Bloomfield Public Schools
Bloomfield, New Jersey 07003

Curriculum Guide

Science
Honors - Grade 8

Prepared by:
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Conforms to the Next Generation Science Standards and the NJSLS Standards

Board Approved: September 12, 2017

COURSE: EIGHTH GRADE SCIENCE
GRADE LEVEL: 8th Honors

Introduction: The Eighth Grade Honors Science course is a requirement for all students in the State of New Jersey and Bloomfield Middle School. The course is typically taught to 8th grade students over the course of one year. The Eighth Grade Science curriculum builds on the concepts and skills acquired in kindergarten through seventh grade. The curriculum is designed to provide opportunities for understanding: the unifying concepts of science, the strands, conceptual goals and objectives. Throughout the course, connections are made to mathematics, technology, social science, and communication skills. This curriculum is aligned with the Next Generation Science Standards, the New Jersey Student Learning Standards for English Language Arts & Literacy in Science, the New Jersey Student Learning Standards for Math, and the New Jersey Core Curriculum Standards for Technology. This document is a tool that will provide an overview as to what to teach, when to teach it, and how to assess student progress. As well, with considerations made for altered pacing, modifications, and accommodations; this document is to be utilized for all students enrolled in this course, regardless of ability level, native language, or classification.

Pacing: The Eighth Grade Honors Science curriculum is divided into four units of study. A fifth unit represents a capstone engineering design challenge that is to be incorporated into units 3 & 4.

Unit 1: Force and Interactions (23 Blocks)
Unit 2: Energy (23 Blocks)
Unit 3: Matter and Energy in Organisms and Ecosystems (18 blocks)
Unit 4: Interdependent Relationships in Ecosystems (11 Blocks)
Unit 5: Engineering Capstone & Independent Study (15 Blocks Built in Throughout the School Year)

Resources: Electronic and text resources are listed in each unit. Teachers will be able to access the curriculum document on the district website.

Textbook: McGraw-Hill: iScience

Established Goals: New Jersey Student Learning Standards

Science: **http://www.nextgenscience.org/next-generation-science-standards**
New Jersey Student Learning Standards Math: **http://www.corestandards.org/Math/**
New Jersey Student Learning Standards ELA: **http://www.corestandards.org/ELA-Literacy/**
Technology: **http://www.state.nj.us/education/cccs/2014/tech/**

Modifications:
● Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. ● Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). ● Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). ● Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). ● Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. ● Use project-based science learning to connect science with observable phenomena. ● Structure the learning around explaining or solving a social or community-based issue. ● Provide ELL students with multiple literacy strategies. ● Collaborate with after-school programs or clubs to extend learning opportunities. ● Restructure lesson using UDL principles (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA).

Unit #: 1	Unit Name: Force and Interactions	Unit Length: 23 blocks

ESSENTIAL QUESTIONS: *How can we predict the motion of an object?* *Is it possible to exert on an object without touching it?*		
#	**STUDENT LEARNING OBJECTIVES (SLO)**	**Corresponding DCIs and PEs**
1	**Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects. ****[Clarification Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.] [Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension.]*	**(MS-PS2-1)**
2	**Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.** *[Clarification Statement: Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units.] [Assessment Boundary: Assessment is limited to forces and changes in motion in one-dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry.]*	**(MS-PS2-2)**
3	**Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.** *[Clarification Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.] [Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.]*	**(MS-PS2-3)**
4	**Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.** *[Clarification Statement: Examples of evidence for arguments could include data generated from simulations or digital tools; and charts displaying mass, strength of interaction, distance from the Sun, and*	**(MS-PS2-4)**

	orbital periods of objects within the solar system.] [Assessment Boundary: Assessment does not include Newton's Law of Gravitation or Kepler's Laws.]	
5	**Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.** *[Clarification Statement: Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, and electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations.] [Assessment Boundary: Assessment is limited to electric and magnetic fields, and limited to qualitative evidence for the existence of fields.]*	**(MS-PS2-5)**

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in grades 6–8 builds from grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. ● Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. (MS-PS2-3) **Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions.	**PS2.A: Forces and Motion** ● For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law). (MS-PS2-1) ● The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. (MS-PS2-2) ● All positions of objects and the directions of forces and motions must be described in an arbitrarily	**Cause and Effect** ● Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS2-3),(MS- PS2-5) **Systems and System Models** ● Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems. (MS-PS2-1),(MS-PS2-4) **Stability and Change** ● Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales. (MS-PS2-2) --- ***Connections to Engineering, Technology, and Applications of Science***

● Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. (MS-PS2-2) ● Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation. (MS- PS2-5) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. ● Apply scientific ideas or principles to design an object, tool, process or system. (MS-PS2-1) **Engaging in Argument from Evidence** Engaging in argument from evidence in 6–8 builds from K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world. ● Construct and present oral and written arguments supported by	chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared. (MS-PS2-2) **PS2.B: Types of Interactions** ● Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. (MS-PS2- 3) ● Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun. (MS-PS2-4) ● Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively). (MS-PS2-5)	**Influence of Science, Engineering, and Technology on Society and the Natural World** ● 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. (MS-PS2-1)

empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-PS2-4) --- ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** ● Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS2- 2),(MS-PS2-4)		

Connections to other DCIs in this grade-band: **MS.PS3.A** (MS-PS2-2); **MS.PS3.B** (MS-PS2-2); **MS.PS3.C** (MS-PS2-1); **MS.ESS1.A** (MS-PS2-4); **MS.ESS1.B** (MS-PS2-4); **MS.ESS2.C** (MS-PS2-2),(MS-PS2-4)
Articulation of DCIs across grade-bands: **3.PS2.A** (MS-PS2-1),(MS-PS2-2); **3.PS2.B** (MS-PS2-3),(MS-PS2-5); **5.PS2.B** (MS-PS2-4); **HS.PS2.A** (MS-PS2-1),(MS-PS2-2); **HS.PS2.B** (MS-PS2-3),(MS-PS2-4),(MS- PS2-5); **HS.PS3.A** (MS-PS2-5); **HS.PS3.B** (MS-PS2-2),(MS-PS2-5); **HS.PS3.C** (MS-PS2-5); **HS.ESS1.B** (MS-PS2-2),(MS-PS2-4)
New Jersey Student Learning Standards Connections: **ELA:** **RST.6-8.1:** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. (MS-PS2-1),(MS-PS2-3) **RST.6-8.3:** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS2-1),(MS- PS2- 2),(MS-PS2-5) **WHST.6-8.1:** Write arguments focused on discipline-specific content. (MS-PS2-4) **WHST.6-8.7:** 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-PS2-1),(MS-PS2-2),(MS-PS2-5) **MATH:**

MP.2: Reason abstractly and quantitatively. (MS-PS2-1),(MS-PS2-2),(MS-PS2-3) **6.NS.C.5:** Understand that positive and negative numbers are used together to describe quantities having opposite directions or values; use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-PS2-1) **6.EE.A.2:** Write, read, and evaluate expressions in which letters stand for numbers. (MS-PS2-1),(MS-PS2-2) **7.EE.B.3:** Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, 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-PS2-1),(MS-PS2-2) **7.EE.B.4:** 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-PS2-1),(MS-PS2-2)
Technology & Career Standards: **8.1 Educational Technology:** All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge. **Career Ready Practices:** 1-12

Unit Plan		
Content Vocabulary	**Academic Vocabulary**	**Required Resources**
Force Motion Sum Mass Position Direction Relative Action Reaction Distance Electrical Magnetic Attractive Repulsive Magnitude Current Charge Strength Gravitational Fields	Cause Effect Distinguish Design Construct Model Investigate Interpret Argumentation Conserve Transfer Release Structure Phenomena Measure Evaluate	McGraw-Hill iScience: Physical Science (Chapters 1-4)

THE 5 "E"s	**Examples of Learning Activities for the specified "E"**	**SLO's and Engineering Practices**
ENGAGE	**Examples of Engaging Activities:**	
	Activator: Describe the game tug-of-war. How does a winner emerge?	1, 2 - Asking Questions and Defining Problems

	Activator: Provide real-world examples of balanced and unbalanced forces.	1, 2 - Developing and Using Models
	Video - Concussions in the NFL (relates to Egg Helmet Design Challenge)	1, 2, - Asking Questions and Defining Problems
	Activator: Show video of riding a rollercoaster. Describe the feelings you experience while riding a roller coaster?	1, 2, 3, 4 - Asking Questions and Defining Problems; Obtaining, Evaluating, and Communicating Information
	Brainstorming Session for Roller Coaster Safety Plan Design Challenge	5 - Constructing Explanations and Designing Solutions
EXPLORE	**Examples of Exploring Activities:**	
	PhET Simulations – Students will manipulate computer simulations on forces. Use higher level inquiry lab sheet found in teacher section to increase the level of inquiry.	1, 2 - Developing and Using Models, Using Mathematics and Computational Thinking
	Distribute illustrations with various objects – students will have to draw arrows representing forces involved. (Honors Level illustrations to include more advanced situations.)	1, 2 - Developing and Using Models; Analyzing and Interpreting Data
	Roller Coaster Graphs – plot speed and time data to create line graphs for 5 roller coasters.	1, 2, 3, 4 - Analyzing and Interpreting Data; Using Mathematics and Computational Thinking
	Students will design possible solutions for Roller Coaster Safety Plan Honors Level Design Challenge	5 - Constructing Explanations and Designing Solutions
EXPLAIN	**Examples of Explaining Activities:**	
	Balanced and Unbalanced Forces - Flipped Classroom	2 - Obtaining, Evaluating, and Communicating Information
	Newton's Laws of Motion - Flipped Classroom	1 - Obtaining, Evaluating, and Communicating Information
	Discovery of Magnetism - Flipped Classroom	3, 5 - Obtaining, Evaluating, and Communicating Information

	Based on the simulations: -Answer questions (See teacher Section) -Observe and record results.	1, 2 - Analyzing and Interpreting Data
	Students will provide an explanation of the strength and direction of the forces and calculate net force.	1, 2 - Using Mathematics and Computational Thinking
	Calculate the acceleration of each roller coaster at specific intervals on the line graph.	1, 2, 3, 4 - Using Mathematics and Computational Thinking
	Write rationales for group solution to Roller Coaster Safety Plan Honors Level Design Challenge	5 - Obtaining, Evaluating, and Communicating Information
ELABORATE	**Examples of Elaborating Activities:**	
	Current Events: Sports Physics	1, 2 - Obtaining, Evaluating, and Communicating Information
	Socratic Seminar: Sports Injuries	1 ,2, 3, 4, 5 - Engaging in Argument from Evidence
	Explain the relationship of the various forces involved with the rate of acceleration or deceleration. (examples of forces: Gravity/Friction/Magnetism)	1, 2, 3, 4 - Using Mathematics and Computational Thinking
	Video - Quantum Levitation demonstration using a magnetic field	4 - Constructing Explanations and Designing Solutions
	Develop a prototype for group solution (diagram, computer graphic, 3-D model options)	5 - Constructing Explanations and Designing Solutions
EVALUATE	**Examples of Evaluating Activities:**	
	Egg Helmet Mini Design Challenge	1, 2 - Constructing Explanations and Designing Solutions
	Video – "Forces and Motion" Write a summary explaining the necessity of force in an object's motion -Include various examples of forces	1, 2, 3, 4 - Engaging in Argument from Evidence
	Evaluation by rubric – Graphing, calculations, and explanations of forces.	5 - Using Mathematics and Computational Thinking
	Presentation of Honors Level Design Challenge Solution based on rubric.	5 - Constructing Explanations and Designing Solutions

Unit #: 2	Unit Name: Energy	Unit Length: 23 blocks

ESSENTIAL QUESTIONS: *How can physics explain sports?* *How can a standard thermometer be used to tell you how particles are behaving?*		
#	**STUDENT LEARNING OBJECTIVES (SLO)**	**Corresponding DCIs and PEs**
1	**Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.** *[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 whiffle ball versus a tennis ball.]*	**(MS-PS3-1)**
2	**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)**
3	**Apply scientific principles to design, construct, and test a device that either minimizes or maximizes 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)**
4	**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*	**(MS-PS3-4)**

	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.]	
5	**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)**

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems. ● Develop a model to describe unobservable mechanisms. (MS-PS3-2) **Planning and Carrying Out Investigations** Planning and carrying out investigations to answer questions or test solutions to problems in 6–8 builds on K–5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or design solutions. ● Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how	**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) ● 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**	**Scale, Proportion, and Quantity** ● Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. (MS-PS3- 1), (MS-PS3-4) **Systems and System Models** ● Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems. (MS-PS3-2) **Energy and Matter** ● Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). (MS- PS3-5) The transfer of energy can be tracked as energy flows through a designed or natural system. (MS- PS3-3)

measurements will be recorded, and how many data are needed to support a claim. (MS-PS3-4) **Analyzing and Interpreting Data** Analyzing data in 6–8 builds on K–5 and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. ● Construct and interpret graphical displays of data to identify linear and nonlinear relationships. (MS- PS3-1) **Constructing Explanations and Designing Solutions** Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories. ● Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system. (MS-PS3-3) **Engaging in Argument from Evidence** Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed worlds.	● When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (MS- PS3-5) ● 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) **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) **ETS1.A: Defining and Delimiting an Engineering Problem** ● 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. (secondary to MS-PS3-3) **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. There	

• Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon. (MS- PS3-5) --- ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** • Science knowledge is based upon logical and conceptual connections between evidence and explanations (MS-PS3- 4), (MS-PS3-5)	are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. (secondary to MS-PS3-3)	

Connections to other DCIs in this grade-band: **MS.PS1.A** (MS-PS3-4); **MS.PS1.B (**MS-PS3-3); **MS.PS2.A** (MS-PS3-1),(MS-PS3-4),(MS-PS3-4); **MS.ESS2.A** (MS-PS3-3); **MS.ESS2.C** (MS-PS3-3),(MS-PS3-4); **MS.ESS2.D** (MS-PS3-3),(MS-PS3-4); **MS.ESS3.D** (MS-PS3-4)
Articulation of DCIs across grade-bands: **4.PS3.B** (MS-PS3-1),(MS-PS3-3); **4.PS3.C** (MS-PS3-4),(MS-PS3-5); **HS.PS1.B** (MS-PS3-4); **HS.PS2.B** (MS-PS3-2); **HS.PS3.A** (MS-PS3-1),(MS-PS3-4),(MS-PS3-5); **HS.PS3.B** (MS-PS3-1),(MS-PS3-2),(MS-PS3-3),(MS-PS3-4),(MS-PS3-5); **HS.PS3.C** (MS-PS3-2)
New Jersey Student Learning Standards Connections: **ELA:** **RST.6-8.1:** 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.6-8.3:** Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS3-3),(MS-PS3-3) **RST.6-8.7:** 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) **WHST.6-8.1:** Write arguments focused on discipline-specific content. (MS-PS3-5) **WHST.6-8.7:** 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),(MS-PS3-4)

SL.8.5: Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-PS3-2) **MATH:** **MP.2:** Reason abstractly and quantitatively. (MS-PS3-1),(MS-PS3-4),(MS-PS3-5) **6.RP.A.1:** 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.2:** 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) **7.RP.A.2:** Recognize and represent proportional relationships between quantities. (MS-PS3-1),(MS-PS3-5) **8.EE.A.1:** Know and apply the properties of integer exponents to generate equivalent numerical expressions. (MS-PS3-1) **8.EE.A.2:** 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 $\sqrt{2}$ is irrational. (MS-PS3-1) **8.F.A.3:** 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) **6.SP.B.5:** Summarize numerical data sets in relation to their context. (MS-PS3-4)
Technology & Career Standards: **8.1 Educational Technology:** All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge. **Career Ready Practices:** 1-12

Unit Plan		
Content Vocabulary	**Academic Vocabulary**	**Required Resources**
Energy Kinetic Motion Potential Stored Forces Mass	Cause Effect Distinguish Design Construct Model Investigate Interpret	McGraw-Hill iScience: Physical Science (Chapters 5-6)
Speed Transfer Distance Height Conservation Temperature Thermal	Argumentation Conserve Transfer Release Structure Phenomena Measure Evaluate	

THE 5 "E"s	Examples of Learning Activities for the specified "E"	SLO's and Engineering Practices

ENGAGE	Examples of Engaging Activities:	
	Popsicle Stick Chain Reaction Lab - Demonstrating Kinetic and Potential Energy	1, 2 - Asking Questions and Defining Problems; Planning and Carrying Out Investigations
	Activator - What happens to the energy in a rubber ball as it bounces? Will it ever return to the height it was dropped from? (Ball Bouncing Activity)	5 - Asking Questions and Defining Problems
	How To Melt A Chocolate Bunny? - Students observe the different ways a chocolate bunny can be melted using a microwave, iron, etc.	3, 4 - Asking Questions and Defining Problems; Obtaining, Evaluating, and Communicating Information
	Activator - Did you ever put a metal spoon in hot soup or hot chocolate and then touch the spoon to your mouth? What do you think might be happening, between the molecules in the soup and the atoms in the spoon, to make the spoon get hot?	3, 4 - Asking Questions and Defining Problems
EXPLORE	**Examples of Exploring Activities:**	
	Inquiry Lab - Roller Coaster Lab to explore Kinetic and Potential Energy	5 - Planning and Carrying Out Investigations; Developing and Using Models
	Computer Simulation - Activity #1 - Students build an understanding of the link between mass, speed, and kinetic energy.	1, 2 - Developing and Using Models, Using Mathematics and Computational Thinking
	Heat Transfer Animation - Explores Radiation, Conduction, and Convection	3, 4 - Obtaining, Evaluating, and Communicating Information
	Washers Investigation - Students observe the change in temperature in hot and cold water when heated or cooled washers are dropped in.	4 - Planning and Carrying Out Investigations; Analyzing and Interpreting Data
	Temperature and Thermal Energy Web Quest	4 - Developing and Using Models, Obtaining and Evaluating Information
EXPLAIN	**Examples of Explaining Activities:**	

	Kinetic Energy, Mass and Velocity - Flipped Classroom	1, 2 - Obtaining, Evaluating, and Communicating Information
	Heat Transfer - Flipped Classroom	3, 4 - Obtaining, Evaluating, and Communicating Information
	Animations of Molecules in Water and Washers - Provides students with models of heat transfer in the Washers Investigation on the molecular level.	4 - Developing and Using Models
ELABORATE	**Examples of Elaborating Activities:**	
	Current Events: Theme Parks	1, 2 - Obtaining, Evaluating, and Communicating Information
	Socratic Seminar: Using Potential and Kinetic Energy	1, 2 - Engaging in Argument from Evidence
	Computer Simulation - Activity #2 - Students create graphs based on the energy of moving matter.	1, 2 - Analyzing and Interpreting Data; Using Mathematics and Computational Thinking
	Computer Simulation - Activity #3 - Kinetic Energy Challenge (Advanced)	1, 2 - Analyzing and Interpreting Data; Using Mathematics and Computational Thinking
	Ball Drop Activity	5 - Planning and Carrying Out Investigations
	Popcorn Party Lab - Mini labs on convection, conduction, and radiation,	3, 4 - Planning and Carrying Out Investigations.
	Extend Section - Students complete an extension activity related to the Washer Investigation.	4 - Analyzing and Interpreting Data; Engaging in Argument from Evidence
EVALUATE	**Examples of Evaluating Activities:**	
	Students will create a diagram explaining the types of energy that were observed during the Ball Drop Activity	5 - Developing and Using Models
	Popcorn Party Lab Sheet - Students will demonstrate understanding of heat transfer.	3, 4 - Engaging in Argument from Evidence

	Building A Solar Oven - Honors Level Design Challenge on building a solar oven based on understanding of heat transfer.	3 - Constructing Explanations and Designing Solutions

Unit #: 3	Unit Name: Matter and Energy in Organisms and Ecosystems	Unit Length: 18 blocks

ESSENTIAL QUESTIONS:

How and why do organisms interact with their environment and what are the effects of these interactions?

How do some organisms turn electromagnetic radiation into matter and energy?

#	STUDENT LEARNING OBJECTIVES (SLO)	Corresponding DCIs and PEs
1	**Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.** *[Clarification Statement: Emphasis is on tracing movement of matter and flow of energy.] [Assessment Boundary: Assessment does not include the biochemical mechanisms of photosynthesis.]*	**(MS-LS1-6)**
2	**Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.** *[Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.] [Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration.]*	**(MS-LS1-7)**
3	**Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.** *[Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.]*	**(MS-LS2-1)**
4	**Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.** *[Clarification Statement: Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems, and on defining the boundaries of the system.] [Assessment Boundary: Assessment does not include the use of chemical reactions to describe the processes.]*	**(MS-LS2-3)**
5	**Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.** *[Clarification Statement: Emphasis is on*	**(MS-LS2-4)**

	recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]	

<table>
<tr><td colspan="3">The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:</td></tr>
<tr><td>Science and Engineering Practices</td><td>Disciplinary Core Ideas</td><td>Crosscutting Concepts</td></tr>
<tr><td>Developing and Using Models
Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.
• Develop a model to describe phenomena. (MS-LS2-3)
• Develop a model to describe unobservable mechanisms. (MS-LS1-7)
Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.
• Analyze and interpret data to provide evidence for phenomena. (MS-LS2-1)
Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence</td><td>LS1.C: Organization for Matter and Energy Flow in Organisms
• Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (MS-LS1-6)
• Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (MS-LS1-7)
LS2.A: Interdependent Relationships in Ecosystems
• Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors. (MS-LS2-1)</td><td>Cause and Effect
• Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-LS2-1)
Energy and Matter
• Matter is conserved because atoms are conserved in physical and chemical processes. (MS-LS1-7)
• Within a natural system, the transfer of energy drives the motion and/or cycling of matter. (MS-LS1-6)
• The transfer of energy can be tracked as energy flows through a natural system. (MS-LS2-3)
Stability and Change
• Small changes in one part of a system might cause large changes in another part. (MS-LS2-4)

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Connections to Nature of Science

Scientific Knowledge Assumes an Order and Consistency in Natural Systems</td></tr>
</table>

consistent with scientific knowledge, principles, and theories. • Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (MS-LS1-6) **Engaging in Argument from Evidence** Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). • Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-LS2-4) -- - ***Connections to Nature of Science*** **Scientific Knowledge is Based on Empirical Evidence** • Science knowledge is based upon logical connections between	• In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction. (MS-LS2-1) • Growth of organisms and population increases are limited by access to resources. (MS-LS2-1) **LS2.B: Cycle of Matter and Energy Transfer in Ecosystems** • Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem. (MS-LS2-3) **LS2.C: Ecosystem Dynamics, Functioning, and Resilience**	• Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation. (MS-LS2-3)

evidence and explanations. (MS-LS1-6) • Science disciplines share common rules of obtaining and evaluating empirical evidence. (MS-LS2-4)	• Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. (MS-LS2-4) **PS3.D: Energy in Chemical Processes and Everyday Life** • The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. *(secondary to MS-LS1-6)* • Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. *(secondary to MS-LS1-7)*	

Connections to other DCIs in this grade-band: **MS.PS1.B** (MS-LS1-6),(MS-LS1-7),(MS-LS2-3); **MS.LS4.C** (MS-LS2-4); **MS.LS4.D** (MS-LS2-4); **MS.ESS2.A** (MS-LS1-6),(MS-LS2-3),(MS-LS2-4); **MS.ESS3.A** (MS-LS2- 1),(MS-LS2-4); **MS.ESS3.C** (MS-LS2-1),(MS-LS2-4)
Articulation of DCIs across grade-bands:

3.LS2.C (MS-LS2-1),(MS-LS2-4); **3.LS4.D** (MS-LS2-1),(MS-LS2-4); **5.PS3.D** (MS-LS1-6),(MS-LS1-7); **5.LS1.C** (MS-LS1-6),(MS-LS1-7); **5.LS2.A** (MS-LS1-6),(MS-LS2- 1),(MS-LS2-3); **5.LS2.B** (MS-LS1-6),(MS-LS1-7);(MS-LS2-3); **HS.PS1.B** (MS-LS1-6),(MS-LS1-7); **HS.PS3.B** (MS-LS2-3); **HS.LS1.C** (MS-LS1-6),(HS-LS1-7),(MS-LS2-3); **HS.LS2.A** (MS-LS2-1); **HS.LS2.B** (MS-LS1-6),(MS-LS1-7),(MS-LS2-3); **HS.LS2.C** (MS-LS2-4); **HS.LS4.C** (MS-LS2-1),(MS-LS2-4); **HS.LS4.D** (MS-LS2-1),(MS-LS2-4); **HS.ESS2.A** (MS-LS2-3); **HS.ESS2.D** (MS-LS1-6); **HS.ESS2.E** (MS-LS2-4); **HS.ESS3.A** (MS-LS2-1); **HS.ESS3.B** (MS-LS2-4); **HS.ESS3.C** (MS-LS2-4)
New Jersey Student Learning Standards Connections: **ELA:** **RST.6-8.1**: Cite specific textual evidence to support analysis of science and technical texts. ,(MS-LS1-6),(MS-LS2-1),(MS-LS2-4) **RST.6-8.2**: Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions. (MS-LS1-6) **RST.6-8.7**: 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-LS2-1) **RI.8.8**: Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims. (MS-LS2-4) **WHST.6-8.1**: Write arguments focused on discipline-specific content. (MS-LS2-4) **WHST.6-8.2**: Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (MS-LS1-6) **WHST.6-8.9**: Draw evidence from informational texts to support analysis, reflection, and research. (MS-LS1-6) **SL.8.5**: Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-LS1-7),(MS- LS2-3) **MATH:** **6.EE.C.9**: Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. (MS-LS1-6),(MS-LS2-3)
Technology & Career Standards: **8.1 Educational Technology:** All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge. **Career Ready Practices:** 1-12

Unit Plan				
Content Vocabulary		**Academic Vocabulary**		**Required Resources**
Organisms	Biotic	Cause	Conserve	McGraw-Hill iScience: Life Science (Chapter 20)
Ecosystems	Abiotic	Effect	Transfer	
Matter	Populations	Distinguish	Release	
Energy	Resilience	Design	Process	
Photosynthesis	Resources	Construct	Structure	
Atoms	Growth	Model	Phenomena	
Molecules	Food Web	Investigate	Cycle	
Chemical Reactions	Producer	Argumentation		
Processes	Consumer			
Cellular Respiration	Decomposer			
Carbon dioxide	Trophic			
Interactions				

THE 5 "E"s	Examples of Learning Activities for the specified "E"	SLO's and Engineering Practices
ENGAGE	**Examples of Engaging Activities:**	
	Activator: Matter vs. Energy Scavenger Hunt - Students will explore the building to find examples of matter and energy.	1, 4 - Asking Question and Defining Problems
	Activator: Where does your energy come from? Did you make your food? Did you produce your own food?	2, 3, 4 - Developing and Using Models
	Activator: Can animals obtain food and energy from the sun?	2, 4 - Constructing Explanations and Designing Solutions
	Modeling Marine Food Webs and Human Impacts Activity (Engage)	3, 4 - Developing and Using Models; Planning and Carrying Out Investigations
EXPLORE	**Examples of Exploring Activities:**	
	Clark's Pond Nature Walk - Students Research the History of Clark's Pond Prior to the Nature Walk; Develop student questions based on what they want to know more about.	3, 4, 5 - Asking Question and Defining Problems

	Meal Journal - Students keep a meal journal for 10 days prior to the start of the unit. Using the journal, they work backwards to predict the source of energy in their food.	2 - Developing and Using Models; Constructing Explanations and Designing Solutions
	Modeling Marine Food Webs and Human Impacts Activity (Explore)	3, 4 - Developing and Using Models; Planning and Carrying Out Investigations
EXPLAIN	**Examples of Explaining Activities:**	
	Flipped Classroom: What is and is not matter and energy? What defines an ecosystem? Students will meet in small groups to discuss their understanding of new concepts while teacher circulates and clarifies misconceptions.	1, 4 - Asking Question and Defining Problems
	Photosynthesis through Khan Academy - Independent Exercise	1 - Developing and Using Models; Obtaining, Evaluating and Communicating Information
	Video: Energy and Life	4 - Constructing Explanations and Designing Solutions
	Producers, Consumers, and Decomposers Text Research - Small Groups will research and create presentations to explain the role each of these plays in an ecosystem.	3, 4, 5 - Developing and Using Models; Obtaining, Evaluating and Communicating Information.
	Modeling Marine Food Webs and Human Impacts Activity (Explain)	3, 4 - Developing and Using Models; Planning and Carrying Out Investigations
	Invasive Species Research Project - Students will view a video on the effect of the lionfish. Students will work with partners to research and example of an additional invasive species in various ecosystems.	5 - Asking Question and Defining Problems
ELABORATE	**Examples of Elaborating Activities:**	
	Current Events: Ecology Theme	1, 2, 3, 4, 5 - Obtaining, Evaluating and Communicating Information
	Socratic Seminar: Human Impact on Ecosystems	1,2, 3, 4, 5 - Engaging in Argument from Evidence

	Evidence of Photosynthesis Lab	2, 4 - Planning and Carrying Out Investigations; Analyzing and Interpreting Data
	Clark's Pond Field Observations - Observing producers, consumers, and decomposers.	3, 4, 5 - Obtaining, Evaluating, and Communicating Information
	Design Simple Food Chains	2, 4 - Developing and Using Models
	Modeling Marine Food Webs and Human Impacts (Elaborate)	3, 4 - Developing and Using Models; Planning and Carrying Out Investigations
EVALUATE	**Examples of Evaluating Activities:**	
	Design a Carbon-Oxygen Cycle Organizer – Create an organizer that demonstrates the movement of carbon and oxygen through an ecosystem; photosynthesis and cellular respiration must be present.	1, 2 - Developing and Using Models
	Create a food web model of Clark's Pond that demonstrates how matter and energy is cycled throughout an ecosystem.	3, 4, 5 - Developing and Using Models
	Modeling Marine Food Webs and Human Impacts (Evaluate)	3, 4, 5 - Developing and Using Models; Planning and Carrying Out Investigations
	Invasive Species Research Project Presentations - Students will share their findings. A model of a food web showing the impact of the invasive species will be required.	5 - Developing and Using Models; Obtaining, Evaluating, and Communicating Information.

Unit #: 3	Unit Name: Interdependent Relationships in Ecosystems	Unit Length: 11 blocks

ESSENTIAL QUESTIONS:

What happens to ecosystems when the environment changes?

#	STUDENT LEARNING OBJECTIVES (SLO)	Corresponding DCIs and PEs
1	**Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.** *[Clarification Statement: Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions could include competitive, predatory, and mutually beneficial.]*	**(MS-LS2-2)**
2	**Evaluate competing design solutions for maintaining biodiversity and ecosystem services. *** *[Clarification Statement: Examples of ecosystem services could include water purification, nutrient recycling, and prevention of soil erosion. Examples of design solution constraints could include scientific, economic, and social considerations.]*	**(MS-LS2-5)**

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.	**LS2.A: Interdependent Relationships in Ecosystems** • Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for	**Patterns** • Patterns can be used to identify cause and effect relationships. (MS-LS2-2) **Stability and Change** • Small changes in one part of a system might cause large changes in another part. (MS-LS2-5) --

- Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena. (MS-LS2-2) **Engaging in Argument from Evidence** Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world(s). - Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-LS2-5)	survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. (MS-LS2-2) **LS2.C: Ecosystem Dynamics, Functioning, and Resilience** - Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health. (MS-LS2-5) **LS4.D: Biodiversity and Humans** - Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. *(secondary to MS-LS2-5)* **ETS1.B: Developing Possible Solutions** - There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. *(secondary to MS-LS2-5)*	***Connections to Engineering, Technology, and Applications of Science*** **Influence of Science, Engineering, and Technology on Society and the Natural World** - The use 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. (MS-LS2-5) --- ***Connections to Nature of Science*** **Science Addresses Questions About the Natural and Material World** - Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes. (MS-LS2-5)

Connections to other DCIs in this grade-band: **MS.LS1.B** (MS-LS2-2)**; MS.ESS3.C** (MS-LS2-5)
Articulation of DCIs across grade-bands: **1.LS1.B** (MS-LS2-2)**; HS.LS2.A** (MS-LS2-2),(MS-LS2-5)**; HS.LS2.B** (MS-LS2-2)**; HS.LS2.C** (MS-LS2-5)**; HS.LS2.D** (MS-LS2-2)**; HS.LS4.D** (MS-LS2-5)**; HS.ESS3.A (**MS-LS2- 5)**; HS.ESS3.C** (MS-LS2-5)**; HS.ESS3.D** (MS-LS2-5)
New Jersey Student Learning Standards Connections: **ELA:** **RST.6-8.1:** Cite specific textual evidence to support analysis of science and technical texts. (MS-LS2-2) **RST.6-8.8**: Distinguish among facts, reasoned judgment based on research findings, and speculation in a text. (MS-LS2-5) **RI.8.8**: Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims. (MS-LS2-5) **WHST.6-8.2:** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (MS-LS2-2) **WHST.6-8.9**: Draw evidence from literary or informational texts to support analysis, reflection, and research. (MS-LS2-2) **SL.8.1**: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly. (MS-LS2-2) **SL.8.4**: Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. (MS-LS2-2) **MATH:** **MP.4:** Model with mathematics. (MS-LS2-5) **6.RP.A.3:** Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-LS2-5) **6.SP.B.5:** Summarize numerical data sets in relation to their context. (MS-LS2-2)
Technology & Career Standards: **8.1 Educational Technology:** All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge. **Career Ready Practices:** 1-12

Unit Plan				
Content Vocabulary		**Academic Vocabulary**		**Required Resources**
Organisms Ecosystems Populations Species Symbiotic Biotic Abiotic Predatory Prey Mutually beneficial Mutualism Competitive	Commensalism Parasitism Dynamic Biodiversity Physical component Biological component Terrestrial Oceanic Resources	Cause Effect Distinguish Design Construct Model Investigate Interpret Measure	Evaluate Argumentation Conserve Transfer Release Process Structure Phenomena Cycle	McGraw-Hill iScience: Life Science (Chapters 21-22)

THE 5 "E"s	Examples of Learning Activities for the specified "E"	SLO's and Engineering Practices
ENGAGE	**Examples of Engaging Activities:**	
	Activator: What relationships do Canadian geese have with the other organisms that live in the Clark's Pond ecosystem?	1, 2 - Asking Questions and Defining Problems; Planning and Carrying Out Investigations
	Video – Health/Ecosystem problems with excessive amounts of Canadian geese.	1, 2 - Engaging in Argument from Evidence
	Clark's Pond Goose Poop Honors Level Design Challenge - Small Group Brainstorming Session	1, 2 - Developing and Using Models; Constructing Explanations and Designing Solutions
	Invasive Pests Activity	1 - Asking Questions and Defining Problems; Analyzing and Interpreting Data; Obtaining, Evaluating, and Communicating Information
EXPLORE	**Examples of Exploring Activities:**	

	SciGirls Video - Turtle Mania: Improving a school pond's habitat	1, 2 - Obtaining, Evaluating, and Communicating Information
	Nature Walk to Clark's Pond Ecosystem – Students will make observations and create a list of the issues goose poop brings to the Clark's Pond Ecosystem	1, 2 - Asking Questions and Defining Problems
	Sampling Activity – Estimate the amount of geese poop present on the fields surrounding Clark's Pond.	1, 2 - Using Mathematics and Computational Thinking
	Clark's Pond Goose Poop Honors Level Design Challenge – Design a system to dispose of/reduce the amount of goose poop entering the Clark's Pond ecosystem.	1, 2 - Developing and Using Models; Constructing Explanations and Designing Solutions
	Invasive Pests Activity	1 - Asking Questions and Defining Problems; Analyzing and Interpreting Data; Obtaining, Evaluating, and Communicating Information
EXPLAIN	**Examples of Explaining Activities:**	
	Why is Biodiversity Important? - Flipped Classroom	1, 2 - Obtaining, Evaluating, and Communicating Information
	Why is Biodiversity Threatened? - Flipped Classroom	1, 2 - Obtaining, Evaluating, and Communicating Information
	Effect of Geese on Your Pond - Students will explain the pathway of geese poop from digestion to the impact it has on the environment.	1, 2 - Constructing Explanations and Designing Solutions
	Clark's Pond Goose Poop Honors Level Design Challenge - Groups will write proposals for their design plan.	1, 2 - Engaging in Argument from Evidence
	Invasive Pests Activity	1 - Asking Questions and Defining Problems; Analyzing and Interpreting Data; Obtaining, Evaluating, and Communicating Information
ELABORATE	**Examples of Elaborating Activities:**	
	Interactive Interdependence Activity	1 - Developing and Using Models

	Determine the population of geese that utilize the Clark's Pond Ecosystem based on the estimated amount of poop using a map of combined sample data.	1, 2 - Using Mathematics and Computational Thinking
	Clark's Pond Goose Poop Honors Level Design Challenge - Build a prototype of the product or system and create an advertisement to describe the benefits of your product.	1, 2 - Constructing Explanations and Designing Solutions
	Invasive Pests Activity	1 - Asking Questions and Defining Problems; Analyzing and Interpreting Data; Obtaining, Evaluating, and Communicating Information
	Current Events: Biodiversity Theme	1, 2 - Obtaining, Evaluating, and Communicating Information.
	Socratic Seminar: Human Impact on Biodiversity	1, 2 - Engaging in Argument from Evidence
EVALUATE	**Examples of Evaluating Activities:**	
	Bird Island Graphing Activity	1 - Developing and Using Models; Using Mathematics and Computational Thinking
	Based on research, what effects would a smaller/larger goose population have on the Clark's Pond ecosystem?	1, 2 - Obtaining, Evaluating, and Communicating Information
	Clark's Pond Goose Poop Honors Level Design Challenge - Present advertisement, plan, and prototype based on provided rubric. Describe in detail what you would do in a redesign phase to improve your prototype.	1, 2 - Obtaining, Evaluating, and Communicating Information
	Invasive Pests Activity	1 - Asking Questions and Defining Problems; Analyzing and Interpreting Data; Obtaining, Evaluating, and Communicating Information

Unit #: 5	Unit Name: Engineering Capstone	Unit Length: 15 blocks

ESSENTIAL QUESTIONS:

How do engineers solve problems?
What are the criteria and constraints of a successful solution?

#	STUDENT LEARNING OBJECTIVES (SLO)	Corresponding DCIs and PEs
1	Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.	(MS-ETS1-1)
2	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.	(MS-ETS1-2)
3	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)
4	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)

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. ● Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (MS-ETS1-1) **Developing and Using Models** Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. ● Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4) **Analyzing and Interpreting Data** Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.	**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,	**Influence of Science, Engineering, and Technology on Society and the Natural World** ● All human activity draws on natural resources and has both short and long- term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ETS1-1) ● The uses of technologies and 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. (MS-ETS1-1)

● Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3) **Engaging in Argument from Evidence** Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world. ● Evaluate competing design solutions based on jointly developed and agreed- upon design criteria. (MS-ETS1-2)	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)	

Connections to MS-ETS1.A: Defining and Delimiting Engineering Problems include: **Physical Science:** MS-PS3-3 Connections to MS-ETS1.B: Developing Possible Solutions Problems include: **Physical Science:** MS-PS1-6, MS-PS3-3, **Life Science:** MS-LS2-5 Connections to MS-ETS1.C: Optimizing the Design Solution include: **Physical Science:** MS-PS1-6
Articulation of DCIs across grade-bands: **3-5.ETS1.A** (MS-ETS1-1 MS-ETS1-2), (MS-ETS1-3); **3-5.ETS1.B** (MS-ETS1-2),(MS-ETS1-3),(MS-ETS1-4); **3-5.ETS1.C** (MS-ETS1-1), (MS-ETS1-2), (MS-ETS1-3), (MS- ETS1-4); **HS.ETS1.A** (MS-ETS1-1), (MS-ETS1-2); **HS.ETS1.B** (MS-ETS1-1), (MS-ETS1-2), (MS-ETS1-3), (MS-ETS1-4); **HS.ETS1.C** (MS-ETS1-3), (MS-ETS1-4)
New Jersey Student Learning Standards Connections: **ELA:** **RST.6-8.1:** Cite specific textual evidence to support analysis of science and technical texts. (MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3) **RST.6-8.7:** 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-ETS1-3) **RST.6-8.9:** 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-ETS1-2),(MS-ETS1-3)

WHST.6-8.7: 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.6-8.8:** 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.6-8.9:** Draw evidence from informational texts to support analysis, reflection, and research. (MS-ETS1-2) SL.8.5: Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-ETS1-4) **MATH:** **MP.2:** Reason abstractly and quantitatively. (MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3),(MS-ETS1-4) **7.EE.3:** 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.SP:** 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)
Technology & Career Standards: **8.1 Educational Technology:** All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge. **Career Ready Practices:** 1-12

Unit Plan				
Content Vocabulary		**Academic Vocabulary**		**Required Resources**
Problem Criteria Constraint Limit Engineering	Solution Design Model Prototype Redesign Modification	Define Evaluate Analyze Explain Model	Demonstrate	McGraw-Hill iScience: Physical Science (Chapters 20-22) McGraw-Hill iScience: Physical Science (Chapters 1-6)

THE 5 "E"s	**Examples of Learning Activities for the specified "E"**	**SLO's and Engineering Practices**
ENGAGE	**Examples of Engaging Activities:**	
	5 Chairs Design Problem - Introduces students to thinking like an engineer. (Start of School Year)	1, 2, 3, 4 - Asking Questions and Defining Problems

EXPLORE	Examples of Exploring Activities:	
	Real World Use of the Design Process	1, 2, 3, 4 - Planning and Carrying Out Investigations; Constructing Explanations and Designing Solutions
EXPLAIN	**Examples of Explaining Activities:**	
	Teaching The Design Process - Students Select a Mini-Design Project to Complete with a Partner (Unit 2)	1, 2, 3, 4 - Obtaining, Evaluating, and Communicating Information
	Egg Helmet Mini Design Challenge (Unit 3)	1, 2, 3, 4 - Planning and Carrying Out Investigations; Constructing Explanations and Designing Solutions
ELABORATE	**Examples of Elaborating Activities:**	
	Roller Coaster Safety Check Design Challenge (Unit 3)	1, 2, 3, 4 - Planning and Carrying Out Investigations; Constructing Explanations and Designing Solutions
	Building A Solar Oven - Students Final Design Challenge (Unit 4)	1, 2, 3, 4 - Planning and Carrying Out Investigations; Constructing Explanations and Designing Solutions
EVALUATE	**Examples of Evaluating Activities:**	
	Theme Park Design Challenge - Year End Culminating Project - Students will design a theme park based on their knowledge of forces, motion, and energy	1, 2, 3, 4 - Planning and Carrying Out Investigations; Constructing Explanations and Designing Solutions
	Ecology Design Challenge - Mid Year Culminating Project - Students will design a self-sustaining mini ecosystem based on their knowledge of ecosystems, biodiversity, and food webs	1, 2, 3, 4 - Planning and Carrying Out Investigations; Constructing Explanations and Designing Solutions