MOUNT HOLLY TOWNSHIP SCHOOL DISTRICT
8th GRADE SCIENCE CURRICULUM

Revised to meet the June 2020 Science NJSLS-S
Board Approval: August, 2022

Board Approved: August 17, 2022

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Board Approved: August 17, 2022

[2020 New Jersey Student Learning Standards for Science](#) (K-5)

[2020 New Jersey Student Learning Standards for Science](#) (6-8)

Intent and Spirit

The New Jersey Student Learning Standards for Science (NJSLS-S) describe the expectations for what students should know and be able to do as well as promote three-dimensional science instruction across the three science domains (i.e., physical sciences, life science, Earth and space sciences). From the earliest grades, the expectation is that students will engage in learning experiences that enable them to investigate phenomena, design solutions to problems, make sense of evidence to construct arguments, and critique and discuss those arguments (in appropriate ways relative to their grade level).

The foundation of the NJSLS-S reflects three dimensions — science and engineering practices, disciplinary core ideas, and crosscutting concepts. The performance expectations are derived from the interplay of these three dimensions. It is essential that these three components are integrated into all learning experiences. Within each standard document, the three dimensions are intentionally presented as integrated components to foster sensemaking and designing solutions to problems. Because the NJSLS-S is built on the notions of coherence and contextuality, each of the science and engineering practices and crosscutting concepts appear multiple times across topics and at every grade level. Additionally, the three dimensions should be an integral part of every curriculum unit and should not be taught in isolation.

Mission

All students will possess an understanding of scientific concepts and processes required for personal decision-making, participation in civic life, and preparation for careers in STEM fields (for those that chose).

Vision

Prepare students to become scientifically literate individuals who can effectively:

- Apply scientific thinking, skills, and understanding to real-world phenomena and problems;

- Engage in systems thinking and modeling to explain phenomena and to give a context for the ideas to be learned;
- Conduct investigations, solve problems, and engage in discussions;
- Discuss open-ended questions that focus on the strength of the evidence used to generate claims;
- Read and evaluate multiple sources, including science-related magazine and journal articles and web-based resources to gain knowledge about current and past science problems and solutions and develop well-reasoned claims; and
- Communicate ideas through journal articles, reports, posters, and media presentations that explain and argue.

Three Dimensions of NJSLS-S

The performance expectations reflect the three dimensions and describe what students should know and be able to do. In layman's terms, they are "the standards." They are written as statements that can be used to guide assessment and allow for flexibility in the way that students are able to demonstrate proficiency.

The example below is provided to illustrate the interconnected nature of the NJSLS-S components.

Disciplinary Core Ideas and Performance Expectations

Disciplinary Core Idea	Performance Expectation
Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models.	Develop and use a model of the Earth-sun moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.

Science and Engineering Practices

Developing and Using Models	Develop and use a model to describe phenomena

Crosscutting Concepts

Scale, Proportion, and Quantity	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.

Becoming familiar with the science practices and crosscutting concepts is a critically important first step in designing learning experiences reflective of the three dimensions. A description of each of the science and engineering practices and the cross-cutting concepts can be found in the next sections.

Further, for students to develop proficiency in the NJSLS-S, they will need to engage in learning experiences that are meaningful, cumulative, and progressive. Learning experiences designed to be meaningful, go beyond reading about science concepts and provide opportunities for students to be active learners and make sense of ideas. Cumulative learning experiences provide opportunities for students to use and build on ideas that they have learned in previous units. Progressive learning experiences provide multiple occasions for students to engage in ways that enable them to improve their construction of explanations and solutions over time by iteratively assessing them, elaborating on them, and holding them up to critique and evidence.

Scientific and Engineering Practices

Asking Questions and Defining Problems

A practice of science is to ask and refine questions that lead to descriptions and explanations of how the natural and designed world works and which can be empirically tested. Engineering questions clarify problems to determine criteria for successful solutions and identify constraints to solve problems about the designed world. Both scientists and engineers also ask questions to clarify the ideas of others.

Planning and Carrying Out Investigations

Scientists and engineers plan and carry out investigations in the field or laboratory, working collaboratively as well as individually. Their investigations are systematic and require clarifying what counts as data and identifying variables or parameters. Engineering investigations identify the effectiveness, efficiency, and durability of designs under different conditions.

Analyzing and Interpreting Data

Scientific investigations produce data that must be analyzed in order to derive meaning. Because data patterns and trends are not always obvious, scientists use a range of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data. Scientists identify sources of error in the investigations and calculate the degree of certainty in the results. Modern technology makes the collection of large data sets much easier, providing secondary sources for analysis. Engineering investigations include analysis of data collected in the tests of designs. This allows comparison of different solutions and determines how well each meets specific design criteria—that is, which design best solves the problem within given constraints. Like scientists, engineers require a range of tools to identify patterns within data and interpret the results. Advances in science make analysis of proposed solutions more efficient and effective.

Developing and Using Models

A practice of both science and engineering is to use and construct models as helpful tools for representing ideas and explanations. These tools include diagrams, drawings, physical replicas, mathematical representations, analogies, and computer simulations. Modeling tools are used to develop questions, predictions and explanations; analyze and identify flaws in systems; and communicate ideas. Models are used to build and revise scientific explanations and proposed engineered systems. Measurements and observations are used to revise models and designs.

Constructing Explanations and Designing Solutions

The products of science are explanations and the products of engineering are solutions. The goal of science is the construction of theories that provide explanatory accounts of the world. A theory becomes accepted when it has multiple lines of empirical evidence and greater explanatory power of phenomena than previous theories. The goal of engineering design is to find a systematic solution to problems that is based on scientific knowledge and models of the material world. Each proposed solution results from a process of balancing competing criteria of desired functions, technical feasibility, cost, safety, aesthetics, and compliance with legal requirements. The optimal choice depends on how well the proposed solutions meet criteria and constraints.

Engaging in Argument from Evidence

Argumentation is the process by which explanations and solutions are reached. In science and engineering, reasoning and argument based on evidence are essential to identifying the best explanation for a natural phenomenon or the best solution to a design problem. Scientists and engineers use argumentation to listen to, compare, and evaluate competing ideas and methods based on merits.

Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to identify strengths and weaknesses of claims.

Using Mathematics and Computational Thinking
In both science and engineering, mathematics and computation are fundamental tools for representing physical variables and their relationships. They are used for a range of tasks such as constructing simulations; statistically analyzing data; and recognizing, expressing, and applying quantitative relationships. Mathematical and computational approaches enable scientists and engineers to predict the behavior of systems and test the validity of such predictions. Statistical methods are frequently used to identify significant patterns and establish correlational relationships.

Obtaining, Evaluating, and Communicating Information
Scientists and engineers must be able to communicate clearly and persuasively the ideas and methods they generate. Critiquing and communicating ideas individually and in groups is a critical professional activity. Communicating information and ideas can be done in multiple ways: using tables, diagrams, graphs, models, and equations as well as orally, in writing, and through extended discussions. Scientists and engineers employ multiple sources to acquire information that is used to evaluate the merit and validity of claims, methods, and design.

{NJDOE NJSLS-S January 2022}

New Jersey Technology Standards

2020 New Jersery Student Learning Standards: Computer Science and Design Thinking

New Jersey Career Readiness, Life Literacies, and Key Skills Standards

2020 New Jersey Student Learning Standards: Career Readiness, Life Literacies & Key Skills

New Jersey Climate Change Standards

2020 New Jersey Student Learning Standards: Climate Change

Pacing Guide

Topic	Unit #	Unit Length
Scientific method, measurement skills, and data analysis principles	1	10 days
Engineering and design process	2	15 days
Atomic structures	3	25 days
Chemical reactions and heat	4	20 days
Forms of energy	5	15 days
Motion and mechanics	6	20 days
Civil structures	7	15 days
Electricity and magnetism	8	20 days
Science fair project	9	20 days
Sound, light, and waves	10	20 days

Science Unit 1 Grade 8	
Unit Title	The scientific method, measurement skills, and data analysis principles
Recommended Pacing	10 days
Unit Summary	In this unit students will… ● Apply the steps of the scientific method to an experiment ● Be able to identify the control and experimental groups in an experiment ● Accurately measure and record data ● Create a data table ● Create a graph
Career Readiness, Life Literacies, and Key Skills Standards	• 9.2.8.CAP.12: Assess personal strengths, talents, values, and interests to appropriate jobs and careers to maximize career potential
Computer Science and Design Thinking (Technology)	8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose. 8.1.8.DA.3: Identify the appropriate tool to access data based on its file format.
Diversity, Equity, and Inclusion	How do temperature changes vary according to geographical location? What are the carbon dioxide emissions by country? Diversity of measurement systems throughout history Ancient ● Arabic ● Biblical and Talmudic ● Egyptian ● Greek ● Hindu

	• Indian
	• Mesopotamian
	• Persian
	• Roman
	
	Europe <u>Byzantine</u>
	• Cornish
	• Cypriot
	• Czech
	• Danish
	• Dutch
	• English
	  ○ Winchester
	  ○ Exchequer
	• Estonian
	• Finnish
	• French
	  ○ Traditional
	  ○ Mesures usuelles
	• German
	• Greek
	• Hungarian
	• Icelandic
	• Irish
	• Italian
	• Latvian
	• Luxembourgian
	• Maltese
	• Norwegian
	• Ottoman
	• Polish
	• Portuguese
	• Romanian
	• Russian
	• Scottish
	• Serbian
	• Slovak
	• Spanish
	• Swedish
	• Swiss
	• Welsh

	Asia • Afghan • Cambodian • Chinese • Hong Kong • Indian • Indonesian • Japanese • Korean • Mongolian • Myanmar • Nepalese • Omani • Philippine • Pegu • Singaporean • Sri Lankan • Syrian • Taiwanese • Tatar • Thai • Vietnamese Africa • Algerian • Ethiopian • Egyptian • Eritrean • Guinean • Libyan • Malagasy • Mauritian • Moroccan • Seychellois • Somali • South African • Tunisian • Tanzanian North America • Costa Rican • Cuban

	• Haitian • Honduran • Mexican • Nicaraguan • Puerto Rican South America • Argentine • Bolivian • Brazilian • Chilean • Colombian • Paraguayan • Peruvian • Uruguayan • Venezuelan Universality of the international system of units (metric system) France's contribution to the metric system and data analysis (e.g. Louis Pasteur)
Climate Change	Analyze local and global temperature data in relation to carbon dioxide levels over an extended period of time
Supplemental Class Resources	https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature https://www.nist.gov/pml/owm/becoming-familiar-si https://www.bbc.com/travel/article/20180923-how-france-created-the-metric-system

	https://www.britannica.com/biography/Louis-Pasteur Glencoe Science Level Blue Textbook - Ch. 1-1, Ch. 1-2, Ch. 1-3, Ch. 1-4, Ch. 23-2 https://www.brainpop.com/science/scientificinquiry/scientificmethod/ https://www.brainpop.com/science/scientificinquiry/criticalreasoning/ https://www.brainpop.com/science/scientificinquiry/imagination/ https://www.brainpop.com/science/scientificinquiry/measuringmatter/ https://www.brainpop.com/science/scientificinquiry/metricunits/ https://www.brainpop.com/science/scientificinquiry/precisionandaccuracy/ https://www.brainpop.com/science/scientificinquiry/standardandscientificnotation/ https://www.brainpop.com/science/scientificinquiry/statistics/ https://www.brainpop.com/technology/scienceandindustry/engineeringdesignprocess/

Disciplinary Core Idea	**Performance Expectation**
Understand the steps of the scientific method Understand how to measure	8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose.

Understand how to perform data analysis	*NJSLSA.R8. Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.* *NJSLSA.R10. Read and comprehend complex literary and informational texts independently and proficiently with scaffolding as needed.* *NJSLSA.W2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.* *NJSLSA.W4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience* *NJSLSA.W6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.* *NJSLSA.W7. Conduct short as well as more sustained research projects, utilizing an inquiry-based research process, based on focused questions, demonstrating understanding of the subject under investigation.* *NJSLSA.W8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism. NJSLSA.W9. Draw evidence from literary or informational texts to support analysis, reflection, and research.*

	NJSLSA.W10. Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences. *Measurement and Data 5.MD* *3. Recognize volume as an attribute of solid figures and understand concepts of volume measurement. a. A cube with side length 1 unit, called a "unit cube," is said to have "one cubic unit" of volume, and can be used to measure volume. b. A solid figure which can be packed without gaps or overlaps using n unit cubes is said to have a volume of n cubic units. 4. Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and non-standard units. 5. Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume. a. Find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes, and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent threefold whole-number products as volumes, e.g., to represent the associative property of multiplication. 1Students able to multiply fractions in general can develop strategies to divide fractions in general, by reasoning about the relationship between multiplication and division. But division of a fraction by a fraction is not a requirement at this grade. New Jersey Student Learning Standards for Mathematics 7 b. Apply the formulas* $V = l \times w \times h$ *and* $V = B \times h$ *for rectangular prisms to find volumes of right rectangular prisms with whole number edge lengths in the context of solving real world and mathematical problems.*

	c. Recognize volume as additive. Find volumes of solid figures composed of two nonoverlapping right rectangular prisms by adding the volumes of the non-overlapping parts, applying this technique to solve real world problems *Statistics and Probability 6.SP* *A. Develop understanding of statistical variability. 1. Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers. For example, "How old am I?" is not a statistical question, but "How old are the students in my school?" is a statistical question because one anticipates variability in students' ages. 2. Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape. 3. Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number.* *B. Summarize and describe distributions. 4. Display numerical data in plots on a number line, including dot plots, histograms, and box plots. 5. Summarize numerical data sets in relation to their context, such as by: a. Reporting the number of observations. b. Describing the nature of the attribute under investigation, including how it was measured and its units of measurement. c. Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which*

	the data were gathered. d. Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered.

Science & Engineering Practices	Asking questions and defining problems Developing and using models Planning and carrying out investigations Analyzing and interpreting data Using mathematics and computational thinking Constructing explanations and designing solutions Engaging in argument from evidence Obtaining, evaluating, and communicating information
Articulation of DCI's Across Grade-Levels	**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)
Crosscutting Concepts	Scientific method, measurement, data analysis

Math Student Learning Objectives Covered in this Unit
Measurement and Data 5.MD 3. Recognize volume as an attribute of solid figures and understand concepts of volume measurement. a. A cube with side length 1 unit, called a "unit cube," is said to have "one cubic unit" of volume, and can be used to measure volume. b. A solid figure which can be packed without gaps or overlaps using n unit cubes is said to have a volume of n cubic units. 4. Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and non-standard units. 5. Relate volume to the operations of multiplication and addition and solve

real world and mathematical problems involving volume. a. Find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes, and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent threefold whole-number products as volumes, e.g., to represent the associative property of multiplication. 1Students able to multiply fractions in general can develop strategies to divide fractions in general, by reasoning about the relationship between multiplication and division. But division of a fraction by a fraction is not a requirement at this grade. New Jersey Student Learning Standards for Mathematics 7 b. Apply the formulas V = l × w × h and V = B × h for rectangular prisms to find volumes of right rectangular prisms with whole number edge lengths in the context of solving real world and mathematical problems. c. Recognize volume as additive. Find volumes of solid figures composed of two nonoverlapping right rectangular prisms by adding the volumes of the non-overlapping parts, applying this technique to solve real world problems

Statistics and Probability 6.SP

A. Develop understanding of statistical variability. 1. Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers. For example, "How old am I?" is not a statistical question, but "How old are the students in my school?" is a statistical question because one anticipates variability in students' ages. 2. Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape. 3. Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number.

B. Summarize and describe distributions. 4. Display numerical data in plots on a number line, including dot plots, histograms, and box plots. 5. Summarize numerical data sets in relation to their context, such as by: a. Reporting the number of observations. b. Describing the nature of the attribute under investigation, including how it was measured and its units of measurement. c. Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered. d. Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered.

ELA Student Learning Objectives Covered in this Unit

NJSLSA.R8. Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence. NJSLSA.R10. Read and comprehend complex literary and informational texts independently and proficiently with scaffolding as needed. NJSLSA.W2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content. NJSLSA.W4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience NJSLSA.W6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others. NJSLSA.W7. Conduct short as well as more sustained research projects, utilizing an inquiry-based research process, based on focused questions, demonstrating understanding of the subject under investigation. NJSLSA.W8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism. NJSLSA.W9. Draw evidence from literary or informational texts to support analysis, reflection, and research. NJSLSA.W10. Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

Modifications
SPED: Provide visuals for students throughout the lesson on promethean board and the focus wall; allow extra time for activities to be completed; dictated responses in lieu of written work; hands on activities instead of pencil and paper

ESL/ELL: Describing pictures or classroom objects; Providing information in graphic organizers; Identifying real life objects based on descriptive oral phrases or short sentences;

504 Students: Provide a checklist of the steps needed to complete the problem; Provide lots of white-space to make it less busy; If still struggling, reteach and retest

At-Risk Students: Reduce the number of problems given; Give extra time

Gifted and Talented: Added detail to written work; find connecting stories from classroom library and compare to the lessons;

Additional Modification Option:
https://www.nextgenscience.org/sites/default/files/Appendix%20D%20Diversity%20and%20Equity%206-14-13.pdf

<table>
<tr><th colspan="2">Unit One: The scientific method, measurement skills, and data analysis principles</th></tr>
<tr><td rowspan="3">NJ Student Learning Standards: Science Grade 8

List Standards here:

8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose.</td><td>Length: 10 days</td></tr>
<tr><td>NJDOE Science Curricular Framework
NJ Science Frameworks</td></tr>
<tr><td>21st Century Student Outcomes
http://www.battelleforkids.org/networks/p21

Learning and Innovation Skills</td></tr>
</table>

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NJSLSA.W9. Draw evidence from literary or informational texts to support analysis, reflection, and research. NJSLSA.W10. Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences. Measurement and Data 5.MD 3. Recognize volume as an attribute of solid figures and understand concepts of volume measurement. a. A cube with side length 1 unit, called a "unit cube," is said to have "one cubic unit" of volume, and can be used to measure volume. b. A solid figure which can be packed without gaps or overlaps using n unit cubes is said to have a volume of n cubic units. 4. Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and non-standard units. 5. Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume. a. Find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes, and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent threefold whole-number products as volumes, e.g., to represent the associative property of multiplication. 1Students able to multiply fractions in general can develop strategies to divide fractions in general, by reasoning about the relationship between multiplication and division. But division of a fraction by a fraction is not a requirement at this grade. New Jersey Student Learning Standards for	

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measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered. d. Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered.	

Unit Focus and Targets:

Essential Questions:

What is science?

Learning Goals:

Understand the steps of the scientific method.

Understand how to measure, record, and analyze data.

NJSLS Lessons:

Unit 1 Lesson 1: Scientific method

Materials: none

Engage: Ask students how they would go about solving a household problem? What steps would they take? Have the students share personal stories of solving problems at home.

Explore: Have the students choose a mini scientific investigation to conduct that will involve all the steps of the scientific method

Explain: Review the steps of the scientific method and review relevant vocabulary
Hypothesis, data, scientific question, communication, experiment, independent variable, dependent variable, control

Elaborate: Have students review practice problems to identify variables and parts of an experiment.

Evaluate: Have students complete a simple lab and Quiz

Unit 1 Lesson 2: Measurement skills

Materials: rulers, balances, and scales

Engage: Ask students how they would measure mass and size of an object?

Explore: Have the students explore different weights and different historical measurement systems.

Explain: The history and diversity of different measurement systems. Explain how the metric system works.

Elaborate: Have students practice measuring various objects and doing measurement conversions

Evaluate: Have students complete a simple lab and quiz

Unit 1 Lesson 3: Data analysis principles

Materials: computer

Engage: Ask students what is the average height of 8th grade student Explore: Have the students measure and records the heights of each other Explain: How to create a data table and graph results Elaborate: Have students explain the height trends of the 8th grade students Evaluate: Have students complete a simple lab and quiz Differentiation: General Accommodations/Modifications: ● Extended time for assignments ● Alternative forms of assessment if appropriate ● Visuals for vocabulary ● Pre-teach new vocabulary when appropriate ● Reduce auditory and visual distractions ● Small group instruction as needed
Unit Assessments: Scientific method quiz, measurement conversion quiz, and data analysis quiz Formative: Brainpops quiz on scientific method, measurement, and data analysis Summative: Scientific method lab, measurement lab, and data analysis lab

Science Unit 2 Grade 8	
Unit Title	Engineering and design process
Recommended Pacing	15 days
Unit Summary	● In this unit the students will work on exploring the fundamentals of the design and engineering process by having to create a chair out of cardboard scraps.
Career Readiness, Life Literacies, and Key Skills Standards	• 9.2.8.CAP.12: Assess personal strengths, talents, values, and interests to appropriate jobs and careers to maximize career potential
Computer Science and Design Thinking (Technology)	8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose. 8.1.8.DA.3: Identify the appropriate tool to access data based on its file format.
Diversity, Equity, and Inclusion	Science is a universal pursuit with diverse contributions from throughout the world. Ultimately, science seeks to understand the natural world. Since the beginning of human existence people have interacted with the natural world and sought to use nature to increase survival odds. The history of science and its earliest roots can be traced to the ancient civilizations of ancient Egypt and Mesopotamia. Next, the Greeks made significant contributions to thinking about and understanding the natural world. After the Greeks, early science investigations were furthered in the Byzantine Empire and in the Arab world during the Islamic Golden age. India and China also had significant contributions to early science investigations in their history. During the Middle Ages medieval universities began formalized educational pursuits in Western Europe. Up to this point in human history humans had an understanding of natural laws, properties of materials, technological tools, and engineering. During the Renaissance the scientific revolution in Europe ushered in a new era of modern scientific thought that had tremendous impact from there on forward. The Age of

	Enlightenment spread ideas across Europe and North America. As the world became more connected over the next centuries ideas spread and science continued to develop and flourish. The last two hundred years have shown rapid development in science, technology, and engineering. Discussions in class will cover many of the scientists/engineers on the list as relevant. The goal is to have the students understand that science is ultimately the pursuit of rational truth in the universe. Progress in science is not limited to any one geographic region or cultural background. Development of scientific knowledge has occurred thanks to various differing and unique individuals from throughout time and the world. Students will research a scientist/engineer of their choice. The following scientists and engineers are related to the unit. Archimedes Leonardo Da Vinci Lonnie Johnson Alexander Graham Bell Thomas Edison James Watt Nicolaus Otto Henry Ford Rudolf Diesel Gottlieb Daimler Sir Mokshagundam Vishveshwarayy Soichiro Honda Imhotep Isambard Kingdom Brunel George Stephenson Burt Rutan Fazlur Rahman Khan

	Nikola Tesla Charles Babbage George Westinghouse Jr. Lee de Forest Frank Whittle Hedy Lamarr Steve Wozniak Guglielmo Marconi James Clerk Maxwell
Climate Change	• MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. Machines that remove carbon from the atmosphere Nuclear power a carbon free energy source
Supplemental Class Resources	https://allthatsinteresting.com/lonnie-johnson https://www.science.org/content/article/switzerland-giant-new-machine-sucking-carbon-directly-air https://www.eia.gov/energyexplained/nuclear/nuclear-power-and-the-environment.php#:~:text=Nuclear%20power%20reactors%20do%20not,or%20carbon%20dioxide%20while%20operating. https://theconversation.com/engineers-have-built-machines-to-scrub-co-from-the-air-but-will-it-halt-climate-change-152975

	https://www.brainpop.com/technology/scienceandindustry/engineeringdesignprocess/

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

Science & Engineering Practices	**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. ● Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3) **Engaging in Argument from Evidence**
Articulation of DCI's Across Grade-Levels	**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)
Crosscutting Concepts	**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)

Math Student Learning Objectives Covered in this Unit

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)*

ELA Student Learning Objectives Covered in this Unit

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)*

Modifications
SPED: Provide visuals for students throughout the lesson on promethean board and the focus wall; allow extra time for activities to be completed; dictated responses in lieu of written work; hands on activities instead of pencil and paper ESL/ELL: Describing pictures or classroom objects; Providing information in graphic organizers; Identifying real life objects based on descriptive oral phrases or short sentences; 504 Students: Provide a checklist of the steps needed to complete the problem; Provide lots of white-space to make it less busy; If still struggling, reteach and retest At-Risk Students: Reduce the number of problems given; Give extra time Gifted and Talented: Added detail to written work; find connecting stories from classroom library and compare to the lessons;
Additional Modification Option: https://www.nextgenscience.org/sites/default/files/Appendix%20D%20Diversity%20and%20Equity%206-14-13.pdf

Board Approved: August 17, 2022

Unit Two: Engineering and the design process	
NJ Student Learning Standards: Science Grade 8 ***List Standards here:*** 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. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. MS-ETS1-2. 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.	**Length: 15 days** **NJDOE Science Curricular Framework** NJ Science Frameworks **21st Century Student Outcomes** http://www.battelleforkids.org/networks/p21 **Learning and Innovation Skills** **highlight appropriate indicators for unit/domain** Think Creatively Work Creatively with Others Implement Innovations Reason effectively Use Systems Thinking Make Judgments and Decisions Solve Problems Communicate Clearly Collaborate with Others **Information, Media and Technology Skills** **highlight appropriate indicators for unit/domain** Information Literacy

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.	Media Literacy ICT (Information, Communications and Technology Literacy) **Life and Career Skills** **highlight appropriate indicators for unit/domain** Adapt to Change Be Flexible Manage Goals and Time Work Independently Be Self-directed Learners Interact Effectively with Others Work Effectively in Diverse Teams
Unit Focus and Targets:	
Essential Questions: How do you create a functioning chair? How do scientists and engineers work in the 21st century to discover problems and create solutions that improve society? What is the engineering and design process? Learning Goals: Use the design process to create a functional cardboard chair.	
NJSLS Lessons:	
Lab 1 - Design Process - Build a cardboard chair - Level 4 DOK:	

Materials:
Supplies needed per class -
12 Cardboard boxes
6 Rolls of duct tape
6 Pairs of scissors

Phenomena/Big Question - How can design and engineering be used to create a functional chair? How do we scientifically test and measure results? How are forces measured?

The students will work in cooperative pairs to create a chair out of pieces of cardboard. The constraints of the project are: the chair will be able to hold the student's weight, the seat will need to be taller than the student's knee height, and the chair will need to have more than five functional parts.

Engage - Show the students PBS Design Squad videos on designing and engineering furniture from cardboard.

Explore - Allow the students in cooperative groups to explore different chair designs.

Explain - The students will have to explain how their chair works and the forces acting upon their chair. The students will test their designs and make improvements as necessary.

Elaborate - The students will elaborate on how static forces such tension, compression, and shear forces interact with their cardboard chair. The students will create a free body diagram of the forces acting on the chair.

Evaluate - The students will present their final findings to the rest of the class for evaluation.

Differentiation: **General Accommodations/Modifications:** ● Extended time for assignments ● Alternative forms of assessment if appropriate ● Visuals for vocabulary ● Pre-teach new vocabulary when appropriate ● Reduce auditory and visual distractions ● Small group instruction as needed
Unit Assessments: Build a cardboard chair Formative: Engineering and design process for project in lab manual, brain pop quiz on design process Summative: Cardboard chair

Science Unit 3 **Grade 8**	
Unit Title	Atomic structures
Recommended Pacing	25 days
Unit Summary	In this unit students will… ● Students will build understanding of what occurs at the atomic and molecular scale. Students apply their understanding that pure substances have characteristic properties and are made from a single type of atom or molecule. They also provide molecular

	level accounts to explain states of matter and changes between states. The crosscutting concepts of *cause and effect*, *scale, proportion and quantity*, *structure and function*,*interdependence of science, engineering, and technology*, and *the influence of science, engineering and technology on society and the natural world* provide a framework for understanding the disciplinary core ideas. Students demonstrate grade appropriate proficiency in *developing and using models*, and *obtaining, evaluating, and communicating information*. Students are also expected to use the scientific and engineering practices to demonstrate understanding of the core ideas.
Career Readiness, Life Literacies, and Key Skills Standards	• 9.2.8.CAP.12: Assess personal strengths, talents, values, and interests to appropriate jobs and careers to maximize career potential
Computer Science and Design Thinking (Technology)	8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose. 8.1.8.DA.3: Identify the appropriate tool to access data based on its file format.
Diversity, Equity, and Inclusion	*Science is a universal pursuit with diverse contributions from throughout the world. Ultimately, science seeks to understand the natural world. Since the beginning of human existence people have interacted with the natural world and sought to use nature to increase survival odds. The history of science and its earliest roots can be traced to the ancient civilizations of ancient Egypt and Mesopotamia. Next, the Greeks made significant contributions to thinking about and understanding the natural world. After the Greeks, early science investigations were furthered in the Byzantine Empire and in the Arab world during the Islamic Golden age. India and China also had significant contributions to early science investigations in their history. During the Middle Ages medieval universities began formalized educational pursuits in Western Europe. Up to this point in human history humans had an understanding of natural laws, properties of materials, technological tools, and engineering. During the Renaissance the scientific revolution in Europe ushered in a new era of modern scientific thought that had tremendous impact from there on forward. The Age of*

	Enlightenment spread ideas across Europe and North America. As the world became more connected over the next centuries ideas spread and science continued to develop and flourish. The last two hundred years have shown rapid development in science, technology, and engineering. *Discussions in class will cover many of the scientists/engineers on the list as relevant. The goal is to have the students understand that science is ultimately the pursuit of rational truth in the universe. Progress in science is not limited to any one geographic region or cultural background. Development of scientific knowledge has occurred thanks to various differing and unique individuals from throughout time and the world. Students will research a scientist/engineer of their choice. The following scientists and engineers are related to the unit.* John Dalton Dmitri Mendeleev Alfred Nobel Percy Julian Alice Ball Marie Curie George Washington Carver Neils Bohr Dorothy Hodgkin Roger Tsien Rosalind Franklin Mario Molina Ahmed Zewail Marie M. Daly Neil deGrasse Tyson Luis Federico Leloir F. Sherwood Rowland

	Mario José Molina Peter Tsai Subrahmanyan Chandrasekhar Mikhail Lomonosov
Climate Change	• MS-ESS2-1: Develop a model to describe the cycling of Earth’s materials and the flow of energy that drives this process. Chemical structure of carbon dioxide
Supplemental Class Resources	https://www.acs.org/content/acs/en/education/whatischemistry/landmarks/carver.html https://www.brainpop.com/science/matterandchemistry/atoms/ https://www.brainpop.com/science/matterandchemistry/bodychemistry/ https://www.brainpop.com/science/matterandchemistry/chemicalbonds/ https://www.brainpop.com/science/matterandchemistry/chemicalequations/ https://www.brainpop.com/science/matterandchemistry/compoundsandmixtures/ https://www.brainpop.com/science/matterandchemistry/conservationofmass/ https://www.brainpop.com/science/matterandchemistry/metals/ https://www.brainpop.com/science/matterandchemistry/nanotechnology/

	https://www.brainpop.com/science/matterandchemistry/periodictableofelements/

Disciplinary Core Idea	Performance Expectation
PS1.A: Structure and Properties of Matter • Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1-1) • Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-3) *(Note: This Disciplinary Core Idea is also addressed by MS-PS1-2.)* • Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4) • In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4) • Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1) • The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (MS-PS1-4) **PS1.B: Chemical Reactions** • Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-3) *(Note: This Disciplinary Core Idea is also addressed by MS-PS1-2 and MS-PS1-5.)* **PS3.A: Definitions of Energy** • The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. *(secondary to MS-PS1-4)*	Develop models to describe the atomic composition of simple molecules and extended structures. [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms. The substructure of atoms and the periodic table are learned in high school chemistry.] [Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure.] (MS-PS1-1) Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. [Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.] [Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.] (MS-PS1- 2)

• The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material. *(secondary to MS-PS1-4)*	Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. [Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.] [Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.] (MS-PS1-5) Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.* [Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.] [Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.] (MS-PS1-6) 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) 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) 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)

Science & Engineering Practices	**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 predict and/or describe phenomena. (MS-PS1-1),(MS-PS1-4) **Obtaining, Evaluating, and Communicating Information** Obtaining, evaluating, and communicating information in 6–8 builds on K–5 and progresses to evaluating the merit and validity of ideas and methods. ● Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or now supported by evidence. (MS-PS1-3)
Articulation of DCI's Across Grade-Levels	**PS1.A: Structure and Properties of Matter** ● Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1-1) ● Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-3) *(Note: This Disciplinary Core Idea is also addressed by MS-PS1-2.)* ● Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4)

	• In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4) • Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1) • The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (MS-PS1-4) **PS1.B: Chemical Reactions** • Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-3) *(Note: This Disciplinary Core Idea is also addressed by MS-PS1-2 and MS-PS1-5.)* **PS3.A: Definitions of Energy** • The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. *(secondary to MS-PS1-4)* • The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material. *(secondary to MS-PS1-4)*
Crosscutting Concepts	**Cause and Effect** • Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4) **Scale, Proportion, and Quantity** • Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-PS1-1) **Structure and Function** • Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (MS-PS1-3) - ***Connections to Engineering,Technology, and Applications of Science*** **Interdependence of Science, Engineering, and Technology** • Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS-PS1-3) **Influence of Science, Engineering and Technology on Society and the Natural World** • The uses of technologies and any limitation 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-PS1-3)

Math Student Learning Objectives Covered in this Unit

MP.2	Reason abstractly and quantitatively. (MS-PS1-1)
MP.4	Model with mathematics. *(MS-PS1-1)*
6.RP.A.3	Use ratio and rate reasoning to solve real-world and mathematical problems. *(MS-PS1-1)*
6.NS.C.5	Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-PS1-4)
8.EE.A.3	Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. *(MS-PS1-1)*

ELA Student Learning Objectives Covered in this Unit

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-PS1-3)
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-PS1-1),(MS-PS1-4)*
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-PS1-3)

Modifications

SPED: Provide visuals for students throughout the lesson on promethean board and the focus wall; allow extra time for activities to be completed; dictated responses in lieu of written work; hands on activities instead of pencil and paper

ESL/ELL: Describing pictures or classroom objects; Providing information in graphic organizers; Identifying real life objects based on descriptive oral phrases or short sentences;

504 Students: Provide a checklist of the steps needed to complete the problem; Provide lots of white-space to make it less busy; If still struggling, reteach and retest

At-Risk Students: Reduce the number of problems given; Give extra time

Gifted and Talented: Added detail to written work; find connecting stories from classroom library and compare to the lessons;

Additional Modification Option:
https://www.nextgenscience.org/sites/default/files/Appendix%20D%20Diversity%20and%20Equity%206-14-13.pdf

Unit Three: Chemistry Fundamentals	
NJ Student Learning Standards: Science Grade 8 ***List Standards here:*** Develop models to describe the atomic composition of simple molecules and extended structures. [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models	**Length: 25 days** **NJDOE Science Curricular Framework** NJ Science Frameworks **21st Century Student Outcomes** http://www.battelleforkids.org/networks/p21 **Learning and Innovation Skills** **highlight appropriate indicators for unit/domain** Think Creatively Work Creatively with Others

could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms. The substructure of atoms and the periodic table are learned in high school chemistry.] [Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure.] (MS-PS1-1) Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. [Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.] [Assessment Boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.] (MS-PS1- 2) Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. [Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.] [Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.] (MS-PS1-5) Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical	Implement Innovations Reason effectively Use Systems Thinking Make Judgments and Decisions Solve Problems Communicate Clearly Collaborate with Others **Information, Media and Technology Skills** **highlight appropriate indicators for unit/domain** Information Literacy Media Literacy ICT (Information, Communicationcs and Technology Literacy) **Life and Career Skills** **highlight appropriate indicators for unit/domain** Adapt to Change Be Flexible Manage Goals and Time Work Independently Be Self-directed Learners Interact Effectively with Others Work Effectively in Diverse Teams

processes.* [Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.] [Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.] (MS-PS1-6) 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) 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)	

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)	

Unit Focus and Targets:

Essential Questions:

How is it that everything is made of stardust?

What is the universe made of?

Learning Goals:

Understand that atoms make up all the stuff in the universe

NJSLS Lessons:

Materials:

- Vinegar
- Baking soda
- Detergent
- Graduated cylinders

Lab 1 - Controlling the amount of products in a chemical reaction

Phenomena/Big Question - What happens when two different chemicals are mixed? What is a physical change vs. a chemical change?

Engage - 1. Have students look at the chemical equation for the vinegar and baking soda reaction as you discuss the reactants. 2. As a demonstration, combine vinegar and baking soda to show students the chemical reaction described in the equation. 3. Review the concept that mass is conserved in a chemical reaction.

Explore - As a demonstration, combine vinegar, detergent, and baking soda in a graduated cylinder so that foam rises and spills over the top. Discuss how to change the amount of foam produced so that it rises to the top of the cylinder without overflowing. Have each group experiment with different amounts of vinegar and baking soda in order to get the foam to rise to the top of the graduated cylinder without overflowing.

Explain - Discuss why adjusting the amount of reactants affects the amount of products.

Elaborate - Do a demonstration using Alka-Seltzer or a similar effervescent tablet in water to show that citric acid reacts with sodium bicarbonate to produce carbon dioxide gas.

Evaluate - The students will present their findings to the rest of the class.

Resources-

http://www.middleschoolchemistry.com/lessonplans/chapter6/lesson2

Materials:

- Baking soda
- Calcium chloride
- Water

- Graduated cylinder
- Measuring spoon (½ teaspoon) or balance
- 2 clear plastic cups
- Masking tape
- Pen

Lab 2 - Forming a precipitate

Engage - Do a demonstration by combining two clear colorless solutions that produce a white solid and introduce the term precipitate.

Explore - Have students combine two liquids to observe another precipitate.

Explain - Discuss the products produced in this chemical reaction. Separate the products to show that the precipitate is a solid. Confirm that a chemical reaction took place.

Elaborate - Do a demonstration to show students another example of a precipitate and a color change.

Evaluate - The students will present their findings to the rest of the class.

Resources-

http://www.middleschoolchemistry.com/lessonplans/chapter6/lesson3

Materials:

- 3 clear plastic cups
- Masking tape and pen or permanent marker

- Universal indicator solution
- pH color chart
- Water
- Citric acid
- Sodium carbonate
- Graduated cylinder
- At least 12 flat toothpicks
- 2 6-well spot plates or 1 12-well spot plate
- 3 droppers

Lab 3 - pH and Color change

Engage - Add universal indicator solution to an acid and a base hidden in “empty” cups to demonstrate how an acid and a base can change the color of a pH indicator.

Explore - Have students prepare the solutions for the activity.

Explain - Explain how water molecules interact with each other to form ions.

Elaborate - Have students slowly pour their remaining acidic and basic solutions into the indicator solution to introduce the idea that acids and bases can neutralize each other.

Evaluate - The students will present their findings to the rest of the class.

Resources-

http://www.middleschoolchemistry.com/lessonplans/chapter6/lesson8

Differentiation: **General Accommodations/Modifications:** ● Extended time for assignments ● Alternative forms of assessment if appropriate ● Visuals for vocabulary ● Pre-teach new vocabulary when appropriate ● Reduce auditory and visual distractions ● Small group instruction as needed
Unit Assessments: Chemistry Unit Test Formative: Brainpop quiz on atoms, periodic table, bonding Summative: Chemistry labs

Science Unit 4 Grade 8	
Unit Title	Chemical reactions and heat
Recommended Pacing	15 days
Unit Summary	● Students provide molecular-level accounts of states of matters and changes between states, of how chemical reactions involve regrouping of atoms to form new substances, and of how atoms rearrange during chemical reactions. Students also apply their

	understanding of optimization design and process in engineering to chemical reaction systems. The crosscutting concept of energy and matter provides a framework for understanding the disciplinary core ideas. Students are expected to demonstrate proficiency in developing and using models, analyzing and interpreting data, designing solutions, and obtaining, evaluating, and communicating information. Students are also expected to use these science and engineering practices to demonstrate understanding of the disciplinary core ideas.
Career Readiness, Life Literacies, and Key Skills Standards	• 9.2.8.CAP.12: Assess personal strengths, talents, values, and interests to appropriate jobs and careers to maximize career potential
Computer Science and Design Thinking (Technology)	8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose. 8.1.8.DA.3: Identify the appropriate tool to access data based on its file format.
Diversity, Equity, and Inclusion	*Science is a universal pursuit with diverse contributions from throughout the world. Ultimately, science seeks to understand the natural world. Since the beginning of human existence people have interacted with the natural world and sought to use nature to increase survival odds. The history of science and its earliest roots can be traced to the ancient civilizations of ancient Egypt and Mesopotamia. Next, the Greeks made significant contributions to thinking about and understanding the natural world. After the Greeks, early science investigations were furthered in the Byzantine Empire and in the Arab world during the Islamic Golden age. India and China also had significant contributions to early science investigations in their history. During the Middle Ages medieval universities began formalized educational pursuits in Western Europe. Up to this point in human history humans had an understanding of natural laws, properties of materials, technological tools, and engineering. During the Renaissance the scientific revolution in Europe ushered in a new era of modern scientific thought that had tremendous impact from there on forward. The Age of Enlightenment spread ideas across Europe and North America. As the world became more*

	connected over the next centuries ideas spread and science continued to develop and flourish. The last two hundred years have shown rapid development in science, technology, and engineering. *Discussions in class will cover many of the scientists/engineers on the list as relevant. The goal is to have the students understand that science is ultimately the pursuit of rational truth in the universe. Progress in science is not limited to any one geographic region or cultural background. Development of scientific knowledge has occurred thanks to various differing and unique individuals from throughout time and the world. Students will research a scientist/engineer of their choice. The following scientists and engineers are related to the unit.* Amedo Avogadro Robert Boyle Frederick Jones Willis Carrier Anders Celsius William Thomson Daniel Fahrenheit Pyotr Leonidovich Kapitsa David Crosthwait, Jr. Frederick McKinley Jones Elijah McCoy James Watt Robert Stirling Benjamin Bradley
Climate Change	• MS-ESS2-6: Develop and use a model to describe how unequal heating and

	rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates. How does climate change affect temperature levels in different areas of the world?
Supplemental Class Resources	https://www.asme.org/topics-resources/content/global-cooling-the-history-of-air-conditioning https://www.energy.gov/articles/history-air-conditioning Glencoe Science Level Blue Textbook - Ch. 20-1, Ch. 20-2 https://www.brainpop.com/science/matterandchemistry/statesofmatter/ https://www.brainpop.com/science/matterandchemistry/temperature/ https://www.brainpop.com/science/matterandchemistry/matterchangingstates/ https://www.brainpop.com/science/energy/fire/ https://www.brainpop.com/science/energy/heat/

Disciplinary Core Idea	Performance Expectation
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)	Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. [Clarification

● 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** ● 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 are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. *(secondary to MS-PS3-3)* **PS1.A: Structure and Properties of Matter** ● Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-2) *(Note: This Disciplinary Core Idea is also addressed by MS-PS1-3.)* **PS1.B: Chemical Reactions** ● Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-2),(MS-PS1-5) *(Note: This Disciplinary Core Idea is also addressed by MS-PS1-3.)*	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) 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) Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. (MS-PS1-2) Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. [Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.] [Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.] (MS-PS1-5)

- The total number of each type of atom is conserved, and thus the mass does not change. (MS-PS1-5) - Some chemical reactions release energy, others store energy. (MS-PS1-6) **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. *(secondary to MS-PS1-6)* **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 the characteristics may be incorporated into the new design. *(secondary to MS-PS1-6)* - 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. *(secondary to MS-PS1-6)*	Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes. (MS-PS1-6) 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) Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. (MS-ETS1-2) 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) 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. (MSETS1-4)

Science & Engineering Practices	**<u>Developing and Using Models</u>** 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 predict and/or describe phenomena. (MS-PS1-1),(MS-PS1-4) - Develop a model to describe unobservable mechanisms. (MS-PS1-5) **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.

	• Analyze and interpret data to determine similarities and differences in findings. (MS-PS1-2) **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 knowledge, principles, and theories. • Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. (MS-PS1-6)
Articulation of DCI's Across Grade-Levels	**5.PS1.B** (MS-PS1-2),(MS-PS1-5); **HS.PS1.A** (MS-PS1-6); **HS.PS1.B** (MS-PS1-2),(MS-PS1-5),(MS-PS1-6); **HS.PS3.A** (MS-PS1-6); **HS.PS3.B** (MS-PS1-6); **HS.PS3.D** (MS-PS1-6)
Crosscutting Concepts	**Patterns** • Macroscopic patterns are related to the nature of microscopic and atomic-level structure. (MS-PS1-2) Energy and Matter • Matter is conserved because atoms are conserved in physical and chemical processes. (MS-PS1-5) • The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS1-6)

Math Student Learning Objectives Covered in this Unit

MP.2	Reason abstractly and quantitatively. (MS-PS1-2),(MS-PS1-5)
MP.4	Model with mathematics. (MS-PS1-5)
6.RP.A.3	Use ratio and rate reasoning to solve real-world and mathematical problems. *(MS-PS1-2)*,(MS-PS1-5)
6.SP.B.4	Display numerical data in plots on a number line, including dot plots, histograms, and box plots. *(MS-PS1-2)*
6.SP.B.5	Summarize numerical data sets in relation to their context. (MS-PS1-2)

ELA Student Learning Objectives Covered in this Unit

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-PS1-2)*

RST.6-8.3	Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (MS-PS1-6)
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-PS1-2),*(MS-PS1-5)*
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-PS1-6)

Modifications
SPED: Provide visuals for students throughout the lesson on promethean board and the focus wall; allow extra time for activities to be completed; dictated responses in lieu of written work; hands on activities instead of pencil and paper ESL/ELL: Describing pictures or classroom objects; Providing information in graphic organizers; Identifying real life objects based on descriptive oral phrases or short sentences; 504 Students: Provide a checklist of the steps needed to complete the problem; Provide lots of white-space to make it less busy; If still struggling, reteach and retest At-Risk Students: Reduce the number of problems given; Give extra time Gifted and Talented: Added detail to written work; find connecting stories from classroom library and compare to the lessons; Additional Modification Option: https://www.nextgenscience.org/sites/default/files/Appendix%20D%20Diversity%20and%20Equity%206-14-13.pdf

Unit Four: Heat	
NJ Student Learning Standards: Science Grade 8 ***List Standards here:*** 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) 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) Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into	**Length: 15 days** **NJDOE Science Curricular Framework** NJ Science Frameworks **21st Century Student Outcomes** http://www.battelleforkids.org/networks/p21 **Learning and Innovation Skills** **highlight appropriate indicators for unit/domain** Think Creatively Work Creatively with Others Implement Innovations Reason effectively Use Systems Thinking Make Judgments and Decisions Solve Problems Communicate Clearly Collaborate with Others **Information, Media and Technology Skills** **highlight appropriate indicators for unit/domain** Information Literacy Media Literacy ICT (Information, Communications and Technology Literacy) **Life and Career Skills** **highlight appropriate indicators for unit/domain** Adapt to Change

account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. (MS-ETS1-1) Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. (MS-ETS1-2) 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) 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. (MSETS1-4)	Be Flexible Manage Goals and Time Work Independently Be Self-directed Learners Interact Effectively with Others Work Effectively in Diverse Teams
Unit Focus and Targets:	
Essential Questions: How can a standard thermometer be used to tell you how particles are behaving? Learning Goals: Understand how temperature is a measurement of the average speed of particles in a system.	
NJSLS Lessons:	

Materials:

- Computer

Lab 1 - States of Matter - Level 2 DOK:
Phenomena/Big Question - How can a standard thermometer be used to tell you how particles are behaving?

The students will use the states of matter simulator on Colorado Phet to investigate how temperature is a measure of the amount of kinetic energy in a system.

https://phet.colorado.edu/en/simulation/legacy/states-of-matter-basics

Engage - Ask the students what is temperature? What is heat? What is cold?
Explore - Individually have the students work on the states of matter simulator on Colorado Phet
Explain - The students will explain how the different states of matter are occurring, the relationship between kinetic energy and temperature, and when phase changes occur.
Elaborate - The students will create a model of how kinetic energy is related to temperature and how it determines states of matter.
Evaluate - The students will present their final models and descriptions to the rest of the class.

Materials:

- Binoculars

Lab 2 - Construct a model of birds of prey using thermals to fly - Level 3 DOK
Phenomena/Big Question - How do birds of prey use thermals to fly?
(Green connection)

Engage - Show the students how a population of red tailed hawks fly in circles on the school's campus grounds
Explore - The students will explore how the red tailed hawks travel
Explain - The students will explain the flight patterns

Elaborate - The students will elaborate on how thermal patterns allow the red tailed hawks to soar
Evaluate - The students will present their final models and descriptions to the rest of the class.

Materials:
- Various household supplies, specific to each students investigation, to be gathered by the student

Lab 3 - Construct a device that utilizes heat transfer principles - Level 4 DOK
Phenomena/Big Question - How can the principles of heat transfer be used for a human benefit?

The students will 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.]

Engage - Show the students examples of devices that use the laws of thermodynamics for an engineered purpose (ex. Solar cooker)
Explore - The students will work in small groups to research whether they want to create a device that absorbs or releases heat.
Explain - The students will construct their device and explain how the device works.
Elaborate - The students will elaborate on how heat is transferred in the device and to the surrounding environment.
Evaluate - The students will present their final models and descriptions to the rest of the class.

Differentiation:
General Accommodations/Modifications:
- Extended time for assignments
- Alternative forms of assessment if appropriate
- Visuals for vocabulary
- Pre-teach new vocabulary when appropriate
- Reduce auditory and visual distractions
- Small group instruction as needed

Unit Assessments: Heat transfer test Formative: Brainpop quiz on heat, temperature, and states of matter Summative: Build a heat transfer device

Science Unit 5 **Grade 8**	
Unit Title	Forms of energy
Recommended Pacing	15 days
Unit Summary	In this unit, students use the practices of *analyzing and interpreting data*, *developing and using models*, and *engaging in arguments from evidence* to make sense of the 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. This unit is based on MS-PS3-1, MS-PS3-2, and MS-PS3-5.
Career Readiness, Life Literacies, and Key Skills Standards	• 9.2.8.CAP.12: Assess personal strengths, talents, values, and interests to appropriate jobs and careers to maximize career potential
Computer Science and Design Thinking (Technology)	8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose. 8.1.8.DA.3: Identify the appropriate tool to access data based on its file format.
Diversity, Equity, and Inclusion	*Science is a universal pursuit with diverse contributions from throughout the world. Ultimately, science seeks to understand the natural world. Since the beginning of human existence people have interacted with the natural world and sought to use nature to increase survival odds. The history of science and its earliest roots can be traced to the ancient civilizations of ancient Egypt and Mesopotamia. Next, the Greeks made significant contributions to thinking about and understanding the natural world. After the Greeks, early science investigations were furthered in the Byzantine Empire and in the Arab world during the Islamic Golden age. India and China also had significant contributions to early science investigations in their history. During the Middle Ages medieval universities began formalized educational pursuits in Western Europe. Up to this point in human history humans had an understanding of natural laws, properties of materials, technological tools, and engineering. During the Renaissance the scientific revolution in Europe ushered in a new era of modern scientific thought that had tremendous impact from there on forward. The Age of*

	Enlightenment spread ideas across Europe and North America. As the world became more connected over the next centuries ideas spread and science continued to develop and flourish. The last two hundred years have shown rapid development in science, technology, and engineering. *Discussions in class will cover many of the scientists/engineers on the list as relevant. The goal is to have the students understand that science is ultimately the pursuit of rational truth in the universe. Progress in science is not limited to any one geographic region or cultural background. Development of scientific knowledge has occurred thanks to various differing and unique individuals from throughout time and the world. Students will research a scientist/engineer of their choice. The following scientists and engineers are related to the unit.* Albert Einstein James Prescott Joule Andrei Sakharov Rudolf Diesel How does energy consumption vary by region and time period?
Climate Change	• MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. • MS-ESS3-4: Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. • MS-ESS3-5: Ask questions to clarify evidence of the factors that have caused climate change over the past century. • MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account

	relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. ● MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. ● MS-ETS1-3: 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-ETS1-4: 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. What are the different types of renewable energy sources? How does human energy consumption affect climate change? What type of human technology/activity produces the most carbon dioxide? What are the energy requirements of modern day living?
Supplemental Class Resources	https://www.eia.gov/energyexplained/what-is-energy/forms-of-energy.php https://www.brainpop.com/science/motionsforcesandtime/potentialenergy/ https://www.brainpop.com/science/motionsforcesandtime/kineticenergy/ https://www.brainpop.com/science/energy/energysources/

	https://www.brainpop.com/science/energy/formsofenergy/ https://www.brainpop.com/science/energy/fossilfuels/ https://www.brainpop.com/science/energy/fuelcells/ https://www.brainpop.com/science/energy/gasandoil/ https://www.brainpop.com/science/energy/naturalresources/ https://www.brainpop.com/science/energy/nuclearenergy/

Disciplinary Core Idea	Performance Expectation
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** • 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)	MS-PS3-1 Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. MS-PS3-2 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. MS-PS1-3 Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.

● 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 are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. *(secondary to MS-PS3-3)*	• MS-ESS3-4 Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

Science & Engineering Practices	**<u>Developing and Using Models</u>** 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 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.

	• 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)
Articulation of DCI's Across Grade-Levels	**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** • 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 are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. *(secondary to MS-PS3-3)*
Crosscutting Concepts	**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)

Math Student Learning Objectives Covered in this Unit

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 ≠ 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 √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)*

ELA Student Learning Objectives Covered in this Unit

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 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)*

Modifications
SPED: Provide visuals for students throughout the lesson on promethean board and the focus wall; allow extra time for activities to be completed; dictated responses in lieu of written work; hands on activities instead of pencil and paper ESL/ELL: Describing pictures or classroom objects; Providing information in graphic organizers; Identifying real life objects based on descriptive oral phrases or short sentences; 504 Students: Provide a checklist of the steps needed to complete the problem; Provide lots of white-space to make it less busy; If still struggling, reteach and retest At-Risk Students: Reduce the number of problems given; Give extra time Gifted and Talented: Added detail to written work; find connecting stories from classroom library and compare to the lessons; Additional Modification Option: https://www.nextgenscience.org/sites/default/files/Appendix%20D%20Diversity%20and%20Equity%206-14-13.pdf

Unit Five: Forms of energy	
NJ Student Learning Standards: Science Grade 8 ***List Standards here:***	**Length: 15 days** **NJDOE Science Curricular Framework** NJ Science Frameworks

MS-PS3-1 Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. MS-PS3-2 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. MS-PS1-3 Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. • MS-ESS3-4 Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.	**21st Century Student Outcomes** http://www.battelleforkids.org/networks/p21 **Learning and Innovation Skills** **highlight appropriate indicators for unit/domain** Think Creatively Work Creatively with Others Implement Innovations Reason effectively Use Systems Thinking Make Judgments and Decisions Solve Problems Communicate Clearly Collaborate with Others **Information, Media and Technology Skills** **highlight appropriate indicators for unit/domain** Information Literacy Media Literacy ICT (Information, Communications, and Technology Literacy) **Life and Career Skills** **highlight appropriate indicators for unit/domain** Adapt to Change Be Flexible Manage Goals and Time Work Independently Be Self-directed Learners Interact Effectively with Others Work Effectively in Diverse Teams

Unit Focus and Targets:
Essential Questions: How can energy be "created"? Learning Goals: Understand that energy cannot be created or destroyed. Energy changes forms.
NJSLS Lessons:
Materials: ● Computer **Lab 1 - Forms of energy - Level 2 DOK:** **Phenomena/Big Question - How can energy be "created"?** **Engage** - Ask the students where does energy come from? **Explore** - Have the student explore the different types of energy sources (fossil fuels, nuclear energy, solar energy, wind energy, electrical energy, geothermal energy, etc.) **Explain** - The students will explain how energy transfers from one form to another **Elaborate** - The students will create a model of all the different forms of energy **Evaluate** - The students will present their final models and descriptions to the rest of the class. **Materials:** ● Computer **Lab 2 - Transportation methods of the past, present, and future - Level 2 DOK:**

Phenomena/Big Question - What type of energy is needed to make people move?

Engage - Ask the students what are the different types of transportation methods
Explore - Have the student explore the history of transportation methods
Explain - The students will explain current popular transportation methods and alternatives
Elaborate - The students will research future transportation methods
Evaluate - The students will present their final models and descriptions to the rest of the class.

Differentiation:
General Accommodations/Modifications:

- Extended time for assignments
- Alternative forms of assessment if appropriate
- Visuals for vocabulary
- Pre-teach new vocabulary when appropriate
- Reduce auditory and visual distractions
- Small group instruction as needed

Unit Assessments: Forms of energy test

Formative: Brainpop quiz on forms of energy, nuclear energy, fossil fuels, solar energy, wind energy

Summative: Analyze the different forms of energy

Unit Title	Motion and mechanics
Recommended Pacing	20 days
Unit Summary	In this unit students will… ● Apply the steps of the scientific method to an experiment ● Be able to identify the control and experimental groups in an experiment ● Accurately measure and record data ● Create a data table ● Create a graph
Career Readiness, Life Literacies, and Key Skills Standards	• 9.2.8.CAP.12: Assess personal strengths, talents, values, and interests to appropriate jobs and careers to maximize career potential
Computer Science and Design Thinking (Technology)	8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose. 8.1.8.DA.3: Identify the appropriate tool to access data based on its file format.
Diversity, Equity, and Inclusion	*Science is a universal pursuit with diverse contributions from throughout the world. Ultimately, science seeks to understand the natural world. Since the beginning of human existence people have interacted with the natural world and sought to use nature to increase survival odds. The history of science and its earliest roots can be traced to the ancient civilizations of ancient Egypt and Mesopotamia. Next, the Greeks made significant contributions to thinking about and understanding the natural world. After the Greeks, early science investigations were furthered in the Byzantine Empire and in the Arab world during the Islamic Golden age. India and China also had significant contributions to early science investigations in their history. During the Middle Ages medieval universities began formalized educational pursuits in Western Europe. Up to this point in human history humans had an understanding of natural laws, properties of materials, technological tools, and engineering. During the Renaissance the scientific revolution in Europe ushered in a new era*

	of modern scientific thought that had tremendous impact from there on forward. The Age of Enlightenment spread ideas across Europe and North America. As the world became more connected over the next centuries ideas spread and science continued to develop and flourish. The last two hundred years have shown rapid development in science, technology, and engineering. *Discussions in class will cover many of the scientists/engineers on the list as relevant. The goal is to have the students understand that science is ultimately the pursuit of rational truth in the universe. Progress in science is not limited to any one geographic region or cultural background. Development of scientific knowledge has occurred thanks to various differing and unique individuals from throughout time and the world. Students will research a scientist/engineer of their choice. The following scientists and engineers are related to the unit.* Isaac Newton Yuri Gagarin Valentina Tereshkova Katherine Johnson Alan Shephard John Glenn Neil Armstrong Mae Jemison Ronald McNair Christa McAuliffe Dick Scobee Michael J. Smith Gregory Jarvis Ellison Onizuka Judith Resnik Wubbo Ockels Aprille Ericsson

	Ellen Ochoa Dr. Franklin Chang-Díaz Dr. Serena Auñón-Chancellor Dr. Luis Walter Alvarez Jose Hernandez Dr. France Córdova Dr. Ellen Ochoa Zhang Heng Kalpana Chawla Chien-Shiung Wu Nils Bohlin
Climate Change	• MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. How do rocket launches affect the environment? What does the Earth look like from outer space?
Supplemental Class Resources	https://eos.org/features/the-coming-surge-of-rocket-emissions https://www.nasa.gov/feature/35-years-ago-remembering-challenger-and-her-crew https://www.nasa.gov/langley/katherine-johnson Glencoe Science Level Blue Textbook - Ch. 21-1, Ch. 21-2, Ch. 21-3, Ch. 22-1, Ch. 22-2, Ch. 22-3, Ch. 23-1, Ch. 23-3

	https://www.khanacademy.org/science/science-engineering-partners/lebron-asks-subject/lebron-asks/v/lebron-asks-about-newton-s-3rd-law https://www.brainpop.com/science/motionsforcesandtime/distancerateandtime/ https://www.brainpop.com/science/motionsforcesandtime/acceleration/ https://www.brainpop.com/science/motionsforcesandtime/forces/ https://www.brainpop.com/science/motionsforcesandtime/newtonslawsofmotion/ https://www.brainpop.com/science/motionsforcesandtime/gravity/ https://www.brainpop.com/science/motionsforcesandtime/isaacnewton/ https://www.brainpop.com/science/motionsforcesandtime/alberteinstein/ https://www.brainpop.com/science/motionsforcesandtime/flight/ https://www.brainpop.com/science/motionsforcesandtime/inclinedplane/

Disciplinary Core Idea	Performance Expectation
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	Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects. * [Clarification Statement: Examples

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

	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. (MSETS1-4)

Science & Engineering Practices	**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. ● 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 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)
Articulation of DCI's Across Grade-Levels	***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)*
Crosscutting Concepts	**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* **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)

Math Student Learning Objectives Covered in this Unit

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)*

ELA Student Learning Objectives Covered in this Unit

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)*

Modifications
SPED: Provide visuals for students throughout the lesson on promethean board and the focus wall; allow extra time for activities to be completed; dictated responses in lieu of written work; hands on activities instead of pencil and paper ESL/ELL: Describing pictures or classroom objects; Providing information in graphic organizers; Identifying real life objects based on descriptive oral phrases or short sentences; 504 Students: Provide a checklist of the steps needed to complete the problem; Provide lots of white-space to make it less busy; If still struggling, reteach and retest At-Risk Students: Reduce the number of problems given; Give extra time Gifted and Talented: Added detail to written work; find connecting stories from classroom library and compare to the lessons; Additional Modification Option: https://www.nextgenscience.org/sites/default/files/Appendix%20D%20Diversity%20and%20Equity%206-14-13.pdf

Unit Six: Motion and mechanics	
NJ Student Learning Standards: Science Grade 8	**Length: 20 days**

Board Approved: August 17, 2022

List Standards here: 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) 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) 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)	**NJDOE Science Curricular Framework** NJ Science Frameworks **21st Century Student Outcomes** http://www.battelleforkids.org/networks/p21 **Learning and Innovation Skills** **highlight appropriate indicators for unit/domain** Think Creatively Work Creatively with Others Implement Innovations Reason effectively Use Systems Thinking Make Judgments and Decisions Solve Problems Communicate Clearly Collaborate with Others **Information, Media and Technology Skills** **highlight appropriate indicators for unit/domain** Information Literacy Media Literacy ICT (Information, Communications and Technology Literacy) **Life and Career Skills** **highlight appropriate indicators for unit/domain** Adapt to Change Be Flexible Manage Goals and Time Work Independently Be Self-directed Learners

Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. (MS-ETS1-2) 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) 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. (MSETS1-4)	Interact Effectively with Others Work Effectively in Diverse Teams

Unit Focus and Targets:

Essential Questions:

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

Learning Goals:

Understand how temperature is a measurement of the average speed of particles in a system.

NJSLS Lessons:

Materials:

- Stopwatch

Lab 1 - Motion Lab

Phenomena/Big Question - What is motion?

Engage - Engage students with a science of running video from pbs https://www.youtube.com/watch?v=jPgTnhJjU0I
Explore - Have the students design an investigation that analyzes their own motion in groups. For example the students can measure their speed while running, hopping, skipping, etc.
Explain - The students will explain their motion in terms of speed, distance, and time
Elaborate - The students will elaborate on the motion of other objects (i.e. cars, motorcycles, planets, etc.)
Evaluate - The students will present their findings to the rest of the class.

Materials:

- Computer

Lab 2 - Physics of roller coasters
Phenomena/Big Question - How do roller coasters work?

Engage - Engage students with videos of roller coasters at Six Flags. Ask the students to share their roller coaster experiences.
Explore - Have the students investigate the different types of roller coaster designs
Explain - The students will explain the physics of roller coasters using the terms mass, force, acceleration, g forces, centrifugal force, and centripetal force
Elaborate - The students will elaborate by designing their own dream roller coaster
Evaluate - The students will present their findings to the rest of the class.

Materials:

- Various household supplies, specific to each students investigation, to be gathered by the student

Lab 3 - Egg drop capsule - Level 4 DOK
Phenomena/Big Question - What happens during a collision?

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)

Engage - Demonstrate the Colorado Phet collision lab:
https://phet.colorado.edu/en/simulation/legacy/collision-lab
Explore - Ask the students to design an investigation that models the motion of an egg capsule being dropped from the school's roof.
Explain - The students will physically demonstrate how momentum is transferred in the collison. The students will explain the forces involved in the collision. The students will quantitatively show momentum before and after the collision. The students will show the direction and magnitude of the forces.
Elaborate - The students will research how an increase in mass of a vehicle increases the forces of impact during a collision. For example an electric truck has a greater mass than its traditional gasoline truck and therefore has greater forces during a collision.
Evaluate - The students will present their models to the rest of the class

Materials:

- Various household supplies, specific to each students investigation, to be gathered by the student

Lab 4 - Rocket engineering challenge - Level 4 DOK
Phenomena/Big Questions - What does a rocket work?

Engage - Show the students videos of the Saturn V rocket.
Explore - Allow the students to research different rocket designs and mechanics.
Explain - The students will design a rocket that uses the chemical reaction of baking soda and vinegar.
Elaborate - The students will create a diagram of the forces acting on the rocket.
Evaluate - The students will present the summarization of their findings to the rest of the class.

Differentiation: **General Accommodations/Modifications:** ● Extended time for assignments ● Alternative forms of assessment if appropriate ● Visuals for vocabulary ● Pre-teach new vocabulary when appropriate ● Reduce auditory and visual distractions ● Small group instruction as needed
Unit Assessments: Motion test Formative: Brainpop quiz on speed, acceleration, Newton's laws, forces Summative: Build a egg drop capsule, build a rocket

Science Unit 7 **Grade 8**	
Unit Title	Civil structures
Recommended Pacing	15 days
Unit Summary	In this unit students will… ● Apply the steps of the scientific method to an experiment ● Be able to identify the control and experimental groups in an experiment

	● Accurately measure and record data ● Create a data table ● Create a graph
Career Readiness, Life Literacies, and Key Skills Standards	• 9.2.8.CAP.12: Assess personal strengths, talents, values, and interests to appropriate jobs and careers to maximize career potential
Computer Science and Design Thinking (Technology)	8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose. 8.1.8.DA.3: Identify the appropriate tool to access data based on its file format.
Diversity, Equity, and Inclusion	*Science is a universal pursuit with diverse contributions from throughout the world. Ultimately, science seeks to understand the natural world. Since the beginning of human existence people have interacted with the natural world and sought to use nature to increase survival odds. The history of science and its earliest roots can be traced to the ancient civilizations of ancient Egypt and Mesopotamia. Next, the Greeks made significant contributions to thinking about and understanding the natural world. After the Greeks, early science investigations were furthered in the Byzantine Empire and in the Arab world during the Islamic Golden age. India and China also had significant contributions to early science investigations in their history. During the Middle Ages medieval universities began formalized educational pursuits in Western Europe. Up to this point in human history humans had an understanding of natural laws, properties of materials, technological tools, and engineering. During the Renaissance the scientific revolution in Europe ushered in a new era of modern scientific thought that had tremendous impact from there on forward. The Age of Enlightenment spread ideas across Europe and North America. As the world became more connected over the next centuries ideas spread and science continued to develop and flourish. The last two hundred years have shown rapid development in science, technology, and engineering.*

	Discussions in class will cover many of the scientists/engineers on the list as relevant. The goal is to have the students understand that science is ultimately the pursuit of rational truth in the universe. Progress in science is not limited to any one geographic region or cultural background. Development of scientific knowledge has occurred thanks to various differing and unique individuals from throughout time and the world. Students will research a scientist/engineer of their choice. The following scientists and engineers are related to the unit. Archimedes Archibald Alexander Fazlur Rahman Khan Frank Lloyd Wright Thomas Telford Santiago Calatrava Christian Menn Jean Muller Eugene Figg Gustave Eiffel Othmar Ammann Conde McCullough Robert Maillart John Roebling Joseph Strauss Zaha Hadid Fritz Leonhardt Jörg Schlaich William Christopher Brown Ralph Modjeski Isambard Kingdom Brunel

Climate Change	• MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. • MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. • MS-ETS1-3: 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. How can structures be designed in an environmentally efficient manner?
Supplemental Class Resources	https://www.brainpop.com/science/motionsforcesandtime/forces/ https://www.brainpop.com/science/motionsforcesandtime/newtonslawsofmotion/ https://www.brainpop.com/science/motionsforcesandtime/gravity/

Disciplinary Core Idea	Performance Expectation
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)	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

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

	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. (MSETS1-4)

Science & Engineering Practices	**<u>Asking Questions and Defining Problems</u>** 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 <u>multiple variables</u> 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 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 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)
Articulation of DCI's Across Grade-Levels	***<u>3.PS2.A</u>*** *(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)*

Crosscutting Concepts	**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* **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)

Math Student Learning Objectives Covered in this Unit

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)*

ELA Student Learning Objectives Covered in this Unit

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)*

Modifications
SPED: Provide visuals for students throughout the lesson on promethean board and the focus wall; allow extra time for activities to be completed; dictated responses in lieu of written work; hands on activities instead of pencil and paper ESL/ELL: Describing pictures or classroom objects; Providing information in graphic organizers; Identifying real life objects based on descriptive oral phrases or short sentences; 504 Students: Provide a checklist of the steps needed to complete the problem; Provide lots of white-space to make it less busy; If still struggling, reteach and retest At-Risk Students: Reduce the number of problems given; Give extra time Gifted and Talented: Added detail to written work; find connecting stories from classroom library and compare to the lessons; Additional Modification Option: https://www.nextgenscience.org/sites/default/files/Appendix%20D%20Diversity%20and%20Equity%206-14-13.pdf

Unit Seven: Structures	
NJ Student Learning Standards: Science Grade 8 ***List Standards here:*** 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) 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) 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	**Length: 15 days** **NJDOE Science Curricular Framework** NJ Science Frameworks **21st Century Student Outcomes** http://www.battelleforkids.org/networks/p21 **Learning and Innovation Skills** **highlight appropriate indicators for unit/domain** Think Creatively Work Creatively with Others Implement Innovations Reason effectively Use Systems Thinking Make Judgments and Decisions Solve Problems Communicate Clearly Collaborate with Others **Information, Media and Technology Skills** **highlight appropriate indicators for unit/domain** Information Literacy Media Literacy ICT (Information, Communications and Technology Literacy) **Life and Career Skills** **highlight appropriate indicators for unit/domain** Adapt to Change

people and the natural environment that may limit possible solutions. (MS-ETS1-1) Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. (MS-ETS1-2) 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) 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. (MSETS1-4)	Be Flexible Manage Goals and Time Work Independently Be Self-directed Learners Interact Effectively with Others Work Effectively in Diverse Teams
Unit Focus and Targets:	
Essential Questions: How can structures be built efficiently? Learning Goals: Understand the physics of structures and how to build efficiently.	
NJSLS Lessons:	

Materials:

- Popsicle sticks
- Hot glue gun and sticks

Lab 1 - Build a bridge - Level 4 DOK
Phenomena/Big Question - How can civil engineering help humanity?

The students will design, construct, and test a bridge made up of popsicle sticks. The students will work in small teams to construct their bridges. Additionally, the students will compete to see whose bridge holds the most weight with the least amount of material used.

Engage - Show the students examples of different types of bridges
Explore - The students will work in small groups to research different bridge designs
Explain - The students will construct their bridges and explain how they work
Elaborate - The students will elaborate on their bridge efficiency
Evaluate - The students will present their final bridges for testing and competition

Differentiation:
General Accommodations/Modifications:

- Extended time for assignments
- Alternative forms of assessment if appropriate
- Visuals for vocabulary
- Pre-teach new vocabulary when appropriate
- Reduce auditory and visual distractions
- Small group instruction as needed

Unit Assessments: Forces in structures (statics) test

Formative: Brainpop quiz on forces, civil engineering Summative: Build an efficient bridge

Science Unit 8 **Grade 8**	
Unit Title	Gravity, electricity, and magnetism
Recommended Pacing	20 days
Unit Summary	Students use *cause and effect*; *system and system models*; and *stability and change* to understand ideas that explain why some materials are attracted to each other while others are not. Students apply ideas about gravitational, electrical, and magnetic forces to explain a variety of phenomena including beginning ideas about why some materials attract each other while others repel. In particular, students develop an understanding that gravitational interactions are always attractive but that electrical and magnetic forces can be both attractive and negative. Students also develop ideas that objects can exert forces on each other even though the objects are not in contact, through fields. Students are expected to consider the influence of science, engineering, and technology on society and the natural world. Students are expected to demonstrate proficiency in *asking questions*, *planning and carrying out investigations*, *designing solutions*, and *engaging in argument*. Students are also expected to use these practices to demonstrate understanding of the core ideas.

	This unit is based on MS-PS2-3, MS-PS2-4, and MS-PS2-5.
Career Readiness, Life Literacies, and Key Skills Standards	• 9.2.8.CAP.12: Assess personal strengths, talents, values, and interests to appropriate jobs and care ers to maximize career potential
Computer Science and Design Thinking (Technology)	8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose. 8.1.8.DA.3: Identify the appropriate tool to access data based on its file format.
Diversity, Equity, and Inclusion	*Science is a universal pursuit with diverse contributions from throughout the world. Ultimately, science seeks to understand the natural world. Since the beginning of human existence people have interacted with the natural world and sought to use nature to increase survival odds. The history of science and its earliest roots can be traced to the ancient civilizations of ancient Egypt and Mesopotamia. Next, the Greeks made significant contributions to thinking about and understanding the natural world. After the Greeks, early science investigations were furthered in the Byzantine Empire and in the Arab world during the Islamic Golden age. India and China also had significant contributions to early science investigations in their history. During the Middle Ages medieval universities began formalized educational pursuits in Western Europe. Up to this point in human history humans had an understanding of natural laws, properties of materials, technological tools, and engineering. During the Renaissance the scientific revolution in Europe ushered in a new era of modern scientific thought that had tremendous impact from there on forward. The Age of Enlightenment spread ideas across Europe and North America. As the world became more connected over the next centuries ideas spread and science continued to develop and flourish. The last two hundred years have shown rapid development in science, technology, and engineering.*

	Discussions in class will cover many of the scientists/engineers on the list as relevant. The goal is to have the students understand that science is ultimately the pursuit of rational truth in the universe. Progress in science is not limited to any one geographic region or cultural background. Development of scientific knowledge has occurred thanks to various differing and unique individuals from throughout time and the world. Students will research a scientist/engineer of their choice. The following scientists and engineers are related to the unit. Thomas Edison Nikola Tesla Otis Boykin James West Philip Emeagwali Mark Dean Lewis Howard Latimer Luis Alvarez Shen Kuo Harry Nyquist Hannes Alfvén
Climate Change	• MS-ETS1-4: 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. How can computers predict future climate change?
Supplemental Class Resources	https://www.brainpop.com/science/energy/electricity/

	https://www.brainpop.com/science/energy/electriccircuits/ https://www.brainpop.com/science/energy/currentelectricity/ https://www.brainpop.com/science/energy/electromagneticinduction/ https://www.brainpop.com/science/energy/thomasedison/ https://www.brainpop.com/science/energy/nikolatesla/ https://www.brainpop.com/science/energy/batteries/ https://www.brainpop.com/science/energy/electromagnets/

Disciplinary Core Idea	Performance Expectation
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, a magnet, or a ball, respectively). (MS-PS2-5)	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 orbital periods of objects within the solar system.] [Assessment Boundary: Assessment does not include Newton's Law of Gravitation or Kepler's Laws.] (MS-PS2-4)

	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 is limited to qualitative evidence for the existence of fields.] (MS-PS2-5) 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) 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) Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. (MS-ETS1-2)

	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) 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. (MSETS1-4)

Science & Engineering Practices	**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. ● 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 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)
Articulation of DCI's Across Grade-Levels	***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)*
Crosscutting Concepts	**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* **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)

Math Student Learning Objectives Covered in this Unit

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)*

ELA Student Learning Objectives Covered in this Unit

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)*

Modifications

SPED: Provide visuals for students throughout the lesson on promethean board and the focus wall; allow extra time for activities to be completed; dictated responses in lieu of written work; hands on activities instead of pencil and paper

ESL/ELL: Describing pictures or classroom objects; Providing information in graphic organizers; Identifying real life objects based on descriptive oral phrases or short sentences;

504 Students: Provide a checklist of the steps needed to complete the problem; Provide lots of white-space to make it less busy; If still struggling, reteach and retest

At-Risk Students: Reduce the number of problems given; Give extra time

Gifted and Talented: Added detail to written work; find connecting stories from classroom library and compare to the lessons;

Additional Modification Option:
https://www.nextgenscience.org/sites/default/files/Appendix%20D%20Diversity%20and%20Equity%206-14-13.pdf

Unit Eight: Electricity and magnetism	
NJ Student Learning Standards: Science Grade 8 ***List Standards here:*** 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 orbital periods of objects within the solar system.] [Assessment Boundary: Assessment does not include Newton's Law of Gravitation or Kepler's Laws.] (MS-PS2-4) 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	**Length: 20 days** **NJDOE Science Curricular Framework** NJ Science Frameworks **21st Century Student Outcomes** http://www.battelleforkids.org/networks/p21 **Learning and Innovation Skills** **highlight appropriate indicators for unit/domain** Think Creatively Work Creatively with Others Implement Innovations Reason effectively Use Systems Thinking Make Judgments and Decisions Solve Problems Communicate Clearly Collaborate with Others **Information, Media and Technology Skills** **highlight appropriate indicators for unit/domain** Information Literacy Media Literacy

Boundary: Assessment is limited to electric and magnetic fields, and is limited to qualitative evidence for the existence of fields.] (MS-PS2-5) 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) 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) Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. (MS-ETS1-2) Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of	ICT (Information, Communicationcs and Technology Literacy) **Life and Career Skills** **highlight appropriate indicators for unit/domain** Adapt to Change Be Flexible Manage Goals and Time Work Independently Be Self-directed Learners Interact Effectively with Others Work Effectively in Diverse Teams

each that can be combined into a new solution to better meet the criteria for success. (MS-ETS1-3) 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. (MSETS1-4)	

Unit Focus and Targets:

Essential Questions:

Is it possible to exert force on an object without touching it?

Learning Goals:
Understand how an electric circuit operates.

Understand that electric fields can exert a magnetic force.

NJSLS Lessons:

Materials:

- Computer

Lab 1 - How does gravity influence motion? - Level 3 DOK
Phenomena/Big Question - How does gravity influence motion?

The students will work in pairs to explore how gravity influences motion in the solar system.

Engage - https://www.brainpop.com/science/motionsforcesandtime/gravity/
Explore - The students will explore the following Colorado Phet simulation to see how gravity influences motion.
Gravity and orbits
https://phet.colorado.edu/en/simulation/legacy/gravity-and-orbits
Explain - The students will explore the simulator and then explain how gravity is linked to motion of the planets
Elaborate - The students will be directed to discover the two factors that influence gravity (mass and distance)
Evaluate - The students will present their final findings to the rest of the class.

Materials:
- Iron filings
- Magnets

Lab 2 - Electric field investigation - Level 2 DOK
Phenomenon/Big Question - Can you apply a force on something without touching it?

The students will investigate electric fields with the following Colorado Phet simulator:
https://phet.colorado.edu/en/simulation/legacy/electric-hockey

Engage - Demonstrate to the students how a magnet affects iron fillings
Explore - Allow the students to explore the Colorado Phet simulator "Electric Field Hockey"
Explain - The students will demonstrate how electric fields are created with iron fillings and a magnet.
Elaborate - The students will elaborate on how electric fields are used in modern technology.
Evaluate - The students will present their findings, models, and further information to the rest of the class.

Materials:
- Computer

Lab 3 - Create an electric circuit - Level 4 DOK

Phenomenon/Big Question - What can an electric circuit do? The students will investigate electric circuits with the following Colorado Phet simulator: https://phet.colorado.edu/en/simulations/circuit-construction-kit-dc **Engage** - Demonstrate to the students the fundamental parts of an electric circuit **Explore** - Allow the students to explore the Colorado Phet simulation "DC Circuit Construction" **Explain** - The students will demonstrate working electric circuits **Elaborate** - The students will elaborate on how electric circuits are used in modern technology. **Evaluate** - The students will present their findings, models, and further information to the rest of the class. **Differentiation:** **General Accommodations/Modifications:** ● Extended time for assignments ● Alternative forms of assessment if appropriate ● Visuals for vocabulary ● Pre-teach new vocabulary when appropriate ● Reduce auditory and visual distractions ● Small group instruction as needed
Unit Assessments: Electricity and magnetism test Formative: Brainpop quiz on magnetism, electricity, and circuits Summative: Build an electric circuit

Science Unit 9 Grade 8	
Unit Title	Science fair
Recommended Pacing	20 days
Unit Summary	In this unit students will… ● Apply the steps of the scientific method to an experiment or apply the steps of the design process to engineer a product
Career Readiness, Life Literacies, and Key Skills Standards	• 9.2.8.CAP.12: Assess personal strengths, talents, values, and interests to appropriate jobs and careers to maximize career potential
Computer Science and Design Thinking (Technology)	8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose. 8.1.8.DA.3: Identify the appropriate tool to access data based on its file format.
Supplemental Class Resources	https://www.jpl.nasa.gov/edu/teach/activity/how-to-do-a-science-fair-project/ https://www.brainpop.com/technology/scienceandindustry/engineeringdesignprocess/ https://www.brainpop.com/science/scientificinquiry/scientificmethod/

Disciplinary Core Idea	Performance Expectation
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)	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)

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)	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. (MS-ETS1-2) 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) 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. (MSETS1-4)

Science & Engineering Practices	**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. ● 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)

Articulation of DCI's Across Grade-Levels	**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)
Crosscutting Concepts	**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)

Math Student Learning Objectives Covered in this Unit

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)*

ELA Student Learning Objectives Covered in this Unit

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)*

Modifications
SPED: Provide visuals for students throughout the lesson on promethean board and the focus wall; allow extra time for activities to be completed; dictated responses in lieu of written work; hands on activities instead of pencil and paper ESL/ELL: Describing pictures or classroom objects; Providing information in graphic organizers; Identifying real life objects based on descriptive oral phrases or short sentences; 504 Students: Provide a checklist of the steps needed to complete the problem; Provide lots of white-space to make it less busy; If still struggling, reteach and retest At-Risk Students: Reduce the number of problems given; Give extra time Gifted and Talented: Added detail to written work; find connecting stories from classroom library and compare to the lessons; Additional Modification Option: https://www.nextgenscience.org/sites/default/files/Appendix%20D%20Diversity%20and%20Equity%206-14-13.pdf

Unit Nine: Science fair	
NJ Student Learning Standards: Science Grade *** ***List Standards here:*** 8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose. NJSLSA.R8. Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence. NJSLSA.R10. Read and comprehend complex literary and informational texts independently and proficiently with scaffolding as needed. NJSLSA.W2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content. NJSLSA.W4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience NJSLSA.W6. Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.	**Length: 20 days** **NJDOE Science Curricular Framework** NJ Science Frameworks **21st Century Student Outcomes** http://www.battelleforkids.org/networks/p21 **Learning and Innovation Skills** **highlight appropriate indicators for unit/domain** Think Creatively Work Creatively with Others Implement Innovations Reason effectively Use Systems Thinking Make Judgments and Decisions Solve Problems Communicate Clearly Collaborate with Others **Information, Media and Technology Skills** **highlight appropriate indicators for unit/domain** Information Literacy Media Literacy ICT (Information, Communications and Technology Literacy) **Life and Career Skills** **highlight appropriate indicators for unit/domain** Adapt to Change

NJSLSA.W7. Conduct short as well as more sustained research projects, utilizing an inquiry-based research process, based on focused questions, demonstrating understanding of the subject under investigation. NJSLSA.W8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism. NJSLSA.W9. Draw evidence from literary or informational texts to support analysis, reflection, and research. NJSLSA.W10. Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences. Measurement and Data 5.MD 3. Recognize volume as an attribute of solid figures and understand concepts of volume measurement. a. A cube with side length 1 unit, called a “unit cube,” is said to have “one cubic unit” of volume, and can be used to measure volume. b. A solid figure which can be packed without gaps or overlaps using n unit cubes is said to have a volume of n cubic units. 4. Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and non-standard units. 5. Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume. a. Find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes, and show that the volume is the same	Be Flexible Manage Goals and Time Work Independently Be Self-directed Learners Interact Effectively with Others Work Effectively in Diverse Teams

as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent threefold whole-number products as volumes, e.g., to represent the associative property of multiplication. 1Students able to multiply fractions in general can develop strategies to divide fractions in general, by reasoning about the relationship between multiplication and division. But division of a fraction by a fraction is not a requirement at this grade. New Jersey Student Learning Standards for Mathematics 7 b. Apply the formulas $V = l \times w \times h$ and $V = B \times h$ for rectangular prisms to find volumes of right rectangular prisms with whole number edge lengths in the context of solving real world and mathematical problems. c. Recognize volume as additive. Find volumes of solid figures composed of two nonoverlapping right rectangular prisms by adding the volumes of the non-overlapping parts, applying this technique to solve real world problems Statistics and Probability 6.SP A. Develop understanding of statistical variability. 1. Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers. For example, "How old am I?" is not a statistical question, but "How old are the students in my school?" is a statistical question because one anticipates variability in students' ages. 2. Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape. 3. Recognize that a measure of center for a numerical data set	

summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number. B. Summarize and describe distributions. 4. Display numerical data in plots on a number line, including dot plots, histograms, and box plots. 5. Summarize numerical data sets in relation to their context, such as by: a. Reporting the number of observations. b. Describing the nature of the attribute under investigation, including how it was measured and its units of measurement. c. Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered. d. Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered.	

Unit Focus and Targets:

Essential Questions:

How can I apply the scientific method or engineering design process in the real world?

Learning Goals:

Understand how to apply the steps of the scientific method or engineering design process for a science fair project.

NJSLS Lessons:

Materials:
Tri-fold for each student

Lab 1 - Science Fair Project - Level 4 DOK:
Phenomena/Big Question - How can I apply the scientific method or engineering design process in the real world?

Engage - Ask the students what is a topic that would like to research over the next 4 weeks?
Explore - Individually have the students explore different science fair project ideas
Explain - The students will explain how they applied the steps of the scientific method or the engineering design process to complete their science fair project
Elaborate - The students will create a trifold presentation for their science fair project
Evaluate - The students will present their final models and descriptions to the local community

Differentiation:
General Accommodations/Modifications:

- Extended time for assignments
- Alternative forms of assessment if appropriate
- Visuals for vocabulary
- Pre-teach new vocabulary when appropriate
- Reduce auditory and visual distractions
- Small group instruction as needed

Unit Assessments: Science fair project

Formative: Weekly progress documents

Summative: Science fair trifold presentation

Science Unit 10 Grade 8	
Unit Title	Sound, light, and waves
Recommended Pacing	20 days
Unit Summary	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. This unit is based on MS-PS4-1, MS-PS4-2, and MS-PS4-3.
Career Readiness, Life Literacies, and Key Skills Standards	• 9.2.8.CAP.12: Assess personal strengths, talents, values, and interests to appropriate jobs and careers to maximize career potential

Computer Science and Design Thinking (Technology)	8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose. 8.1.8.DA.3: Identify the appropriate tool to access data based on its file format.
Diversity, Equity, and Inclusion	*Science is a universal pursuit with diverse contributions from throughout the world. Ultimately, science seeks to understand the natural world. Since the beginning of human existence people have interacted with the natural world and sought to use nature to increase survival odds. The history of science and its earliest roots can be traced to the ancient civilizations of ancient Egypt and Mesopotamia. Next, the Greeks made significant contributions to thinking about and understanding the natural world. After the Greeks, early science investigations were furthered in the Byzantine Empire and in the Arab world during the Islamic Golden age. India and China also had significant contributions to early science investigations in their history. During the Middle Ages medieval universities began formalized educational pursuits in Western Europe. Up to this point in human history humans had an understanding of natural laws, properties of materials, technological tools, and engineering. During the Renaissance the scientific revolution in Europe ushered in a new era of modern scientific thought that had tremendous impact from there on forward. The Age of Enlightenment spread ideas across Europe and North America. As the world became more connected over the next centuries ideas spread and science continued to develop and flourish. The last two hundred years have shown rapid development in science, technology, and engineering.* *Discussions in class will cover many of the scientists/engineers on the list as relevant. The goal is to have the students understand that science is ultimately the pursuit of rational truth in the universe. Progress in science is not limited to any one geographic region or cultural background. Development of scientific knowledge has occurred thanks to various differing and unique individuals from throughout time and the world. Students will research a scientist/engineer of their choice. The following scientists and engineers are related to the unit.*

	Isaac Newton Thomas Edison James Clerk Maxwell Guglielmo Marconi Vladimir K. Zworykin Kenjiro Takayanagi Philo Taylor Farnsworth John Logie Baird Nikola Tesla Tuan Vo-Dinh Narinder S. Kapany Louis Roberts
Climate Change	• MS-ESS3-2: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. How is infrared light trapped in the atmosphere?
Supplemental Class Resources	https://science.nasa.gov/ems/05_radiowaves https://www.aps.org/publications/apsnews/201911/history.cfm https://www.brainpop.com/science/energy/waves/ https://www.brainpop.com/science/energy/electromagneticspectrum/ https://www.brainpop.com/science/energy/sound/

	https://www.brainpop.com/science/energy/light/ https://www.brainpop.com/science/energy/refractionanddiffraction/

Disciplinary Core Idea	Performance Expectation
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)	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) 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) 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)

Science & Engineering Practices	**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 and use a model to describe phenomena. (MS-PS4-2) **Using Mathematics and Computational Thinking** Mathematical and computational thinking at the 6–8 level builds on K–5 and progresses to identifying patterns in large data sets and using mathematical concepts to support explanations and arguments. ● Use mathematical representations to describe and/or support scientific conclusions and design solutions. (MS-PS4-1) **Obtaining, Evaluating, and Communicating Information** Obtaining, evaluating, and communicating information in 6-8 builds on K-5 and progresses to evaluating the merit and validity of ideas and methods. ● Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings. (MS-PS4-3) - ***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-PS4-1)
Articulation of DCI's Across Grade-Levels	**4.PS3.A** (MS-PS4-1); **4.PS3.B** (MS-PS4-1); **4.PS4.A** (MS-PS4-1); **4.PS4.B** (MS-PS4-2); **4.PS4.C** (MS-PS4-3); **HS.PS4.A** (MS-PS4-1),(MS-PS4-2),(MS-PS4-3); **HS.PS4.B** (MS-PS4-1),(MS-PS4-2); **HS.PS4.C** (MS-PS4-3); **HS.ESS1.A** (MS-PS4-2); **HS.ESS2.A** (MS-PS4-2); **HS.ESS2.C** (MS-PS4-2); **HS.ESS2.D** (MS-PS4-2)
Crosscutting Concepts	**Patterns** ● Graphs and charts can be used to identify patterns in data. (MS-PS4-1) **Structure and Function** ● Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (MS-PS4-2) ● Structures can be designed to serve particular functions. (MS-PS4-3) - ***Connections to Engineering, Technology, and Applications of Science***

	Influence of Science, Engineering, and Technology on Society and the Natural World ● Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. (MS-PS4-3) - ***Connections to Nature of Science*** **Science is a Human Endeavor** ● Advances in technology influence the progress of science and science has influenced advances in technology. (MS-PS4-3)

Math Student Learning Objectives Covered in this Unit

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

ELA Student Learning Objectives Covered in this Unit

RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. (MS-PS4-3)
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-PS4-3)*
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-PS4-3)
WHST.6-8.9	Draw evidence from informational texts to support analysis, reflection, and research. (MS-PS4-3)

SL.8.5	Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. *(MS-PS4-1),(MS-PS4-2)*

Modifications
SPED: Provide visuals for students throughout the lesson on promethean board and the focus wall; allow extra time for activities to be completed; dictated responses in lieu of written work; hands on activities instead of pencil and paper ESL/ELL: Describing pictures or classroom objects; Providing information in graphic organizers; Identifying real life objects based on descriptive oral phrases or short sentences; 504 Students: Provide a checklist of the steps needed to complete the problem; Provide lots of white-space to make it less busy; If still struggling, reteach and retest At-Risk Students: Reduce the number of problems given; Give extra time Gifted and Talented: Added detail to written work; find connecting stories from classroom library and compare to the lessons; Additional Modification Option: https://www.nextgenscience.org/sites/default/files/Appendix%20D%20Diversity%20and%20Equity%206-14-13.pdf

Unit Ten: Sound, light, and waves	
NJ Student Learning Standards: Science Grade 8	**Length: 20 days**

Board Approved: August 17, 2022

List Standards here: 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) 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) 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	**NJDOE Science Curricular Framework** NJ Science Frameworks

does not include binary counting. Assessment does not include the specific mechanism of any given device.] (MS-PS4-3) Board Approved: August 17, 2022	**21st Century Student Outcomes** http://www.battelleforkids.org/networks/p21 **Learning and Innovation Skills** **highlight appropriate indicators for unit/domain** Think Creatively Work Creatively with Others Implement Innovations Reason effectively Use Systems Thinking Make Judgments and Decisions Solve Problems Communicate Clearly Collaborate with Others **Information, Media and Technology Skills** **highlight appropriate indicators for unit/domain** Information Literacy Media Literacy ICT (Information, Communicationcs and Technology Literacy) **Life and Career Skills** **highlight appropriate indicators for unit/domain** Adapt to Change Be Flexible Manage Goals and Time Work Independently Be Self-directed Learners Interact Effectively with Others Work Effectively in Diverse Teams

Unit Focus and Targets:
Essential Questions: What is a wave? Learning Goals: Understand the properties of sound waves and light waves.

NJSLS Lessons:
Materials: ● Slinky **Lab 1 - Wave Model - Level 3 DOK** **Phenomena/Big Question - How is a wave created?** The students will design an investigation that analyzes how the amplitude of a wave affects its energy level. The students will be asked to describe a wave quantitatively and qualitatively. Wavelength, frequency, and amplitude will all be addressed. **Engage** - Use a slinky to demonstrate the properties of a wave https://www.youtube.com/watch?v=SCtf-z4t9L8 **Explore** - The students will explore the different types of waves found in nature (for example sound, light, and water) **Explain** - Allow the students, in small cooperative groups, to investigate how a wave works and what are the major parts of the wave through their creation of a wave model. https://www.youtube.com/watch?v=VE520z_ugcU

Elaborate - The students will elaborate by investigating other wave examples in nature such as visual colors on the electromagnetic spectrum, how a tsunami works, sound waves, etc.

Evaluate - The students will present their findings to the rest of the class for peer review.

Materials:
- Flashlights
- Prisms
- Mirrors

Lab 2 - Light investigation - Level DOK 4
Phenomena/Big Question - What is light? How does light behave?

The students will conduct an investigation of light waves using reflection, refraction, absorption, and transmission.

Engage - Show the students a laser pointer
Explore - The students will explore how reflection, refraction, absorption, and transmission work
Explain - The students will be asked to create an investigation that uses flashlight or laser pointers to demonstrate reflection, refraction, absorption, and transmission.
Elaborate - The students can elaborate on how lasers are used in technology and medicine.
Evaluate - The students will present their findings to the rest of the class for evaluation.

Materials:
- Vinyl record
- Record player
- Computer
- Speakers

Lab 3 - Analog vs. digital wave signals

Engage - Play for the students an analog (vinyl) recording of Johnny B. Goode and a digital recording of Johnny B. Goode
Explore - The students will explore how analog and digital are fundamentally different formats
Explain - The students will explain the pros and cons of analog and digital wave signals
Elaborate - The students can elaborate on how lasers are used in technology and medicine.
Evaluate - The students will present their findings to the rest of the class for evaluation.

Materials:

- Computer

Lab 4 - Digital data communication - Level 4 DOK

Engage - Show the students an analog signal waveform and a digital signal waveform
Explore - Allow for the students to explore the construction of a digital signal from an analog source at various frequencies and bit rates
Explain - Have the students can explain why a lower bit rate and frequency audio sample sounds worse than an a higher bit rate and frequency audio sample
Elaborate - Investigate how a analog to digital converter works and how a digital to analog converter works
Evaluate - Have the students evaluate whether analog or digital signals are more reliable

Differentiation:
General Accommodations/Modifications:

- Extended time for assignments
- Alternative forms of assessment if appropriate
- Visuals for vocabulary
- Pre-teach new vocabulary when appropriate
- Reduce auditory and visual distractions
- Small group instruction as needed

Unit Assessments: Waves test

Formative: Brainpop quiz on sound, light, and waves

Summative: Build a wave, analog vs. digital signal analysis