Untimed and/or extended test taking time
- Shorten assignments to focus on mastery concept
- Leveled Reading Materials
- Acronyms
- Graphic Organizers
- Notes Provided
- Check agenda book for parent(s) communication
- Read directions aloud
- Assignment, Project, and Assessment Modification Based on Individual Student Needs
- Speech to Text/Text to Speech Features in Google Apps
- Technology assisted instruction
- Preferential seating utilized
- Redirect student(s) as necessary
- Student choice for project or approach to assignment
- Inquiry-Based Learning
- Genius Hour

Adapted from: Wiggins, Grant and J. McTighe. (1998). *Understanding by Design*, Association for Supervision and Curriculum Development and 5E NGSS Lesson Plan from www.lewiscenter.org and NJ Science Model Curriculum athttp://www.nj.gov/education/modelcurriculum/sci/7.shtml

Science- Grade 8

Unit # 3	**Title**: Human Impacts	**Pacing**: 25 days

Stage 1- Desired Results

Established Goals/NJSLS Standards

Next Generation Science Standards/NJSLS:

MS-ESS3-3 Earth and Human Activity

- Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. [Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating) solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).] (MS-ESS3-3)

MS-ETS1-1 Engineering Design

- 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. (MS-ETS1-1)

MS-ETS1-2 Engineering Design

- Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. (MS-ETS1-2)

MS-ETS1-3 Engineering Design

- Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. (MS-ETS1-3)

English Language Arts Standards

- Cite specific textual evidence to support analysis of science and technical texts. (MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3) RST.6-8.1
- 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). (MS-ESS3-3),(MS-ETS1-3) RST.6-8.7
- Compare and contrast the information gained from experiments, simulations, videos, or multimedia sources with that gained from reading a text on the same topic. (MS-ETS1-2),(MS-ETS1-3) RST.6-8.9
- 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. (MS-ETS1-2) WHST.6- 8.7
- Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-ESS3-3),(MS-ETS1-1) WHST.6-8.8
- Draw evidence from informational texts to support analysis, reflection, and research. (MS-ETS1-2) WHST.6-8.9
- Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-ETS1-4) SL.8.5

Mathematics Standards

- 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. (MS-ESS3-3) 6.EE.B.6
- 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. (MS-ESS3-3) 7.EE.B.4
- Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-ESS3-3) 6.RP.A.1
- Recognize and represent proportional relationships between quantities. (MS-ESS3-3) 7.RP.A.2
- Reason abstractly and quantitatively. (MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3) MP.2
- Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3) 7.EE.3

Enduring Understandings (DCI) ***Students will understand…***	**Essential Questions** ***Students will consider...***
ESS3.C: Human Impacts on Earth Systems ● Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. (MS-ESS3-3) ● Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. (MSESS3-3),(MS-ESS3-4) **ETS1.A: Defining and Delimiting Engineering Problems** ● The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1) **ETS1.B: Developing Possible Solutions** ● A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) ● There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3) ● Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3) ● Models of all kinds are important for testing solutions. (MS-ETS1-4)	● How do we monitor the health of the environment (our life support system)?

Knowledge (Concepts) ***Students will know…***	**Academic Vocabulary**
• Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.	• species • biosphere • extinction • natural resources • habitat • negative impact • positive impact • environment • climate

Skills

Students will be able to…

- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species.
- Changes to Earth's environments can have different impacts (negative and positive) for different living things.
- Typically as human populations and per capita consumption of natural resources increase, so do the negative impacts on Earth, unless the activities and technologies involved are engineered otherwise.
- Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.
- The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time.

21ST Century/ Interdisciplinary Themes	**21st Century Skills**
Global Awareness Financial, Business, & Entrepreneurial Literacy Civic Literacy **Environmental Literacy** Health Literacy	**Creativity & Innovation** **Communication & Collaboration** **Media Literacy** **Critical Thinking & Problem Solving** **Information Literacy** **Information, Communication, & Technology** **Life & Career Skills**

Stage 2- Assessment Evidence
from the NJ Model Curriculum:

How do we monitor the health of the environment (our life support system)?

Is it possible to predict and protect ourselves from natural hazards? In this unit of study, students analyze and interpret data and design solutions to build on their understanding of the ways that human activities affect Earth's systems. The emphasis of this unit is the significant and complex issues surrounding human uses of land, energy, mineral, and water resources and the resulting impacts of these uses. The crosscutting concepts of cause and effect and the influence of science, engineering, and technology on society and the natural world are called out as organizing concepts for these disciplinary core ideas. Building on Unit 3, students define a problem by precisely specifying criteria and constraints for solutions as well as potential impacts on society and the natural environment; systematically evaluate alternative solutions; analyze data from tests of different solutions; combining the best ideas into an improved solution; and develop and iteratively test and improve their model to reach an optimal solution. In this unit of study students are expected to demonstrate proficiency in analyzing and interpreting data and designing solutions. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Summative Assessment 1

- ***Standard:*** MS-ESS3-3, MS-ETS1-1,MS-ETS1-2, MS-ETS1-3
- ***Type:*** PBL (project-based assessment)
- ***Overview:*** Participate in a class debate to evaluate options for cleaning up the mess known as the "Great Pacific Garbage Patch" Students will work in groups of 3. After watching videos and researching the topic, with defined limitations, students will consider whether or not the ideas presented in class will actually work. Student will present their ideas and use evidence to justify their claims.

- ***Rubric:*** https://docs.google.com/a/linwoodschools.org/document/d/1G4-GzJZ1OsMVMKYBq8vs9BZbnm0mb_K4lKv0Q_xxXa8/edit?usp=sharing
- ***Resources:*** https://api.betterlesson.com/mtp/lesson/631903/print
  https://betterlesson.com/lesson/631903/the-great-pacific-garbage-patch

Formative Assessments	***Student Self-Assessment***	***Common Assessments***
• Pre-assessments • Labs • Quizzes • Project and problem-based learning activities • Graphic organizers • Short research projects • Collaborative learning projects • Formative checks (whiteboards, T/F, vote with your feet, thumbs up or thumbs down) • Summary Diagrams • Open ended responses • Short responses • Conferencing • Unit tests • Checklists	• Reflection activities (on the learning scale, on the daily target, on labs, on summative assessments, on collaborative work, on projects) • Responses to inquiry-based questions • Think-pair-share activities • Student revising knowledge throughout the unit	• Summative Assessments

Stage 3- Learning Plan

Suggested Learning Activities from the NJ DOE Model Curriculum

Human Impacts

Throughout this unit of study, students will be engaged in the engineering design process. Students can start by identifying a human impact on the environment that has resulted from human consumption of natural resources. Using what they have identified, students will begin to define the criteria and constraints of the design problem whose solution will help to monitor and minimize the human impact on the environment. Using informational texts to support this process is important. Students will draw evidence from these texts in order to support their analysis, reflection, and research.

When students consider criteria, they should conduct short research projects to examine factors such as societal and individual needs, cost effectiveness, available materials and natural resources, current scientific knowledge, and current advancements in science and technology. They should also consider limitations due to natural factors such as regional climate and geology. While conducting their research, students will need to gather their information from multiple print and digital sources and assess the credibility of each source.

When students quote or paraphrase the data and conclusions found in these resources, they will need to avoid plagiarism and provide basic bibliographic information for each source. After comparing the information gained from their research, experiments, simulations, video, or other multimedia sources, they will be able to determine precise design criteria and constraints that lead to a successful solution.

Students will need to jointly develop and agree upon the design criteria that will be used to evaluate competing existing design solutions (i.e., varying dam designs, irrigation systems, varying methods of reducing pollution, varying methods of urban development). Students can use a rubric, checklist, or decision tree to assist them in evaluating the design solution selected.

Students can be provided with data from tests performed on these existing design solutions. They will analyze and interpret these data to determine similarities and differences in findings. This is where they are deciding where different parts of the pre-existing solutions can be combined. For example, the building materials of a particular dam may be superior while the shape of another design may be more suitable. Students should consider the ratio relationship between the impacts that humans have on the environment and the impact that the design solution has on minimizing these impacts. Students will need to consider both qualitative and quantitative data when drawing conclusions about the various design solutions.

It is important that students handle mathematical data appropriately. They should use variables to represent quantities and construct simple equations and inequalities to solve problems. While analyzing numerical data, students will need to solve mathematical problems that show both positive and negative values and apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computations and estimation strategies. Support from mathematics teachers will help students with the mathematics required for this type of analysis.

Once students have evaluated competing solutions and analyzed and interpreted data showing the similarities and differences of these solutions, they may then begin designing their own solutions. It is important that students consider the benefits and risks of each existing design solution. The impact on the environment and human society must be considered in the design. The final goal for students is to identify the parts of each design solution that best fit their criteria and constraints and combine these parts into a design solution that is better than any of its predecessors.

Resources/Instructional Materials
(articles, novels, websites, books, magazines, art, media)

- NJ DOE Model Curriculum - http://www.nj.gov/education/modelcurriculum/sci/8u4.pdf
- http://education.usgs.gov/secondary.html
- http://www.education.noaa.gov/

Technology Resources

- Google Classroom
- Socrative
- BrainPop
- Nasa website
- Google Apps
- Quizlet
- Science World
- Kahoot!
- Youtube
- Mystery Science
- Discovery
- PowerPoint
- Nova
- Scholastic

Accommodations & Modifications
for Spec. Ed., ELL, GT, & At Risk Students

- Allow oral responses
- Allow verbalization before writing
- Use audio materials when necessary
- Modify homework assignments
- Read tests aloud
- Provide math manipulatives as necessary
- Restate, reword, clarify directions
- Re-teach concepts using small groups
- Provide educational "breaks" as necessary
- Expanding time for free reading
- Chunking Content
- Calculator
- Use mnemonic devices
- Provide a cueing system
- Untimed and/or extended test taking time
- Shorten assignments to focus on mastery concept
- Leveled Reading Materials
- Acronyms
- Graphic Organizers
- Notes Provided
- Check agenda book for parent(s) communication
- Read directions aloud
- Assignment, Project, and Assessment Modification Based on Individual Student Needs
- Speech to Text/Text to Speech Features in Google Apps
- Technology assisted instruction
- Preferential seating utilized
- Redirect student(s) as necessary
- Student choice for project or approach to assignment
- Inquiry-Based Learning
- Genius Hour

Adapted from: Wiggins, Grant and J. McTighe. (1998). *Understanding by Design*, Association for Supervision and Curriculum Development and 5E NGSS Lesson Plan from www.lewiscenter.org and NJ Science Model Curriculum athttp://www.nj.gov/education/modelcurriculum/sci/7.shtml

Science- Grade 8

Unit # 4	Title: Relationships among Forms of Energy//Thermal Energy	Pacing: 50 days

Stage 1- Desired Results

Established Goals/NJSLS Standards

Next Generation Science Standards/NJSLS:

MS-PS3-1 Energy

- 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. *[Clarification Statement: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a wiffle ball versus a tennis ball.] (MS-PS3-1)*

MS-PS3-2 Energy

- 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. *[Clarification Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.] [Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions.] (MS-PS3-2)*

MS-PS3-5 Energy

- 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. *[Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.] [Assessment Boundary: Assessment does not include calculations of energy.] (MS-PS3-5)*

MS-PS3-3 Energy

- Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. *[Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.] (MS-PS3-3)*

MS-PS3-4 Energy

- 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. *[Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.] (MS-PS3-4)*

MS-ETS1-1 Engineering Design

- 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. (MS-ETS1-1)

MS-ETS1-2 Engineering Design

- Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. (MS-ETS1-2)

MS-ETS1-3 Engineering Design

- Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. (MS-ETS1-3)

MS-ETS1-4 Engineering Design

- Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. (MS-ETS1-4)

English Language Arts Standards

- Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. (MS-PS3-1),(MS-PS3-5) RST.6-8.1
- 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). (MS-PS3-1) RST.6-8.7
- Write arguments focused on discipline content. (MS-PS3-5) WHST.6-8.1
- 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. (MS-PS3-3) WHST.6-8.7
- Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-PS3-2) SL.8.5
- Cite specific textual evidence to support analysis of science and technical texts. (MS-PS3-5),MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3) RST.6-8.1
- Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS3-3),(MS-PS3-4) RST.6-8.3
- 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). (MS-PS3-3),(MS-PS3-4),(MS-ETS1-3) RST.6-8.7
- Compare and contrast the information gained from experiments, simulations, videos, or multimedia sources with that gained from reading a text on the same topic. (MS-ETS1-2),(MS-ETS1-3) RST.6-8.9
- 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. (MS-ETS1-2) WHST.6- 8.7
- Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-ETS1-1) WHST.6-8.8
- Draw evidence from informational texts to support analysis, reflection, and research. (MS-ETS1-2) WHST.6-8.9
- Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-ETS1-4) SL.8.5

Mathematics Standards

- Reason abstractly and quantitatively. (MS-PS3-1),(MS-PS3-5) MP.2
- Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities. (MS-PS3-1),(MS-PS3-5) 6.RP.A.1
- Understand the concept of a unit rate a/b associated with a ratio a:b with $b \neq 0$, and use rate language in the context of a ratio relationship. (MS-PS3-1) 6.RP.A.2
- Recognize and represent proportional relationships between quantities. (MS-PS3-1),(MS-PS3-5) 7.RP.A.2
- Know and apply the properties of integer exponents to generate equivalent numerical expressions. (MS-PS3-1) 8.EE.A.1
- 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. (MS-PS3-1) 8.EE.A.2
- 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. (MS-PS3-1),(MS-PS3- 5) 8.F.A.3
- Reason abstractly and quantitatively. (MS-PS3-4),(MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3),(MS-ETS1-4) MP.2
- Summarize numerical data sets in relation to their context. (MS-PS3-4) 6.SP.B.5
- Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3) 7.EE.3
- Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. (MS-ETS1-4) 7.SP

Enduring Understandings (DCI) *Students will understand…*	**Essential Questions** *Students will consider...*
PS3.A: Definitions of Energy ● Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed. (MS-PS3-1) ● A system of objects may also contain stored (potential) energy, depending on their relative positions. (MS-PS3-2) **PS3.B: Conservation of Energy and Energy Transfer** ● When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (MS-PS3-5) **PS3.C: Relationship Between Energy and Forces** ● When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. (MS-PS3-2) **PS3.A: Definitions of Energy** ● Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (MS-PS3-3),(MS-PS3- 4) **PS3.B: Conservation of Energy and Energy Transfer** ● The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. (MS-PS3-4) ● Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS-PS3- 3) **ETS1.A: Defining and Delimiting Engineering Problems** ● The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1) **ETS1.B: Developing Possible Solutions** ● A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) ● There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1- 2), (MS-ETS1-3) ● Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3) ● Models of all kinds are important for testing solutions. (MS-ETS1-4) **ETS1.C: Optimizing the Design Solution** ● Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3) ● The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4)	● Is it better to have an aluminum (baseball/softball) bat or a wooden bat? ● What would give you a better chance of winning a bowling match, using a basketball that you can roll really fast, or a bowling ball that you can only roll slowly? ● Who can design the best roller coaster? ● How can a standard thermometer be used to tell you how particles are behaving?

Knowledge (Concepts) ***Students will know…***	**Academic Vocabulary**
• Kinetic energy is related to the mass of an object and to the speed of an object. • Kinetic energy has a relationship to mass separate from its relationship to speed. • Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of the object's speed. • Proportional relationships among different types of quantities provide information about the magnitude of properties and processes. • When the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. • A system of objects may contain stored (potential) energy, depending on the objects' relative positions. • When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the objects. • Models that could include representations, diagrams, pictures, and written descriptions of systems can be used to represent systems and their interactions, such as inputs, processes, and outputs, and energy and matter flows within systems. • When the kinetic energy of an object changes, energy is transferred to or from the object. • When the motion energy of an object changes, there is inevitably some other change in energy at the same time. • Kinetic energy may take different forms (e.g., energy in fields, thermal energy, energy of motion). • Temperature is a measure of the average kinetic energy of particles of matter. • The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. • Energy is spontaneously transferred out of hotter regions or objects and into colder ones. • The transfer of energy can be tracked as energy flows through a designed or natural system. • The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. • Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. • A solution needs to be tested and then modified on the basis of the test results in order to improve it. • There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem.	• motion • energy • kinetic energy • potential energy • speed • velocity • acceleration • force • mass • thermal energy • temperature

Skills

Students will be able to…

- Construct and interpret graphical displays of data to identify linear and nonlinear relationships of kinetic energy to the mass of an object and to the speed of an object.
- Develop a model to describe what happens to the amount of potential energy stored in the system when the arrangement of objects interacting at a distance changes
- Use models to represent systems and their interactions, such as inputs, processes, and outputs, and energy and matter flows within systems. Models could include representations, diagrams, pictures, and written descriptions.
- Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
- Conduct an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of an object. Do not include calculations of energy.
- Apply scientific ideas or principles to design, construct, and test a design of a device that either minimizes or maximizes thermal energy transfer.
- Determine design criteria and constraints for a device that either minimizes or maximizes thermal energy transfer.
- Test design solutions and modify them on the basis of the test results in order to improve them.
- Use a systematic process for evaluating solutions with respect to how well they meet criteria and constraints.

21ST Century/ Interdisciplinary Themes	21st Century Skills
Global Awareness **Financial, Business, & Entrepreneurial Literacy** Civic Literacy **Environmental Literacy** Health Literacy	**Creativity & Innovation** **Communication & Collaboration** **Media Literacy** **Critical Thinking & Problem Solving** **Information Literacy** **Information, Communication, & Technology** **Life & Career Skills**

Stage 2- Assessment Evidence
from the NJ Model Curriculum:

How can physics explain sports?

In this unit, students use the practices of analyzing and interpreting data, developing and using models, and engaging in argument from evidence to make sense of relationship between energy and forces. Students develop their understanding of important qualitative ideas about the conservation of energy. Students understand that objects that are moving have kinetic energy and that objects may also contain stored (potential) energy, depending on their relative positions. Students also understand the difference between energy and temperature, and the relationship between forces and energy. The crosscutting concepts of scale, proportion, and quantity, systems and system models, and energy and matter are called out as organizing concepts for these disciplinary core ideas. Students use the practices of analyzing and interpreting data, developing and using models, and engaging in argument from evidence. Students are also expected to use these practices to demonstrate understanding of the core ideas.

How can a standard thermometer be used to tell you how particles are behaving?

In this unit, students ask questions, plan and carry out investigations, engage in argument from evidence, analyze and interpret data, construct explanations, define problems and design solutions as they make sense of the difference between energy and temperature. They use the practices to make sense of how the total change of energy in any system is always equal to the total energy transferred into or out of the system. The crosscutting concepts of energy and matter, scale, proportion, and quantity, and influence of science, engineering, and technology on society and the natural world are the organizing concepts for these disciplinary core ideas. Students ask questions, plan and carry out investigations, engage in argument from evidence, analyze and interpret data, construct explanations, define problems and design solutions. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Summative Assessment 1

- ***Standard:*** MS-PS3-1, MS-PS3-2, MS-PS3-3, MS-PS3-4, MS-PS3-5, MS-ETS1-1, MS-ETS1-2, MS-ETS1-3, MS-ETS1-4
- ***Type:*** PBL (problem-based assessment) Creation of an invention or solving an idea
- ***Overview:*** Students will design, construct, and test a thermos structure to determine which model keeps the warmest temperature. (*Design and build a thermos/cup that can keep 250 ml of water the warmest for 30 minutes).*
- ***Rubric:*** https://docs.google.com/a/linwoodschools.org/document/d/15ybWaljGXLgCVYR3OMNlegiydZb4xa8vdcSG1_d-_LA/edit?usp=sharing
- ***Resources:***
  - https://api.betterlesson.com/mtp/lesson/628050/print
  - https://betterlesson.com/lesson/628050/build-a-thermos

Summative Assessment 2

- ***Standard:*** MS-PS3-1, MS-PS3-2, MS-PS3-3, MS-PS3-4, MS-PS3-5, MS-ETS1-1, MS-ETS1-2, MS-ETS1-3, MS-ETS1-4
- ***Type:*** Exam
- ***Overview:*** Students will synthesize information gather throughout the unit by completing the end of unit exam
- ***Resources:*** Student composition books

Formative Assessments	*Student Self-Assessment*	*Common Assessments*
• Pre-assessments • Labs • Quizzes • Project and problem-based learning activities • Graphic organizers • Short research projects • Collaborative learning projects • Formative checks (whiteboards, T/F, vote with your feet, thumbs up or thumbs down) • Summary Diagrams • Open ended responses • Short responses • Conferencing • Unit tests • Checklists	• Reflection activities (on the learning scale, on the daily target, on labs, on summative assessments, on collaborative work, on projects) • Responses to inquiry-based questions • Think-pair-share activities • Student revising knowledge throughout the unit	• Summative Assessments

Stage 3- Learning Plan

Suggested Learning Activities from the NJ DOE Model Curriculum

Relationships among Forms of Energy

Prior to middle school, students know that energy is present whenever there are moving objects, sound, light, or heat and that when objects collide, energy can be transferred from one object to another, thereby changing the objects' motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. Students also know that when objects collide, the contact forces transfer energy so as to change the objects' motions.

Students will need to construct graphical displays of data that describe the relationships between kinetic energy and mass of an object and speed of an object. These displays can be based on information from examples such as riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a whiffle ball versus a tennis ball. Through using one of these examples, students can record either mass or speed data to identify linear and nonlinear relationships. When constructing and interpreting graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object, students will 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. A simple demonstration of how increased speed or mass contributes to increased kinetic energy could include two objects of different masses (e.g., balls) rolling into a targets (e.g., plastic bowling pins, wooden blocks, etc.). From these examples, students will also be able to describe differences between kinetic energy and mass separately from kinetic energy and speed. Students will understand that an increase in speed will have a different effect on kinetic energy than an increase in mass. They will recognize and represent proportional relationships between kinetic energy and mass separately from kinetic energy and speed. Students will include a narrative that explains the information found in their graphical displays.

Students investigate the potential energy stored in a variety of systems. It will be necessary for students to have opportunities to rearrange objects in the systems in order to determine the impact on the amount of potential energy stored in the system. Systems to be investigated could be balloons with static electrical charge being brought closer to a classmate's hair, carts at varying positions on a hill, cars at different positions on hot wheels tracks, objects at varying heights on shelves (drop a book of the same mass from different heights onto a cup) to demonstrate changes to potential energy in a system.

Students will develop models to describe how changing distance changes the amount of potential energy stored in the system. The models students use to describe any of these examples will be multimedia presentations that could include diagrams, pictures, and/or written descriptions of the system examined. These models will help students represent interactions within systems, such as inputs, processes, and outputs, and energy flows within the system.

Suggested Learning Activities from the NJ DOE Model Curriculum Continued

Students will now have an opportunity to use an understanding of kinetic and potential energy within a system to construct a claim about the relationship between the transfer of energy to or from an object and changes in kinetic energy. Using data from the graphical displays of data and models that students developed earlier in this unit of study, as well as textual evidence, students will construct, use, and present oral and written arguments to support claims that when kinetic energy changes, energy is transferred to or from the object.

Students can provide evidence of this energy transfer by looking at the distance an object travels when energy is transferred, how temperature changes when energy is transferred, or how a compass responds to a magnetic field at different distances. Students will conduct an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of an object, but they are not required to include calculations of energy. However, students should interpret the equation $y = mx + b$ as defining a linear function whose graph is a straight line and be able to give examples of functions that are not linear when describing the change in the kinetic energy of an object and the energy transferred to or from the object.

Thermal Energy

In Unit 5, students learned about the interactions between kinetic and potential energy. In this unit, they will be introduced to the idea of thermal energy and will explore how it relates to the interactions from Unit 5. Prior to planning an investigation, students will need to understand that temperature is actually a measure of the average kinetic energy of the particles in a sample of matter.

Students will begin this unit by individually and collaboratively planning an investigation to determine energy transfer relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of particles as measured by the temperature of the sample. Students could start with an individual, small-group, or whole-class brainstorm to determine what might happen if they changed the temperature in a sample of matter. This brainstorm could take the form of a sketch, graphic organizer, or written response, and it could include everyday activities like taking a can of soda out of the refrigerator and setting it on a table or putting an ice cube into a warm beverage.

After brainstorming, students may need some guidance to determine what variables they would like to test in their experiment. Students could examine how the mass of ice cubes added to the beverage affects the temperature change. They could also investigate how the mass of the can of soda affects the temperature change as it sits on the table after being removed from the refrigerator. Examples of experiments could include a comparison of final temperatures after different masses of ice have melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials as they cool or heat in the environment, or the same material with different masses when a specific amount of thermal energy is added. Another example could include placing heated steel washers into water to investigate temperature changes. Each of these examples helps to show the proportional relationship between different masses of the same substance and the change in average kinetic energy when thermal energy is added to or removed from the system.

In planning, students will identify independent and dependent variables and controls, decide what tools and materials are needed, how measurements will be recorded, and how many data are needed to support their claim. Once experiments have been planned and performed, students will move into the engineering process to solve a problem using this content.

In Unit 4, students used the design and engineering process to maximize a solution to a problem. In this unit of study, students will combine the concepts of thermal energy and engineering processes to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. Examples of devices could include an insulated box, a solar cooker, or a Styrofoam cup. Calculation of the total amount of thermal energy is not to be assessed at this time.

Based on their brainstorm and investigations, students will identify a device to control the transfer of thermal energy into or out of the system they studied. Once students have identified the type of device they will construct, they can begin to define the criteria and constraints of the design problem that will help to minimize or maximize the transfer of thermal energy. Using informational texts to support this process is important. Students will draw evidence from these texts in order to support their analysis, reflection, and research.

Suggested Learning Activities from the NJ DOE Model Curriculum Continued

When students consider constraints, they should conduct short research projects to examine factors such as societal and individual needs, cost effectiveness, available materials and natural resources, current scientific knowledge, and current advancements in science and technology. They should also consider limitations (design constraints) due to the properties of the materials of their design (i.e., Styrofoam vs. glass). While conducting their research, students will need to gather their information from multiple print and digital sources and assess the credibility of each source. When they quote or paraphrase the data and conclusions found in their resources, they will need to avoid plagiarism and provide basic bibliographic information for each source. After comparing the information gained from their research, experiments, simulations, video, or other multimedia sources, they will be able to determine precise design criteria and constraints that lead to a successful solution.

Part B: You are an engineer working for NASA. In preparation for a manned space mission to the Moon, you are tasked with designing, constructing, and testing a device that will keep a hot beverage hot for the longest period of time. It costs approximately $10,000 per pound to take payload into orbit so the device must be lightweight and compact. The lack of atmosphere on the Moon produces temperature extremes that range from -157 degrees C in the dark to +121 degrees C in the light. Your devise must operate on either side of the Moon (https://spaceflightsystems.grc.nasa.gov/education/rocket/moon.html).

Resources/Instructional Materials

(articles, novels, websites, books, magazines, art, media)

- NJ DOE Model Curriculum - http://www.nj.gov/education/modelcurriculum/sci/8u5.pdf
- http://www.scilinks.org/Handlers/GoToWebsite.ashx?EntPt=EPW_POST_SCI&Enc=1&SiteID=YH5v3sUqQojw=&Scilink=YuNsfUqlMrJjNXKdugJbLHA==
- http://www.scilinks.org/Handlers/GoToWebsite.ashx?EntPt=EPW_POST_SCI&Enc=1&SiteID=Y1B1XMNgPJUM=&Scilink=YuNsfUqlMrJjNXKdugJbLHA==
- https://phet.colorado.edu/en/simulation/energy-skate-park-basics
- http://www.scilinks.org/Handlers/GoToWebsite.ashx?EntPt=EPW_POST_SCI&Enc=1&SiteID=Yo0NCnM5Mw9M=&Scilink=YeEmTdL14ZWc=
- NJ DOE Model Curriculum - http://www.nj.gov/education/modelcurriculum/sci/8u6.pdf
- Energy Forms and Changes: Explore how heating and cooling iron, brick, and water adds or removes energy. See how energy is transferred between objects. Build your own system, with energy sources, changers, and users. Track and visualize how energy flows and changes through your system.
- https://phet.colorado.edu/en/simulation/states-of-matter;jsessionid=AC62BC80A24F40C8DBF64D00C012480A#for-teachers-header

Technology Resources

- Google Classroom
- Socrative
- BrainPop
- Nasa website
- Google Apps
- Quizlet
- Science World
- Kahoot!
- Youtube
- Mystery Science
- Discovery
- PowerPoint
- Nova
- Scholastic

Accommodations & Modifications

for Spec. Ed., ELL, GT, & At Risk Students

- Allow oral responses
- Allow verbalization before writing
- Use audio materials when necessary
- Modify homework assignments
- Read tests aloud
- Provide math manipulatives as necessary
- Restate, reword, clarify directions
- Re-teach concepts using small groups
- Provide educational “breaks” as necessary
- Expanding time for free reading
- Chunking Content
- Calculator
- Use mnemonic devices
- Provide a cueing system
- Untimed and/or extended test taking time
- Shorten assignments to focus on mastery concept
- Leveled Reading Materials
- Acronyms
- Graphic Organizers
- Notes Provided
- Check agenda book for parent(s) communication
- Read directions aloud
- Assignment, Project, and Assessment Modification Based on Individual Student Needs
- Speech to Text/Text to Speech Features in Google Apps
- Technology assisted instruction
- Preferential seating utilized
- Redirect student(s) as necessary
- Student choice for project or approach to assignment
- Inquiry-Based Learning
- Genius Hour

Adapted from: Wiggins, Grant and J. McTighe. (1998). *Understanding by Design*, Association for Supervision and Curriculum Development and 5E NGSS Lesson Plan from www.lewiscenter.org and NJ Science Model Curriculum athttp://www.nj.gov/education/modelcurriculum/sci/7.shtml

Science- Grade 8

Unit # 5	**Title:** The Electromagnetic Spectrum	**Pacing**: 20 days

Stage 1- Desired Results

Established Goals/NJSLS Standards

Next Generation Science Standards/NJSLS:

MS-PS4-1 Waves and Their Applications in Technologies for Information Transfer

- 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. *[Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.] [Assessment Boundary: Assessment does not include electromagnetic waves and is limited to standard repeating waves.] (MS-PS4-1)*

MS-PS4-2 Waves and Their Applications in Technologies for Information Transfer

- Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. *[Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.] [Assessment Boundary: Assessment is limited to qualitative applications pertaining to light and mechanical waves.] (MS-PS4-2)*

MS-PS4-3 Waves and Their Applications in Technologies for Information Transfer

- Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals. *[Clarification Statement: Emphasis is on a basic understanding that waves can be used for communication purposes. Examples could include using fiber optic cable to transmit light pulses, radio wave pulses in wifi devices, and conversion of stored binary patterns to make sound or text on a computer screen.] [Assessment Boundary: Assessment does not include binary counting. Assessment does not include the specific mechanism of any given device.] (MS-PS4-3)*

English Language Arts

- Cite specific textual evidence to support analysis of science and technical texts. (MS-PS4-3) RST.6-8.1
- Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (MS-PS4-3) RST.6-8.2
- Compare and contrast the information gained from experiments, simulations, videos, or multimedia sources with that gained from reading a text on the same topic. (MS-PS4-3) RST.6-8.9
- Draw evidence from informational texts to support analysis, reflection, and research. (MS-PS4-3) WHST.6-8.9
- Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-PS4-1),(MS-PS4-2) SL.8.5

Mathematics

- Reason abstractly and quantitatively. (MS-PS4-1) MP.2
- Model with mathematics. (MS-PS4-1) MP.4
- Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-PS4-1) 6.RP.A.1
- Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS4-1) 6.RP.A.3
- Recognize and represent proportional relationships between quantities. (MS-PS4-1) 7.RP.A.2
- 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. (MS-PS4-1) 8.F.A.3

Enduring Understandings (DCI) ***Students will understand…***	**Essential Questions** ***Students will consider...***
PS4.A: Wave Properties ● A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS-PS4-1) ● A sound wave needs a medium through which it is transmitted. (MS-PS4-2) **PS4.B: Electromagnetic Radiation** ● When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. (MS-PS4-2) ● The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. (MS-PS4-2) ● A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. (MS-PS4-2) ● However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2) **PS4.C: Information Technologies and Instrumentation** ● Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (MS-PS4-3)	● Why do surfers love physicists? ● How do the light and sound system in the auditorium work? ● If rotary phones worked for my grandparents, why did they invent cell phones?
Knowledge (Concepts) ***Students will know…***	**Academic Vocabulary**
● A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. ● Describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. ● Graphs and charts can be used to identify patterns in data. ● Waves can be described with both qualitative and quantitative thinking. ● When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. ● The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. ● A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. ● Waves are reflected, absorbed, or transmitted through various materials. ● A sound wave needs a medium through which it is transmitted. ● Because light can travel through space, it cannot be a matter wave, like sound or water waves. ● The structure of a wave can be modified to serve particular functions by taking into account properties of different materials and how materials can be shaped and used.	● wave ● wavelength ● frequency ● amplitude ● sound wave ● electromagnetic wave ● medium ● light ● transverse wave ● longitudinal wave ● reflect ● absorb ● transmit ● refract ● rarefaction ● digitized signals ● waves pulses

Knowledge (Concepts)

Students will know…

- Structures can be designed to use properties of waves to serve particular functions.
- Waves can be used for communication purposes.
- Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information than are analog signals.
- Wave-related technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations.

Skills

Students will be able to…

- Use mathematical representations to describe and/or support scientific conclusions about how the amplitude of a wave is related to the energy in a wave.
- Use mathematical representations to describe a simple model.
- Develop and use models to describe the movement of waves in various materials.
- Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims that digitized signals are a more reliable way to encode and transmit information than analog signals are.

21ST Century/ Interdisciplinary Themes	21st Century Skills
Global Awareness **Financial, Business, & Entrepreneurial Literacy** Civic Literacy Environmental Literacy Health Literacy	**Creativity & Innovation** **Communication & Collaboration** **Media Literacy** **Critical Thinking & Problem Solving** **Information Literacy** **Information, Communication, & Technology** **Life & Career Skills**

Stage 2- Assessment Evidence
from the NJ Model Curriculum

How do cell phones work?

In this unit of study, students develop and use models, use mathematical thinking, and obtain, evaluate, and communicate information in order to describe and predict characteristic properties and behaviors of waves. Students also apply their understanding of waves as a means of sending digital information. The crosscutting concepts of patterns and structure and function are used as organizing concepts for these disciplinary core ideas. Students develop and use models, use mathematical thinking, and obtain, evaluate, and communicate information. Students are also expected to use these practices to demonstrate understanding of the core ideas.

Summative Assessment 1

- ***Standard:*** MS-PS4-1, MS-PS4-2
- ***Type:*** Lab
- ***Overview:*** Wave behavior - Students go through a series of hands-on lab stations that engage students in not only identifying the properties of waves, but in creating mathematical representations as well.
- ***Rubric:*** https://docs.google.com/a/linwoodschools.org/document/d/15ybWaljGXLgCVYR3OMNlegiydZb4xa8vdcSG1_d-_LA/edit?usp=sharing
- ***Resources:***
  - https://betterlesson.com/lesson/633386/wave-behavior-lab-rotation-day-1
  - https://betterlesson.com/lesson/633450/wave-behavior-lab-rotation-day-2

Stage 2- Assessment Evidence Continued

Summative Assessment 2

- ***Standard:*** MS-PS4-1, MS-PS4-2, MS-PS4-3
- ***Type:*** Exam
- ***Overview:*** Students will synthesize information gather throughout the unit by completing the end of unit exam
- ***Resources:*** Student composition books

Formative Assessments	*Student Self-Assessment*	*Common Assessments*
• Pre-assessments • Labs • Quizzes • Project and problem-based learning activities • Graphic organizers • Short research projects • Collaborative learning projects • Formative checks (whiteboards, T/F, vote with your feet, thumbs up or thumbs down) • Summary Diagrams • Open ended responses • Short responses • Conferencing • Unit tests • Checklists	• Reflection activities (on the learning scale, on the daily target, on labs, on summative assessments, on collaborative work, on projects) • Responses to inquiry-based questions • Think-pair-share activities • Student revising knowledge throughout the unit	• Summative Assessments

Stage 3- Learning Plan

Suggested Learning Activities from the NJ DOE Model Curriculum

The Electromagnetic Spectrum

In this unit of study, students learn that simple waves have repeating patterns with specific wavelengths, frequencies, and amplitudes. They will use both qualitative and quantitative thinking as they describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. For example, students could use a slinky to make a small wave, then increase the energy input and observe that an increase in energy results in an increase in the amplitude of the wave. Or they could push on the surface of a container of water with different amounts of energy and observe the amplitude of the waves created inside the container. Any modeling or demonstrations used to help students visualize this should be followed up with mathematical representations that students could use as evidence to support scientific conclusions about how the amplitude of a wave is related to the energy in a wave. Students can use graphs and charts (teacher provided) to identify patterns in their data.

Students will then develop and use models to describe the movement of waves in various materials. Through the use of models and other multimedia and visual displays, students will describe that when light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light. Students could then broaden their understanding of wave behavior by using models to demonstrate that waves are reflected, absorbed, or transmitted through various materials. Students can observe the behavior of ways by using a penlight and tracing the path that light travels between different transparent materials (e.g., air and water, air and glass. Students could also shine a light through a prism onto a screen or piece of paper, observe a pencil in a glass of water.

A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. For example, students could observe some of the wave behaviors or light by observing that when light passes through a small opening the waves spread out. They could observe that if the wavelength is short, the waves spread out very little, whereas longer wavelengths spread out more. Students could them produce sketches of their observations.

Suggested Learning Activities from the NJ DOE Model Curriculum Continued

They may need some guidance in the elaboration of their sketches as it relates to the wave properties of light. Students can use a model of the electromagnetic spectrum to make connections between the brightness and color of light and the frequency of the light.

Students will continue their study of waves by observing the behavior of sound waves. Before students begin to study the behavior of sound waves, the teacher could demonstrate the importance of the presence of a medium for sound to travel. For example, if an alarm clock is placed inside a bell jar and the air is removed, the alarm will not be heard outside of the jar. Students could be asked to explain why the can hear the sound before the air is pumped out and not after. This type of demonstration could be followed by discussion of the types of media that sound passes through and how these different media impacts the sound.

Students could then participate in scientific discussions where they compare the behavior of mechanical waves (sound) and light waves. Based on their observations, students should be able to explain that the amplitude of all waves are related to the energy of the wave and that waves are reflected, absorbed, or transmitted through various materials. They should be able to explain that while mechanical waves need a medium in order to be transmitted, light waves do not. Therefore, because light can travel through space, it cannot be a matter wave, like sound or water waves.

Once students have a clear understanding of how different types of waves behave, they can start to explore how society utilizes those waves. The structure of a wave can be modified to serve particular functions by taking into account properties of different materials and how materials can be shaped and used. Devices have been designed to utilize properties of waves to serve particular functions. For example, cell phones use wave properties for mobile communication purposes. These devices use digitized signals (sent as wave pulses) because they are a more reliable way than analog signals to encode and transmit information (compare capacity of an LP record to a CD or MP3 player). Another example of this is how digital signals can send information over much longer distances with less loss of information because background noise can be easily converted out by the receiving devices. Wave related technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. Students will integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims that digitized signals are a more reliable way to encode and transmit information than analog signals. Examples include basic understanding that waves can be used for communication purposes including using fiber optic cable to transmit light pulses, radio wave pulses in Wi-Fi devices, and conversation of stored binary patterns to make sound or text on a computer screen.

Resources/Instructional Materials

(articles, novels, websites, books, magazines, art, media)

- NJ DOE Model Curriculum - http://www.nj.gov/education/modelcurriculum/sci/8u7.pdf
- https://phet.colorado.edu/en/contributions/view/4105
- https://phet.colorado.edu/en/contributions/view/2970
- http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Electromagnetic_Math.html#.VmcxSrgrJD

Technology Resources

- Google Classroom
- Socrative
- BrainPop
- Nasa website
- Google Apps
- Quizlet
- Science World
- Kahoot!
- Youtube
- Mystery Science
- Discovery
- PowerPoint
- Nova
- Scholastic

Accommodations & Modifications
for Spec. Ed., ELL, GT, & At Risk Students

- Allow oral responses
- Allow verbalization before writing
- Use audio materials when necessary
- Modify homework assignments
- Read tests aloud
- Provide math manipulatives as necessary
- Restate, reword, clarify directions
- Re-teach concepts using small groups
- Provide educational “breaks” as necessary
- Expanding time for free reading
- Chunking Content
- Calculator
- Use mnemonic devices
- Provide a cueing system
- Untimed and/or extended test taking time
- Shorten assignments to focus on mastery concept
- Leveled Reading Materials
- Acronyms
- Graphic Organizers
- Notes Provided
- Check agenda book for parent(s) communication
- Read directions aloud
- Assignment, Project, and Assessment Modification Based on Individual Student Needs
- Speech to Text/Text to Speech Features in Google Apps
- Technology assisted instruction
- Preferential seating utilized
- Redirect student(s) as necessary
- Student choice for project or approach to assignment
- Inquiry-Based Learning
- Genius Hour

Adapted from: Wiggins, Grant and J. McTighe. (1998). *Understanding by Design*, Association for Supervision and Curriculum Development and 5E NGSS Lesson Plan from www.lewiscenter.org and NJ Science Model Curriculum athttp://www.nj.gov/education/modelcurriculum/sci/7.shtml