Egg Harbor City Public Schools

Science Curriculum Grades 6-8

Completed By:

Alysha Garcia

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Contributions and Thanks:

The New Jersey Center for Teaching and Learning, Andrew Ross, Deanna Walker, Kelsey Wertz, Pam Clouser

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Introduction

Rationale for the Middle School Model Curriculum Design

The goal of science education curriculum is to produce students who have gained sufficient knowledge of the practices, crosscutting concepts, and core ideas of science and engineering to engage in public discussions on science-related issues, to be critical consumers of scientific information related to their everyday lives, and to continue to learn about science throughout their lives. They should come to appreciate that science and the current scientific understanding of the world are the result of many hundreds of years of creative human endeavor. It is especially important to note that the above goals are for all students, not just those who pursue careers in science, engineering, or technology or those who continue on to higher education (p. 9, NRC, 2012).
Given this goal, an integrated science curriculum model should drive the formation of middle school science curriculum because:

- The nature of science is complex and multidisciplinary.
- Learning theory research in science shows expert knowledge base develops better through interdisciplinary connections and not through isolated content.
- Effective research-based practices for curriculum and instruction in science and engineering are supported through this approach.

Nature of Science

The nature of science is complex and multidisciplinary. From research about how scientists work, we know that scientists do not work in isolation in their own house of physics, or biology or chemistry but they reach out and create networks of scientists within and across disciplines who can contribute understanding, share ideas, and critique evidence and explanations. As we see in the science of global climate change, scientists work across the fields of geology, physics, and biology to provide evidence, plan investigations, and develop models to represent new ways to think about Earth systems. Important practices like engaging in argument from evidence, modeling, and communicating information do not occur in isolation but rely on feedback from within and across scientific communities and disciplines. Basing the middle school model curriculum in an integrated model where the students are engaged with a variety of topics at each grade, focused on the connection of ideas across the domains, enhances the interdisciplinary nature of science.

Learning Theory

In the elementary years, students build their understandings of core concepts across all three domains of science: physical, life and Earth and space. Continuing this model in grades 6-8 better supports student learning in that there will not be a large gap of time in which a student does not engage in a specific discipline. This model takes advantage of current research which recognizes that there is variation across children at a given age and that thinking does not develop along a preset roadmap for each student. It allows middle school students to build on what they know and think they understand from their elementary years with the goal in middle school of helping students to revise their knowledge and understanding about those core ideas. Learning theory research shows expert knowledge base develops better through interdisciplinary real-world connections

then through isolated content. This is especially important in middle school where motivation is critical to learning. An integrated and better articulated middle school model science curriculum that reflects what we know currently about how children learn science and how their mastery develops over time promotes deeper learning in science. As we know and understand about how students develop understanding while learning content, it informs teachers' practice; if teachers understand where their students are in their understanding of core ideas, and anticipate what students' misconceptions and struggles may be, they are better able to differentiate instruction and provide scaffolding that allows students to develop an integrated and deeper understanding of the science.

Research Based Science Instruction and Curriculum

Effective science instruction can take many forms but includes similar components. According to the Center on Instruction's 2010 report, *Effective Science Instruction: What does the Research Tell Us?*, research-based effective practices of curriculum and instruction important to science learning are: Motivation, Eliciting Students' Prior Knowledge, Intellectual Engagement; Use of Evidence to Critique Claims, and Sense-Making. The integrated model may be better able to support some of these instructional practices especially if it frames curriculum around engaging, relevant, and real-world interdisciplinary questions that will increase student motivation, intellectual engagement and sense-making. Effective science instruction helps middle school students build their understandings and practices, makes connections among and between core concepts and practices, and links to their prior knowledge. Students in grades 6-8 come to understand the natural world in a more scientifically accurate way and understand the nature of science.

Conclusion

Science curriculum should be thematic with a focus on connections among and between core concepts and practices. This approach reinforces the interdisciplinary nature of science and allows for a sequential progression of skills and concepts. This supports developmentally appropriate teaching and assessments. Each grade level has its own specific standards from each science domain that are seen as stepping stones in the progression of learning about a core idea and that meet a specific level of understanding. The idea is to embed technology and engineering in this interdisciplinary progression which would also be coordinated with the Common Core State Standards.
The model science curriculum for grades K-8 provides a common pathway that mitigates some of the challenges a student experiences when they transfer between schools or districts in the state. The model also allows educators from multiple districts in a region to align teaching and learning; assessments; and professional development. Districts retain their local control over the implementation of a common curriculum. The day to day decisions about how best to meet the specific needs of a student still rest with the local teacher of science and school. The common model for local curriculum development allows school districts to share science curriculum resources, formative and summative assessment items, teacher professional development, and other tools.

Grades 6-8 Science Standards:

Physical Science

PS1 Matter and Its Interactions
PS1A Structure and Properties of matter
PS1B Chemical Reactions
PS1C Nuclear Processes

PS2 Motion and Stability: Forces and Interactions
PS2A Forces and Motion
PS2B Types of Interactions
PS2C Stability and Instability in Physical Systems

PS3 Energy
PS3A Definitions of Energy
PS3B Conservation of Energy and Energy Transfer
PS3C Relationship Between Energy and Forces
PS3D Energy and Chemical Processes in Everyday Life
PS4 Waves and Their Applications in Technologies for Information Transfer

PS4 Waves and Their Applications in Technologies for Information Transfer
PS4A Wave Properties
PS4B Electromagnetic Radiation
PS4C Information Technologies and Instrumentation

Life Science

LS1 From Molecules to Organisms: Structures and Processes
LS1A Structure and Function
LS1B Growth and Development of Organisms
LS1C Organization for Matter and Energy Flow in Organisms
LS1D Information Processing

LS2 Ecosystems: Interactions, Energy, and Dynamics
LS2A Interdependent Relationships in Ecosystems
LS2B Cycles of Matter and Energy Transfer in Ecosystems
LS2C Ecosystem Dynamics, Functioning, and Resilience
LS2D Social Interactions and Group Behavior

LS3 Heredity: Inheritance and Variation of Traits
LS3A Inheritance of Traits
LS3B Variation of Traits

LS4 Biological Evolution: Unity and Diversity
LS4A Evidence of Common Ancestry
LS4B Natural Selection
LS4C Adaptation
LS4D Biodiversity and Humans

Earth and Space Science

ESS1 Earth's Place in the Universe
ESS1A The Universe and Its Stars
ESS1B Earth and the Solar System
ESS1C The History of Planet Earth

ESS2 Earth's Systems
ESS2A Earth Materials and Systems
ESS2B Plate Tectonics and Large-Scale System Interactions
ESS2C The Roles of Water in Earth's Surface Processes
ESS2D Weather and Climate
ESS2E Biogeology

ESS3 Earth and Human Activity
ESS3A Natural Resources
ESS3B Natural Hazards
ESS3C Human Impacts on Earth Systems
ESS3D Global Climate Change

Curriculum Design:

Addressing Grade Level Expectations –
Highlighted within the Lesson (Unit) Plan
→ Select Standards
→ State the Rationale (Goal)
→ Describe the Context (Objective)

→ Address a Timeframe
→ Identify Instructional Strategies
→ Present an Overview
→ Devise Essential and Guiding Questions
→ Determine Exit Outcomes and Indicators
→ Devise Learning Opportunities
→ Develop Assessment Opportunities
→ Use Data to Drive Instruction
→ Provide appropriate Accommodations/Modifications
→ Address Cross-Curricular Connections
→ Integrate Technology and Career Readiness Skills
    → Incorporate LGBTQ+ and Disabilities Awareness
→ Reflect on Teaching Practices

Accommodations/Modifications:

Overview –
Accommodations Versus Modifications

Accommodations:
→ Are changes to how the content is:
    1) Taught
    2) Made Accessible
    3) Assessed
→ Do not change what the student is expected to master.
→ Maintain the objectives of the course.

Modifications:
    → Are changes to what a student learns or is expected to do.
    → May be incorporated to assist students who are behind grade level.
    → Could take the form of an alternative assessment.

Special Education Students (IEP –Individualized Education Program) –

- Implemented by Special Education Self-Contained Teachers
- Implemented by Special Education In-Class Resource Teachers
- Implemented by General Education Teachers (Supplemental Instruction)
- Implemented by Special Area Teacher (as per discipline area)
- Accommodation and Modification Options Chart

Visual Reinforcement	Use Manipulatives (use and show science tools, science experiments, etc.)	Multi-Sensory Approach (Students work through the three dimensions of the)
Repeat Instructions	Review Directions	Visual Reminders

Modified Tests	Oral Testing	Scribe
On Computer	Preferential Seating	Study Carrel
Avoid placing student under pressure of time or completion	Post Assignments	Assignment Pad
Limited Multiple Choice	Prior Notice of Test	Test Setting: Administer tests in small group and/or in a separate room
Check Work in Progress	Immediate Feedback	Have Student Restate Information
Support Auditory Presentations with Visuals	Repeat Directions Quietly	Provide Extra Assignment Time
Highlight Key Words (science vocabulary)	Have the student repeat and explain directions	Modified Homework
Clean Work Area	Test Scheduling: Adding time as needed, providing frequent breaks	Test Study Guides
Concrete Examples	Extra Response Time	Extra Time Tests
Provide Models	Extra Drill/Practice	Monitor Assignments
Recognize and Give Credit for Oral Participation	No Handwriting Penalty	Post Routines
Extra Time - Written Work	Positive Reinforcement	Mindfulness Activities

504 Plan Students –

- Implemented by General Education Teachers
- Implemented by Special Area Teacher (as per discipline area)
- Accommodation and Modification Options Chart

Visual Reinforcement	Use Manipulatives (use and show science tools, science experiments, etc.)	Multi-Sensory Approach(Students work through the three dimensions of the)
Repeat Instructions	Review Directions	Visual Reminders
Modified Tests	Oral Testing	Scribe
On Computer	Preferential Seating	Study Carrel
Avoid placing student under pressure of time or completion	Post Assignments	Assignment Pad
Limited Multiple Choice	Prior Notice of Test	Test Setting: Administer tests in small group and/or in a separate room
Check Work in Progress	Immediate Feedback	Have Student Restate Information
Support Auditory Presentations with Visuals	Repeat Directions Quietly	Provide Extra Assignment Time

Highlight Key Words (science vocabulary)	Have the student repeat and explain directions	Modified Homework
Clean Work Area	Test Scheduling: Adding time as needed, providing frequent breaks	Test Study Guides
Concrete Examples	Extra Response Time	Extra Time Tests
Provide Models	Extra Drill/Practice	Monitor Assignments
Recognize and Give Credit for Oral Participation	No Handwriting Penalty	Post Routines
Extra Time - Written Work	Positive Reinforcement	Mindfulness Activities

English Language Learners –

- Implemented by ESL Teacher
- Implemented by General Education Teachers
- Implemented by Special Area Teacher (as per discipline area)
- Accommodation and Modification Options Chart

Visual Reinforcement	Use Manipulatives (use and show science tools, science experiments, etc.)	Multi-Sensory Approach(Students work through the three dimensions of the)
Repeat Instructions	Review Directions	Visual Reminders
Modified Tests	Oral Testing	Scribe
On Computer	Preferential Seating	Study Carrel
Avoid placing student under pressure of time or completion	Post Assignments	Assignment Pad
Limited Multiple Choice	Prior Notice of Test	Test Setting: Administer tests in small group and/or in a separate room
Check Work in Progress	Immediate Feedback	Have Student Restate Information
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Recognize and Give Credit for Oral Participation	No Handwriting Penalty	Post Routines

Extra Time - Written Work	Positive Reinforcement	Mindfulness Activities
Science vocabulary in native language and English		

Basic Skills Instruction Students or Students at Risk of School Failure (IPP –Individualized Program Plan) –

- Implemented by Special Education In-Class Resource Teachers
- Implemented by General Education Teachers
- Implemented by Special Area Teacher (as per discipline area)
- Accommodation and Modification Options Chart

Visual Reinforcement	Use Manipulatives (use and show science tools, science experiments, etc.)	Multi-Sensory Approach(Students work through the three dimensions of the)
Repeat Instructions	Review Directions	Visual Reminders
Modified Tests	Oral Testing	Scribe
On Computer	Preferential Seating	Study Carrel
Avoid placing student under pressure of time or completion	Post Assignments	Assignment Pad
Limited Multiple Choice	Prior Notice of Test	Test Setting: Administer tests in small group and/or in a separate room
Check Work in Progress	Immediate Feedback	Have Student Restate Information
Support Auditory Presentations with Visuals	Repeat Directions Quietly	Provide Extra Assignment Time
Highlight Key Words (science vocabulary)	Have the student repeat and explain directions	Modified Homework
Clean Work Area	Test Scheduling: Adding time as needed, providing frequent breaks	Test Study Guides
Concrete Examples	Extra Response Time	Extra Time Tests
Provide Models	Extra Drill/Practice	Monitor Assignments
Recognize and Give Credit for Oral Participation	No Handwriting Penalty	Post Routines
Extra Time - Written Work	Positive Reinforcement	Mindfulness Activities

Gifted and Talented Students –

- Implemented by General Education Teachers
- Implemented by Special Education In-Class Resource Teachers
- Implemented by Special Area Teacher (as per discipline area)

- Accommodation and Modification Options Chart

Encourage students to explore science concepts in depth and encourage independent studies or investigations.	Use thematic instruction to connect learning across the curriculum.	Encourage creative expression and thinking by allowing students to choose how to approach a problem or assignment.
Expand students' time for free reading about scientists, science theories, etc.	Invite students to explore different points of view on a topic of study and compare the two, which can include science theories or scientists.	Provide learning centers where students are in charge of their learning.
Brainstorm with gifted children on what types of projects they would like to explore to extend what they're learning in the classroom.	Determine where students' interests lie and capitalize on their inquisitiveness.	Refrain from having them complete more work in the same manner.
Employ differentiated curriculum to keep interest high.	Avoid drill and practice activities.	Ask students' higher level questions that require students to look into causes, experiences, and facts to draw a conclusion or make connections to other areas of learning.
If possible, compact curriculum to allow gifted students to move more quickly through the material	Encourage students to make transformations- use a common task or item in a different way.	Allow for choice.

Amistad Law: N.J.S.A. 18A 52:16A-88 Every board of education shall incorporate the information regarding the contributions of African-Americans to our country in an appropriate place in the curriculum of elementary and secondary school students.

Holocaust Law: N.J.S.A. 18A:35-28 Every board of education shall include instruction on the Holocaust and genocides in an appropriate place in the curriculum of all elementary and secondary school pupils. The instruction shall further emphasize the personal responsibility that each citizen bears to fight racism and hatred whenever and wherever it happens.

LGBTQ+ & Disabilities Awareness:
Instruction on the political, economic, and social contributions of persons with disabilities and lesbian, gay, bisexual, and transgender people, in an appropriate place in the curriculum are in place as part of the district's implementation of the New Jersey Student Learning Standards. Materials used come from a variety of sources that are diverse and inclusive.

Diversity, Equity, and Inclusion:
Instruction on the contributions of a diverse population of people, that may include, LGBTQ+, Asian American & Pacific Islanders, persons with disabilities, to the growth of science knowledge and practices over the years is discussed throughout the curriculum and are included in lessons and the variety of resources used.

Integration of Asian-American and Pacific Islander Legislation:

In each curricular area, the district will adopt inclusive instructional materials that portray the contributions of members of the Asian American and Pacific Islander communities in regards to the realm of science.

Resources-
Virginia Commonwealth University provides resources for teaching about individuals with disabilities.
National Parks Service Disability History series brings attention to some of the many disability stories interwoven across the National Park Service's 400+ units and its programs. "Disability stories" refer to the array of experiences by, from, and about people with disabilities represented across our nation.

Respect Ability website contains a wealth of educational resources as well as profiles of individuals with disabilities of different ethnicities as well as women and LGBT.

Asian American Scientists Learn about Asian and Pacific Islander American scientists who have helped change the world

Diverse Scientists Explore scientists that come from diverse backgrounds and their impact they are making on the world

Additional resources:
https://sites.udel.edu/seli-ud/famous-scientists-with-disabilities/
https://iscrm.uw.edu/celebrating-asian-american-and-native-hawaiian-pacific-islander-scientists/
https://www.discovery.com/science/LGBT-Scientists-Who-Changed-World

Assessments:

Formative – (Refer to **Tools for Formative Assessment** on the Google Team Drive in the Staff Resources Folder under the Formative Assessment Folder for a list of techniques to check for understanding and how to utilize each.)

- Analyzing Student Work (Homework, Classwork, Tests, Quizzes)
- Observation
- Smart Responders
- Round Robin Charts
- Strategic Questioning
- 3-Way Summaries
- Think-Pair-Share.
- 3,2,1 Countdown
- Classroom Polls
- Exit Slips
- Admit Slips
- One Minute Papers
- Thumbs Up and Thumbs Down

- Extended Projects
- Self-Assessment
- Peer-Assessment
- Portfolio Check
- Journal Entry
- Choral Response
- Story Map
- Quizlet
- LinkIt Standards Based Assessments

Summative –
- End of Unit Assessment
- End of Chapter Test
- LinkIt Benchmark Assessments
- Project Based Assignments
- LinkIt PSI Assessments

Benchmark –
- Grade-Level Fall Science Benchmark
- Grade-Level Spring Science Benchmark

Alternative -
- Projects
- Contests
- Student Centered Assessments
- Presentations
- Mini Quizzes
- Performance Tasks
- Google Forms

Instructional Materials:

*All materials are diverse, inclusive, and differentiated to meet all needs

Science		
Grade K-8	Core Text	Publisher
	Progressive Science Initiative	New Jersey Center for Teaching and Learning
	Supplemental text or materials	Publisher

Supplemental Materials:

*All materials are diverse, inclusive, and differentiated to meet all needs

- Carolina Science Kits
- Online Resources (PhET, Gizmos, etc)
- Mystery Science (grade level specific & differentiated)

Pacing Guide:

- Refer to Matrix (where identified)
- Refer to Unit Plan Time Frames
- Identified on Lesson Plan

Interdisciplinary Connections:

Identified on Lesson Plan –

Interdisciplinary learning develops real-world, multi-faceted knowledge. Integration identifies logical connections between and among the content and learning experiences in all areas of the curriculum. Integrating and connecting various content areas improves learning outcomes and provides more authentic and relevant experiences for students. Interdisciplinary connections both enrich and extend learning. Interdisciplinary connections are studies that cross the boundaries of two or more district disciplines such as mathematics and art or literature and science. By purposefully looking for "essential concepts" and "big ideas," we purposefully design deliberate integration of the various content areas whenever appropriate. This includes, but is not limited to, examining how curriculum themes, project based learning, understanding by design essential questions, inquiry approaches, curriculum mapping, and the standards merge, while always keeping student best interests at the heart of this work.

The following areas are integrated into all areas of the instructional program:

Reading

<u>Key Ideas and Details</u>

- RST.6-8.1. Cite specific textual evidence to support analysis of science and technical texts.
- 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.
- RST.6-8.3. Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

<u>Craft and Structure</u>

- RST.6-8.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.
- RST.6-8.5. Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic.

- RST.6-8.6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text.

Integration of Knowledge and Ideas
- 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).
- RST.6-8.8. Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.
- 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.

Range of Reading and Level of Text Complexity
- RST.6-8.10. By the end of grade 8, read and comprehend science/technical texts in the grades 6-8 text complexity band independently and proficiently.

Writing

Text Types and Purposes
- WHST.6-8.1. Write arguments focused on discipline-specific content.
    - A. Introduce claim(s) about a topic or issue, acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically.
    - B. Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.
    - C. Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence.
    - D. Establish and maintain a formal/academic style, approach, and form.
    - E. Provide a concluding statement or section that follows from and supports the argument presented.
- WHST.6-8.2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
    - A. Introduce a topic and organize ideas, concepts, and information using text structures (e.g. definition, classification, comparison/contrast, cause/effect, etc.) and text features (e.g. headings, graphics, and multimedia) when useful to aiding comprehension.
    - B. Develop the topic with relevant, well-chosen facts, definitions, concrete details, quotations, or other information and examples.
    - C. Use appropriate and varied transitions to create cohesion and clarify the relationships among ideas and concepts.
    - D. Use precise language and domain-specific vocabulary to inform about or explain the topic.
    - E. Establish and maintain a formal/academic style, approach, and form.

- F. Provide a concluding statement or section that follows from and supports the information or explanation presented.

Production and Distribution of Writing

- WHST.6-8.4. Produce clear and coherent writing in which the development, organization, voice, and style are appropriate to task, purpose, and audience.
- WHST.6-8.5. With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on how well purpose and audience have been addressed.
- WHST.6-8.6. Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.

Research to Build and Present Knowledge

- 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.
- 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.
- WHST.6-8.9. Draw evidence from informational texts to support analysis, reflection, and research.

Range of Writing

- WHST.6-8.10. Write routinely over extended time frames (time for research, reflection, metacognition/self correction, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Math:

The Standards for Mathematical Practice describe varieties of expertise that educators at all levels should seek to develop in their students. These practices rest on important "processes and proficiencies" that help develop an understanding of the importance of mathematics education. The incorporation of these standards into the science classroom provide students with a "real-world" application of their mathematics skills.

These standards are:

1. Make sense of problems and persevere in solving them
2. Reason abstractly and quantitatively
3. Construct viable arguments and critique the reasoning of others
4. Model with mathematics
5. Use appropriate tools strategically
6. Attend to precision
7. Look for and make use of structure

8. Look for and express regularity in repeated reasoning

Social Studies:

Social studies education provides learners with the knowledge, skills, attitudes, and perspectives needed to become active, informed, and contributing members of local, state, national, and global communities. The incorporation of social studies principles into the science curriculum allows students to understand the lasting effects of human interaction with each other and with the natural world.

Relevant Disciplinary Concepts include, but are not limited to:

<u>Geography, People and the Environment:</u>

- *Spatial Views of the World*: Spatial views of the world focus on the creation of maps and use of geospatial technologies. Creating maps and other geographical representations is an essential and enduring part of seeking new geographic knowledge that is personally and socially useful and that can be applied in making decisions and solving problems. Once maps or other representations are created, it prompts new questions concerning the locations, spaces, and patterns portrayed.

- *Human Population Patterns*: Human population, patterns and movement focus on the size, composition, distribution, and movement of human populations and how they are fundamental and active features on Earth's surface. This includes understanding that the expansion and redistribution of the human population affects patterns of settlement, environmental changes, and resource use. Patterns and movements of population also relate to physical phenomena including climate variability, landforms, and locations of various natural hazards and their effects on population size, composition, and distribution

- *Human Environment Interaction*: Human-environment interactions are essential aspects of human life in all societies and they occur at local-to-global scales. Human-environment interactions happen both in specific places and across broad regions. Culture influences the locations and the types of interactions that occur. Earth's human systems and physical systems are in constant interaction and have reciprocal influences flowing among them. These interactions result in a variety of spatial patterns that require careful observation, investigation, analysis, and explanation.

- *Global Interconnections*: Global interconnections occur in both human and physical systems. Earth is a set of interconnected ecosystems of which humans are an influential part. Many natural phenomena have no perceptible boundaries. For example, the oceans are one dynamic system. The atmosphere covers the entire planet. Land and water forms shift over geological eons. Many life forms diffuse from place to place and bring environmental changes with them. Humans have spread across the planet, along with their cultural practices, artifacts,

languages, diseases, and other attributes. All of these interconnections create complex spatial patterns at multiple scales that continue to change over time.

Computer Science & Design Thinking:

New approaches necessary for solving the critical challenges that we face as a society will require harnessing the power of technology and computing. Rapidly changing technologies and the proliferation of digital information have permeated and radically transformed learning, working, and everyday life. To be well-educated, global-minded individuals in a computing-intensive world, students must have a clear understanding of the concepts and practices of computer science. As education systems adapt to a vision of students who are not just computer users but also computationally literate creators who are proficient in the concepts and practices of computer science and design thinking, engaging students in computational thinking and human-centered approaches to design through the study of computer science and technology serves to prepare students to ethically produce and critically consume technology.

Computing Systems:
People interact with a wide variety of computing devices that collect, store, analyze, and act upon information in ways that can affect human capabilities both positively and negatively. The physical components (hardware) and instructions (software) that make up a computing system communicate and process information in digital form.

Networks and the Internet:
Computing devices typically do not operate in isolation. Networks connect computing devices to share information and resources and are an increasingly integral part of computing. Networks and communication systems provide greater connectivity in the computing world.

Data & Analysis:
Computing systems exist to process data. The amount of digital data generated in the world is rapidly expanding, so the need to process data effectively is increasingly important. Data is collected and stored so that it can be analyzed to better understand the world and make more accurate predictions.

Algorithms & Programming:
An algorithm is a sequence of steps designed to accomplish a specific task. Algorithms are translated into programs, or code, to provide instructions for computing devices. Algorithms and programming control all computing systems, empowering people to communicate with the world in new ways and solve compelling problems.

Engineering Design:
People design for enjoyment and to solve problems, extend human capabilities, satisfy needs and wants, and improve the human condition. Engineering Design, a systematic approach to creating solutions to technological problems and finding ways to meet

people's needs and desires, allows for the effective and efficient development of products and systems.

Interaction of Technology and Humans:
Societies influence technological development. Societies are characterized by common elements such as shared values, differentiated roles, and cultural norms, as well as by entities such as community institutions, organizations, and businesses. Interaction of Technology and Humans concerns the ways society drives the improvement and creation of new technologies, and how technologies both serve and change society.

Nature of Technology:
Human population, patterns and movement focus on the size, composition, distribution, and movement of human populations and how they are fundamental and active features on Earth's surface. This includes understanding that the expansion and redistribution of the human population affects patterns of settlement, environmental changes, and resource use. Patterns and movements of population also relate to physical phenomena including climate variability, landforms, and locations of various natural hazards and their effects on population size, composition, and distribution.

Effects of Technology on the Natural World:
Many of engineering and technology's impacts on society and the environment are widely regarded as desirable. However, other impacts are regarded as less desirable. Effects of Technology on the Natural World concerns the positive and negative ways that technologies affect the natural world.

Ethics & Culture:
Ethics and Culture concerns the profound effects that technologies have on people, how those effects can widen or narrow disparities, and the responsibility that people have for the societal consequences of their technological decisions.

Visual and Performing Arts:

The NJ Visual & Performing Arts Standards emphasize the process-oriented nature of the arts and arts learning by:

- Defining artistic literacy through a set of overarching philosophical foundations and lifelong goals that clarify long-term expectations for arts learning;
- Placing artistic processes and anchor standards at the forefront of the work;
- Identifying creative artistic practices as the bridge for the application of the artistic processes and anchor standards across all learning; and
- Specifying enduring understandings and essential questions that provide conceptual through lines and articulate value and meaning within and across the arts discipline.

The development of artistic literacy is dependent on creating an environment in which students are encouraged to independently and collaboratively imagine, investigate, construct, and reflect. These steps are much the same as those taken in the Science

classroom, and mirror those of both the Engineering Design Process and the Scientific Method. The artistic processes: *creating, performing/presenting/producing, responding, and connecting*, are the foundation for developing artistic literacy and fluency in the arts and, subsequently, the sciences.

Health and Physical Education:

The NJ Comprehensive Health & Physical Education Standards highlight the expectation that all students participate in a high-quality, K–12 sequential health and physical education program that emphasizes 21st Century skills and interdisciplinary connections to empower students to live a healthy active lifestyle. The primary focus of the standards consists of the development of concepts and skills that promote and influence healthy behaviors. These concepts can be supported in the science classroom, as science instruction can help students gain a deeper understanding of the material.

- Standard 2.1 - Personal & Mental Health
- Standard 2.2 - Physical Wellness
- Standard 2.3 - Safety

Integration of 21st Century Skills through NJSLS 9:

New Jersey's Standard 9 is composed of the Career Readiness, Life Literacies, and Key Skills

- Mission- Career readiness, life literacies, and key skills education provides students with the necessary skills to make informed career and financial decisions, engage as responsible community members in a digital society, and to successfully meet the challenges and opportunities in an interconnected global economy.

- This standard will be addressed via researching and presenting information, working collaboratively with partners or small groups, using technology like Google Suite on a regular basis, grounding reading, writing, and speaking in evidence from text, both literary and informational, building knowledge through content rich non-fiction, inferencing, identifying main idea and theme, sequence of events, cause and effect, vocabulary, problem and solution, point of view, and by evaluating various forms of media and formats.

- **Vision- An education in career readiness, life literacies, and key skills fosters a population that:**
  Continually self-reflects and seeks to improve the essential life and career practices that lead to success;

Uses effective communication and collaboration skills and resources to interact with a global society; Possesses financial literacy and responsibility at home and in the broader community; Plans, executes, and alters career goals in response to changing societal and economic conditions; and seeks to attain skill and content mastery to achieve success in a chosen career path.

9.1 Financial Literacy Themes

- Civic Financial Responsibility
- Financial Institutions
- Financial Psychology
- Planning and Budgeting
- Risk Management
- Economic and Government Influences
- Credit Profile

9.2 Career Awareness, Exploration, Preparation and Training Themes

- Career Awareness and Planning

9.4 Life Literacies and Key Skills Themes

- Creativity and Innovation
- Critical Thinking and Problem Solving
- Digital Citizenship
- Global and Cultural Awareness
- Information and Media Literacy
- Technology Literacy
- Career Readiness, Life Literacy, and Key Skills Practices

NJSLS Standard 9 is integrated across the K-8 curriculum in various subject areas, where appropriate. Lessons could include:

- working collaboratively to solve problems
- comparing and contrasting
- classroom debates and negotiations
- speaking and listening skills
- networking
- customizing resumes and references
- questioning techniques
- communicating clearly and effectively, with reason
- employ valid and reliable research strategies
- accept and integrating criticism and feedback
- utilize critical thinking to make sense of problems and persevere in solving them
- use technology to enhance productivity

- In addition, a yearly career fair will be conducted.

The integration of 21st century skills will be identified on lesson plans.

Career Readiness, Life Literacies, and Key Skills

- Act as a responsible and contributing community members and employee.
- Attend to financial well-being
- Consider the environmental, social and economic impacts of decisions
- Demonstrate creativity and innovation.
- Utilize critical thinking to make sense of problems and persevere in solving them.
- Model integrity, ethical leadership and effective management.
- Plan education and career paths aligned to personal goals.
- Use technology to enhance productivity, increase collaboration and communicate effectively.
- Work productively in teams while using cultural/global competence.

Standards in Action: Climate Change

- The NJSLS-CLKS includes the skills, knowledge and practices necessary for success in an increasingly complex world and changing natural environment. Climate change is included in these standards. Collaborating to solve a problem, approaching a solution with innovation, and determining the validity of a source of information are all essential skills required in the standards and necessary for students to maintain awareness of and successfully address climate change. Climate change can be integrated into the teaching of these standards in a few ways. For example, middle school students could develop a plan for implementing an environmentally focused project in the local community such as protecting a wetland or developing an urban greenway along a stream. The plan would include goals, priorities and necessary resources. In a career and technical education program, as a part of a green building design integrated project, students could explore various sustainable and reclaimed products used for construction. After researching several sources, students would create a collage of information, share with their classmates and take notes on new products and ideas.

New Jersey's Standard 9.1 Financial Literacy

- This standard outlines the important fiscal knowledge, habits, and skills that must be mastered in order for students to make informed decisions about personal finance.

- Financial literacy is an integral component of a student's college and career readiness, enabling students to achieve fulfilling, financially-secure, and successful careers.
- This standard would be addressed via read alouds, STEAM and problem solving activities, by having a classroom economy, the use of school-wide currency, higher order thinking and questioning strategies, and by hosting a career fair each year.
- Resources-My Classroom Economy link
    - Free Experiential learning / Financial Literacy
    - My Classroom Economy Resource

New Jersey's Standard 9.2 Career Awareness, Exploration, and Preparation

- This standard outlines the importance of being knowledgeable about one's interests and talents, and being well informed about postsecondary and career options, career planning, and career requirements.
- This standard would be addressed via researching and presenting information, working collaboratively with partners or small groups, using technology like Google Suite on a regular basis, grounding reading, writing, and speaking in evidence from text, both literary and informational, building knowledge through content rich non-fiction, inferencing, identifying main idea and theme, sequence of events, cause and effect, vocabulary, problem and solution, point of view, and by evaluating various forms of media and formats.

New Jersey's Technology Standard 9.3 Career and Technical Education

- All students will apply knowledge about and engage in the process of career awareness, exploration, and preparation in order to navigate the globally competitive work environment of the information age.

  Standard 9.3 is broken into the following strands:

    - Strand A: Career Awareness (met by Grade 4)
    - Strand B: Career Exploration (met by Grade 8)

- This standard would be addressed via researching and presenting information, working collaboratively with partners or small groups, using technology like Google Suite on a regular basis, grounding reading, writing, and speaking in evidence from text, both literary and informational, building knowledge through content rich non-fiction, inferencing, identifying main idea and theme, sequence

of events, cause and effect, vocabulary, problem and solution, point of view, and by evaluating various forms of media and formats.

Standard 9.4 Life Literacies and Key Skills.

- This standard outline key literacies and technical skills such as critical thinking, global and cultural awareness, and technology literacy* that are critical for students to develop to live and work in an interconnected global economy.

Personal Financial Literacy:

- New Jersey's Standard 9.1 Personal Financial Literacy
  - This standard outlines the important fiscal knowledge, habits, and skills that must be mastered in order for students to make informed decisions about personal finance.
  - Financial literacy is an integral component of a student's college and career readiness, enabling students to achieve fulfilling, financially-secure, and successful careers.

<u>Theme 1: Civic Financial Responsibility</u>

- This idea will be addressed via read alouds, researching various civic duties and responsibilities, delineating classroom jobs, project based learning activities on volunteering and giving back to the community

<u>Theme 2: Financial Institutions</u>

- This standard will be addressed via read alouds, researching the American banking and credit system, STEAM and problem solving activities, analysis of informational text (primary and secondary)

<u>Theme 3: Financial Psychology</u>

- This standard will be addressed via STEAM and problem solving activities, having a classroom token economy, personal reflections on spending habits and emotional well-being

<u>Theme 4: Planning and Budgeting</u>

- This standard will be addressed via STEAM and problem solving activities, by having a classroom economy, the use of school-wide currency, analysis of informational texts regarding savings accounts

<u>Theme 5: Risk Management</u>

- This standard will be addressed via the use of read alouds regarding insurance, higher order thinking and questioning techniques regarding when insurance is needed

Theme 6: Economic and Government Influences (Grades 5- 8)

- This standard will be addressed via read alouds, research and debates on taxation, research on the history of taxation, defining trade practices throughout American history, determining state and federal financial laws.

Theme 7: Credit Profile (Grades 5th- 8th)

- This standard will be addressed via read alouds, analysis of informational texts, compare and contrasting product prices, classroom discussions on credit score

Career Awareness, Exploration and Preparation

New Jersey's Standard 9.2 Career Awareness, Exploration, and Preparation

- This standard outlines the importance of being knowledgeable about one's interests and talents, and being well informed about postsecondary and career options, career planning, and career requirements.
- This standard would be addressed via researching and presenting information, working collaboratively with partners or small groups, using technology like Google Suite on a regular basis, grounding reading, writing, and speaking in evidence from text, both literary and informational, building knowledge through content rich non-fiction, inferencing, identifying main idea and theme, sequence of events, cause and effect, vocabulary, problem and solution, point of view, and by evaluating various forms of media and formats.

Theme 1: Career Awareness and Planning

- This standard will be addressed via the use of read alouds regarding occupations, defining individual skills, training, and knowledge required for various occupations and higher education, determining incomes associated with various careers, compare and contrast of public, private and entrepreneurial occupations

Career Readiness, Life Literacies, and Key Skills

Standard 9.4 Life Literacies and Key Skills.

- This standard outline key literacies and technical skills such as critical thinking, global and cultural awareness, and technology literacy* that are critical for students to develop to live and work in an interconnected global economy.

Theme 1: Creativity and Innovation

- This standard will be addressed via read alouds, project based learning assignments, think-a-louds, classroom collaboration activities, perspective- taking assignments, and problem solving assignments as they relate to career readiness

Theme 2: Critical thinking and problem solving

- This standard will be addressed via read alouds, project based learning assignments, research assignments, compare and contrast activities, multi-solution project based learning assignments, local, national, and global research projects based on current events

Theme 3: Digital Citizenship

- This standard will be addressed via read alouds, project based learning assignments, research assignments, primary and secondary resource analysis, citation assignments, online safety and research assignments, student presentations, collaborative activities, outcome based assignments regarding technology safety

Theme 4: Global and Cultural Awareness

- This standard will be addressed via read alouds, project based learning assignments, research assignments, classroom discussions, cultural awareness activities,

Theme 5: Information and Media Literacy

- This standard will be addressed via read alouds, project based learning assignments, research assignments, classroom discussions, Google Scholar assignments, Google Suite activities, analysis of media bias assignments

Theme 6: Technology Literacy

- This standard will be addressed via read alouds, project based learning assignments, research assignments, classroom discussions, use of Google Docs and Microsoft Word assignments, Google Suite Slides and Microsoft Powerpoint assignments, Google Sheets and Microsoft Excel assignments, current events assignments

Career Ready Practices:

Career Ready Practices describe the career-ready skills that all educators in all content areas should seek to develop in their students. They are practices that have been linked to increase college, career, and life success. Career Ready Practices should be taught and reinforced in all career exploration and preparation programs with increasingly higher levels of complexity and expectation as a student advances through a program of Study.

Integration and Focus -

- Our career programs are focused on STEAM based practices, meaning all lessons are hands-on and introduce students to high interest, STEM-based careers.
- With our career programs, students learn how the concepts and topics they learn in school are related to the real world. And, all lessons are experiential and use simple supplies, no text book or handout is used.
- The career programs will utilize videos, magazines, presenters, internet search engines, hands on projects, and experiments that focus on topics that link student learning to various career options.

Technology through NJSLS and Career Education:
Identified on Lesson Plan –

Mission:

Readiness in this century demands that students actively engage in critical thinking, communication, collaboration, and creativity. Technology empowers students with real-world data, tools, experts and global outreach to actively engage in solving meaningful problems in all areas of their lives. The power of technology discretely supports all curricular areas and multiple levels of mastery for all students.

Vision:

The design process builds in our students the recognition that success is not merely identifying a problem but working through a process and that failure is not an end but rather a point for reevaluation. Whether applied as a skill in product development, in the learning environment, in daily life, in a local or more global arena, the design process supports students in their paths to becoming responsible, effective citizens in college, careers and life. Computational thinking provides an organizational means of approaching life and its tasks. It develops an understanding of technologies and their operations and provides students with the abilities to build and create knowledge and new technologies.

Standards:

Technology Standard 8.1: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and create and communicate knowledge.

> *Use of non-fiction media, science-specific vocabulary, data analysis, lab reports, research-based assignments, word processing, online spreadsheet tools, STEM activities, problem-based learning*

Technology Standard 8.2: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.

_____*Problem-based learning, STEM activities, use of non-fiction media, solving real-world science-based issues (ex. global warming, filtration, alternate fuels, etc), engineering activities (particularly civil engineering), projects with constraints*

Implementation During Instruction:

→ Webquests
→ Demos Activities
→ Classroom Responders
→ Chromebooks
→ Online Progress Monitoring Tools
→ Online Assessments
→ Online Word Processing
→ Let's Go Learn
→ LinkIt

Additional Content-Specific Information/Resources –

1. National / International Technology Student Standards
    1. 8.1 Educational Technology
        1. International Society for Technology in Education (ISTE) Standards for Student
        2. American Association of School Librarians (AASL) Student Standards for the 21st-Century Learner
        3. Common Sense Student Standards Alignment in the K-12 Digital Citizenship Curriculum
    2. 8.2 Technology Education, Engineering, Design and Computational Thinking - Programming
        1. K12 Computer Science Student Framework Statements by Grade Band
        2. International Technology and Engineering Educators Association Standards for Technological Literacy

Career Education:

Identified on Lesson Plan –

- Integrated into 21st Century Skills (NJSLS 9) and (NJSLS 8)
- Annual Career Fair

Integration and Focus -

- Our career programs are focused on STEM based practices, meaning all lessons are hands-on and introduce students to high interest, STEM-based careers.
- With our career programs, students learn how the concepts and topics they learn in school are related to the real world. And, all lessons are experiential and use simple supplies, no text book or handout is used.
- The career programs will utilize videos, magazines, presenters, internet search engines, hands on projects, and experiments that focus on topics that link student learning to various career options.

6th Grade PSI Year Long Plan with NGSS

Unit 1: Hurricanes - 50 Days	Unit 2: Global Climates - 22 Days
Core Ideas: MS.PS1.4 MS.PS3.3 MS.PS3.4 MS.ESS2.4 MS.ESS2.5 MS.ESS2.6	**Core Ideas:** MS.PS2.4 MS.PS3.3 MS.LS2.3 MS.ESS1.1 MS.ESS2.1 MS.ESS2.5 MS.ESS2.6 MS.ESS3.5
Unit 3: History of the Earth and Solar System & Natural Disasters - 45 Days	**Unit 4: Trees - An Introduction to Chemistry - 30 Days**
Core Ideas: MS.ESS.1.2 MS.ESS1.3 MS.ESS1.4 MS.ESS2.1 MS.ESS2.2 MS.ESS2.3 MS.ESS3.2	**Core Ideas:** MS.PS1.1 MS.PS1.2 MS.LS1.6 MS.LS2.3 MS.ESS3.5
Unit 5: A Changing World - 23 Days	
Core Ideas: MS.LS2.4 MS.ESS2.6 MS.ESS3.3 MS.ESS3.5	

Unit 1 - Hurricanes	
Time Frame:	50 Days

Next Generation Science Standards	
MS.PS1.4	Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed
MS.PS3.3	Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer
MS.PS3.4	Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.
MS.ESS2.4	Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.
MS.ESS2.5	Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.
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.

NJSLS - Computer Science & Design Thinking Standards	
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.5	Test, analyze, and refine computational models.
8.1.8.DA.6	Analyze climate change computational models and propose refinements.
8.1.8.AP.2	Create clearly named variables that represent different data types and perform operations on their values.
8.2.8.ITH.4	Identify technologies that have been designed to reduce the negative consequences of other technologies and explain the change in impact.
8.2.8.ETW.4	Compare the environmental effects of two alternative technologies devised to address climate

	change issues and use data to justify which choice is best.

Essential Questions
(What questions will the student be able to answer as a result of the instruction?)
1. What information about the physical properties of matter can be gathered by investigation? 2. How is density determined? 3. How does density affect floating and sinking and changes in pressure? 4. How is heat transferred? 5. How does the Sun's energy and the motion of the Earth create patterns of movement in the Earth's atmosphere?

Knowledge & Skills	
(What skills are needed to achieve the desired results?)	
By the end of this unit, students will know: ● What an atom is ● The various states of matter ● The concepts of evaporation and condensation ● How heat capacity affects things in our world	By the end of this unit, students will be able to: ● Collect and graph data for an experiment ● Design and build both a mass and volume measuring device ● Relate pressure to how hurricanes move ● Relate the Coriolis Effect to the motion of hurricanes

Scope and Sequence (Pacing Guide)			
Matter & Its Properties			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
What information about the physical properties of matter can be gathered by investigation?	22	*Lesson 1: What is an atom?* *Lesson 2: Changing States of Matter*	PhET: Build an Atom - also found in 7th Grade Lab: Heating Ice Lab: Heating Gas - Balloon Expansion Lab: Homemade Terrarium PhET: States of Matter
Density & Pressure			

NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
How is density determined? **How does density affect floating and sinking and changes in pressure?**	17	*Lesson 1: Measuring Matter* *Lesson 2: Determining Density* *Lesson 3: Atmospheric Pressure*	PhET: Density Lab: Finding the Mass & Volume of Regular & Irregular Objects Determining Density (Technology) Lab: Density Column Lab: Homemade Cartesian Diver Lab: Floating & Sinking Lab: Homemade Barometer PhET: Gases
Heat & Air Flow			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
How is heat transferred? **How does the Sun's energy and the motion of the Earth create patterns of movement in the Earth's atmosphere?**	11	*Lesson 1: Three Types of Heat Transfer* *Lesson 2: Coriolis Effect*	Lab: Measuring Radiant Energy Lab: Hot Plate Conduction Lab: Modeling the Coriolis Effect Examining Wind & Solar Energy (Technology) Activity: Tropical Cyclone Counts - Data Analysis (Technology)

Unit 2 - Global Climates	
Time Frame:	22 Days

Next Generation Science Standards	
MS.PS2.4	Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.
MS.PS3.3	Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer
MS.LS2.3	Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
MS.ESS1.1	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. .
MS.ESS2.1	Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
MS.ESS2.5	Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions.
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
MS.ESS3.5	Ask questions to clarify evidence of the factors that have caused the rise in global temperatures 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.

NJSLS - Computer Science & Design Thinking Standards

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.
8.1.8.DA.5	Test, analyze, and refine computational models.
8.1.8.DA.6	Analyze climate change computational models and propose refinements
8.2.8.ED.2	Identify the steps in the design process that could be used to solve a problem.
8.2.8.ED.3	Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).
8.2.8.ED.5	Explain the need for optimization in a design process.
8.2.8.ED.6	Analyze how trade-offs can impact the design of a product.

Essential Questions
(What questions will the student be able to answer as a result of the instruction?)
1. What is climate? 2. What effect do greenhouse gases have on global temperature? 3. How do the components of our solar system move and interact with one another? 4. How can patterns be used to describe the universe? 5. How does latitude affect weather? 6. How does the heat capacity of land and water differ? 7. What causes the currents?

Knowledge & Skills	
(What skills are needed to achieve the desired results?)	
By the end of this unit, students will know: ● Which main factors that affect climate ● Which celestial object has the most impact on Earth ● The phases of the moon ● The effect of the moon on tides ● The causes of solar and lunar eclipses	By the end of this unit, students will be able to: ● Explain why different geographic regions have different climates ● Describe annual solar patterns ● Explain how the Earth's tilt and revolution affect climate ● Describe the lunar phases ● Explain what causes a solar and lunar eclipse

Scope and Sequence (Pacing Guide)
Introduction to Global Climates

NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
What is climate? **What effect do greenhouse gases have on global temperature?**	3	*Lesson 1: Climate*	Lab: Climate Trends
Earth, Moon & Sun System			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
How do the components of our solar system move and interact with one another? **How can patterns be used to describe the universe?**	11	*Lesson 1: Solar Patterns* *Lesson 2: Lunar Patterns*	PhET: Gravity & Orbits Gizmo: Gravity Pitch Lab: Tilt of the Earth - Seasons Lab: Changing Shadows Lunar Calendar Lab: Eclipses Gizmo: Ocean Tides Tides & Moon Phases
Global Energy Flow - Weather & Climates			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
How does latitude affect weather? **How does the heat capacity of land and water differ?** **What causes the currents?**	8	*Lesson 1: Latitude* *Lesson 2: Heat Capacity* *Lesson 3: Currents*	Lab: Direct v Indirect Sunlight Lab: Heating Land v Water Data Collection: Temperatures of Beach Towns v Inland (Technology) Lab: Temperature & Circulation - Convection Currents Lab: Ocean Currents Simulation: Ocean Currents Game: NASA - Go With the Flow Lab: Global Energy Flows

Unit 3 - History of the Earth and Solar System & Natural Disasters	
Time Frame:	45 Days

Next Generation Science Standards	
MS.ESS1.2	Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.
MS.ESS1.3	Analyze and interpret data to determine scale properties of objects in the solar system.
MS.ESS1.4	Construct a scientific explanation based on evidence from rock strate for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.
MS.ESS2.1	Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.
MS.ESS2.2	Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.
MS.ESS2.3	Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of past plate motions.
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.
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.

NJSLS - Computer Science & Design Thinking Standards	
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.4	Transform data to remove errors and improve the accuracy of the data for analysis.
8.2.8.ED.1	Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.

8.2.8.ED.2	Identify the steps in the design process that could be used to solve a problem.
8.2.8.ED.3	Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).
8.2.8.ED.4	Investigate a malfunctioning system, identify its impact, and explain the step-by-step process used to troubleshoot, evaluate, and test options to repair the product in a collaborative team.
8.2.8.ED.5	Explain the need for optimization in a design process.
8.2.8.ED.6	Analyze how trade-offs can impact the design of a product.
8.2.8.ED.7	Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches).
8.2.8.ITH.1	Explain how the development and use of technology influences economic, political, social, and cultural issues.
8.2.8.ITH.5	Compare the impacts of a given technology on different societies, noting factors that may make a technology appropriate and sustainable in one society but not in another.

Essential Questions
(What questions will the student be able to answer as a result of the instruction?)
1. How do objects in our solar system interact with each other? 2. What makes up our Earth? 3. What are tectonic plates and how do they interact? 4. What are the three types of rocks? 5. How do rock strata and fossils provide scientific evidence that explains the history of the Earth? 6. How can plate interactions result in natural disasters?

Knowledge & Skills	
(What skills are needed to achieve the desired results?)	
By the end of this unit, students will know: ● The theoretical explanation regarding the formation of our universe. ● The celestial bodies found within our solar system. ● What causes the orbits of celestial bodies around our Sun and the orbits of moons around their planets. ● The size of celestial bodies, relative to each other. ● The layers and internal makeup of the Earth.	By the end of this unit, students will be able to: ● Explain how gravity holds together solar systems, and, subsequently, galaxies ● Discuss the required criteria to be considered a planet. ● Use rock strata and fossils to explain the history of a region. ● Discuss how the theory of plate tectonics relates to the formation and breakup of Pangaea. ● Discuss the relationship between tectonic movement and the strength of an earthquake. ● Locate areas that are particularly susceptible to tsunamis. ● Relate tectonic plate movement to volcano formation.

• How rock strata help explain Earth's history. • How the process of convection drives plate movement. • How observable scientific evidence can help explain large-scale processes, such as continental drift. • The three types of tectonic plate interaction. • The three types of rocks. • The causes of earthquakes, volcanoes, and tsunamis.	• Explain the rock cycle.

Scope and Sequence (Pacing Guide)			
Orbits & Gravity: The Solar System & the Universe			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
How do objects in our solar system interact with each other?	12	*Lesson 1: Gravity and Orbits* *Lesson 2: The Formation of our Solar System and its Celestial Bodies*	PhET: Gravity and Orbits PhET: Gravity Force Lab: Orbital Speed Simulation: Orbital Speed (Technology) Lab: Scale Model Solar System Lab: Create a Comet
History & Geology of Earth			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
What makes up our Earth? **What are tectonic plates and how do they interact?** **What are the three types of rocks?** **How do rock strata and fossils provide scientific evidence that explains the history of the Earth?**	17	*Lesson 1: Layers of the Earth* *Lesson 2: Earth's Tectonic Plates* *Lesson 3: Rocks, Rock Strata & Fossils*	Lab: Layers of the Earth Lab: Wegener's Puzzling Continents Lab: Evidence of Plate Tectonics Gizmo: Building Pangaea Activity: World Map of Plate Boundaries Gizmo: Plate Tectonics Lab: Graham Cracker Plate Tectonics

			Lab: Exploring and Sorting Rocks Lab: Rock Identification Game: Rock Cycle Lab: Bread Fossils / Rock Strata PhET: Radioactive Dating Game (Technology)
Exploring Earthquakes, Tsunamis & Volcanoes			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
How can plate interactions result in natural disasters?	16	*Lesson 1: Earthquakes* *Lesson 2: Tsunamis* *Lesson 3: Volcanoes*	Lab: Homemade Seismograph Lab: Tabletop Earthquake - Exploring Friction Design Lab: Seismic Shake-Up (or Alternative) (Technology) Gizmo: Earthquakes 1 - Recording Station Gizmo: Earthquakes 2 - Determination of Epicenter Gizmo: Earthquake-Proof Homes (Technology) Website: Earthquake Tracker (Technology) Lab: Tsunami Attack Lab: Tsunami Bottle Lab: Tsunami Simulator Game: Stop Disasters Website: NOAA Center for Tsunami Research Lab: Tabletop Volcano Lab: Making & Mapping a Volcano

Unit 4 - Trees: An Introduction to Chemistry	
Time Frame:	30 Days

Next Generation Science Standards	
MS.PS1.1	Develop models to describe the atomic composition of simple molecules and extended structures.

MS.PS1.2	Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
MS.LS1.6	Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.
MS.LS2.3	Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
MS.ESS3.5	Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

NJSLS - Computer Science & Design Thinking Standards	
8.1.8.DA.6	Analyze climate change computational models and propose refinements.
8.2.8.ED.6	Analyze how trade-offs can impact the design of a product.
8.2.8.ITH.1	Explain how the development and use of technology influences economic, political, social, and cultural issues.
8.2.8.ITH.2	Compare how technologies have influenced society over time.
8.2.8.ITH.3	Evaluate the impact of sustainability on the development of a designed product or system.
8.2.8.ITH.4	Identify technologies that have been designed to reduce the negative consequences of other technologies and explain the change in impact.
8.2.8.ITH.5	Compare the impacts of a given technology on different societies, noting factors that may make a technology appropriate and sustainable in one society but not in another.
8.2.8.ETW.2	Analyze the impact of modifying resources in a product or system (e.g., materials, energy, information, time, tools, people, capital).
8.2.8.ETW.3	Analyze the design of a product that negatively impacts the environment or society and develop possible solutions to lessen its impact.
8.2.8.ETW.4	Compare the environmental effects of two alternative technologies devised to address climate change issues and use data to justify which choice is best.
8.2.8.EC.1	Explain ethical issues that may arise from the use of new technologies.
8.2.8.EC.2	Examine the effects of ethical and unethical practices in product design and development.

Essential Questions
(What questions will the student be able to answer as a result of the instruction?)
1. What are the differences between physical and chemical changes? 2. How do atoms bond to create molecules? 3. How is photosynthesis a demonstration of a chemical change?

4. What are the differences between renewable and nonrenewable resources?
5. What impact does the burning of fossil fuels have on our atmosphere?

Knowledge & Skills	
(What skills are needed to achieve the desired results?)	
By the end of this unit, students will know: ● The difference between a chemical change vs a physical change. ● The names of the subatomic particles along with their locations in the atom. ● How an atom can become a charged ion. ● The factors that impact whether or not an atom is likely to bond to form a molecule ● The difference between spontaneous and nonspontaneous reactions. ● The reactants and products in photosynthesis. ● The difference between renewable and nonrenewable resources, along with examples	By the end of this unit, students will be able to: ● Explain why physical changes are reversible and chemical changes are not. ● Explain the structure of an atom. ● Explain how chemical bonds form. ● Describe the process of photosynthesis. ● Explain the conservation of mass.

Scope and Sequence (Pacing Guide)			
Chemistry			
NJCTL Documents (Part 2)			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
What are the differences between physical and chemical changes? **How do atoms bond to create molecules?** **How is photosynthesis a demonstration of a chemical change?**	19	*Lesson 1: Physical & Chemical Changes* *Lesson 2: The Formation of Molecules* *Lesson 3: Photosynthesis & Conservation of Matter*	Project Learning Tree Demo: Burning Wood Demo: Burning Steel Wool Lab: Photosynthesis - Oxygen Creation Lab: Photosynthesis - The Role of Sunlight & Water Lab: Photosynthesis Using Elodea (Alternative) PhET: Build a Molecule - also found in 7th Grade

			PhET: Reactants, Products, and Leftovers Gizmo: Growing Plants Gizmo: Photosynthesis Lab - also found in 7th Grade
Hydrocarbons & The Atmosphere			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
What are the differences between renewable and nonrenewable resources? **What impact does the burning of fossil fuels have on our atmosphere?**	11	*Lesson 1: The Impact of Fossil Fuels*	Researching Fossil Fuels Webquest: Using Energy (Technology) Energy Audit Gizmo: Carbon Cycle Activity: Fossil Fuels - Air Pollution & the Greenhouse Effect (Technology)

Unit 5 - A Changing World	
Time Frame:	23 Days

Next Generation Science Standards	
MS.LS2.4	Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
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.

MS.ESS3.3	Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
MS.ESS3.5	Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

NJSLS - Computer Science & Design Thinking Standards	
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.6	Analyze climate change computational models and propose refinements.
8.2.8.ITH.1	Explain how the development and use of technology influences economic, political, social, and cultural issues.
8.2.8.ITH.2	Compare how technologies have influenced society over time.
8.2.8.ITH.3	Evaluate the impact of sustainability on the development of a designed product or system.
8.2.8.ITH.4	Identify technologies that have been designed to reduce the negative consequences of other technologies and explain the change in impact.
8.2.8.ITH.5	Compare the impacts of a given technology on different societies, noting factors that may make a technology appropriate and sustainable in one society but not in another.
8.2.8.ETW.2	Analyze the impact of modifying resources in a product or system (e.g., materials, energy, information, time, tools, people, capital).
8.2.8.ETW.3	Analyze the design of a product that negatively impacts the environment or society and develop possible solutions to lessen its impact.
8.2.8.ETW.4	Compare the environmental effects of two alternative technologies devised to address climate change issues and use data to justify which choice is best.

Essential Questions
(What questions will the student be able to answer as a result of the instruction?)
1. What factors contribute to Earth's rising temperature? 2. What effect do rising sea levels have on Earth's geography and its weather? 3. What does global warming affect local climates and the creatures that live there? 4. How can we shrink our individual carbon footprint and help reduce the risks of global warming?

Knowledge & Skills
(What skills are needed to achieve the desired results?)

By the end of this unit, students will know:	By the end of this unit, students will be able to:
• How the Sun's energy and Earth's own atmosphere contribute to rising temperatures. • The impacts of the greenhouse effect. • Factors that contribute to global warming. • The importance of the threat of rising sea levels. • How global warming threatens to alter climates worldwide. • Global warming's impact on life on Earth. • Ways in which we can help reduce the rate of global warming.	• Explain the rise in Earth's temperature as a result of the Sun's energy and the greenhouse effect. • Explain the connection between rising sea levels and an increase in severe storms. • Explain how global warming can also result in colder temperatures and more severe winter storms in various regions worldwide. • Discuss global warming's effects on life on Earth. • Provide ways in which they can reduce their own individual carbon footprints.

Scope and Sequence (Pacing Guide)			
A Changing World			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
What factors contribute to Earth's rising temperature? **What effect do rising sea levels have on Earth's geography and its weather?** **What does global warming affect local climates and the creatures that live there?** **How can we shrink our individual carbon footprint and help reduce the risks of global warming?**	23	*Lesson 1: Earth's Atmosphere and the Greenhouse Effect* *Lesson 2: Rising Sea Levels and Severe Storms* *Lesson 3: Climate Change and its Impact on Living Things* *Lesson 4: Reducing our Footprint*	Lab: Greenhouse Effect Lab: Impact of CO_2 on the Greenhouse Effect PhET: Greenhouse Effect Gizmo: Greenhouse Effect Lab: Melting Ice & Sea Level Rise Lab: Sea Ice v Land Ice Lab: Thermal Expansion & Sea Level Rise Activity: Comparing Coastal Flooding (Technology) Website: Climate Change Indicators - Ocean Activity: Earth Observations Website: NASA's Eyes on Extreme Weather Website: A Student's Guide to Global Climate Change

			Activity: Climate Change Online Lab Activity: Carbon Footprint Website: WWF Footprint Calculator Webquest: Using Energy (Technology) Energy Audit Activity: Fossil Fuels - Air Pollution & the Greenhouse Effect (Technology)

7th Grade PSI Year Long Plan with NGSS

Unit 1: Cellular Life - 61 Days	Unit 2: Big Life - 62 Days
Core Ideas: MS.PS1.1 MS.PS1.2 MS.PS1.6 MS.LS1.1 MS.LS1.2 MS.ETS1.1 MS.ETS1.2 MS.ETS1.3 MS.ETS1.4	**Core Ideas:** MS.LS1.1 MS.LS1.2 MS.LS1.3 MS.LS1.4 MS.LS1.5 MS.LS1.6 MS.LS1.7 MS.LS1.8 MS.LS3.1 MS.LS3.2 MS.ETS1.1 MS.ETS1.2 MS.ETS1.3 MS.ETS1.4

Unit 3: Biodiversity - 47 Days	[redacted]
Core Ideas: MS.LS1.4 MS.LS1.5 MS.LS1.6 MS.LS2.1 MS.LS2.2 MS.LS2.3 MS.LS2.4 MS.LS2.5 MS.LS4.1 MS.LS4.2 MS.LS4.3 MS.LS4.4 MS.LS4.5 MS.LS4.6 MS.ETS1.1 MS.ETS1.2 MS.ETS1.3 MS.ETS1.4	

Unit 1 - Cellular Life	
Time Frame:	61 Days

Next Generation Science Standards	
MS.PS1.1	Develop models to describe the atomic composition of simple molecules and extended structures.
MS.PS1.2	Analyze and interpret data on the properties of substances before and after the substances

	interact to determine if a chemical reaction has occurred.
MS.PS1.6	Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes
MS.LS1.1	Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.
MS.LS1.2	Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.
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.

NJSLS - Computer Science & Design Thinking Standards	
8.2.8.ED.1	Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.
8.2.8.ED.2	Identify the steps in the design process that could be used to solve a problem.
8.2.8.ED.3	Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).
8.2.8.ED.5	Explain the need for optimization in a design process.
8.2.8.ED.6	Analyze how trade-offs can impact the design of a product.
8.2.8.ED.7	Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches).

Essential Questions
(What questions will the student be able to answer as a result of the instruction?)
1. What information about physical and chemical properties of matter can be gathered by investigation? 2. What information can we gather from the Periodic Table of Elements? 3. How do atoms bond to create molecules? 4. How do we read and write chemical formulas?

5. What are the differences between physical and chemical changes?
6. What is the difference between an exothermic and an endothermic reaction?
7. How do catalysts and enzymes accelerate the process of a chemical reaction?
8. How did life emerge on Earth?
9. What are the characteristics of a prokaryote?
10. What are the characteristics of a eukaryote?
11. What are the differences between plant and animal cells?

Knowledge & Skills	
(What skills are needed to achieve the desired results?)	
By the end of this unit, students will know: ● The makeup of atoms and molecules. ● How to read the Periodic Table of Elements ● The difference between physical and chemical reactions. ● The difference between exothermic and endothermic reactions. ● The role of catalysts and enzymes in chemical reactions. ● How life theoretically emerged on our planet. ● The differences between prokaryotic and eukaryotic cells. ● The differences between animal and plant cells.	By the end of this unit, students will be able to: ● Use scientific evidence to determine whether a physical or a chemical change occurred. ● Utilize their understanding of exothermic and endothermic reactions to solve a real-world problem regarding heat and temperature. ● Explain the theory behind the emergence of life on Earth. ● Explain the differences between various types of cells (prokaryotic vs eukaryotic and plant vs animal) and use the understanding of these differences to be able to categorize unknown cell samples. ● Explain the role that cellular mitosis plays in the formation and maintenance of multicellular living things.

Scope and Sequence (Pacing Guide)			
Chemistry & Chemical Bonding			
NJCTL Documents (Part 2)			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
What information about physical and chemical properties of matter can be gathered by investigation? **What information can we gather from the Periodic Table of Elements?** **How do atoms bond to create molecules?**	12	*Lesson 1: Atoms, Elements, and the Periodic Table* *Lesson 2: Molecules and Chemical Formulas* *Lesson 3: Physical and Chemical Reactions*	PhET: Build an Atom - also found in 6th Grade Activity: Reading the Periodic Table PhET: Build a Molecule - also found in 6th Grade Lab: Ball and Stick Models Lab: Applying the Heat - Physical and

How do we read and write chemical formulas? **What are the differences between physical and chemical changes?**			Chemical Changes Lab: Physical or Chemical Change? Lab: Acids and Bases Gizmo: Chemical and Physical Changes STEM Case
Energy & Entropy			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
What is the difference between an exothermic and an endothermic reaction? **How do catalysts and enzymes accelerate the process of a chemical reaction?**	14	*Lesson 1: Exothermic and Endothermic Reactions* *Lesson 2: Catalysts and Enzymes*	Lab: Endothermic and Exothermic Reactions (1) Lab: Endothermic and Exothermic Reactions (2) Lab: Endothermic and Exothermic Reactions (3) Lab: Thermal Energy Design Project - Johnson & Johnson Backup Device (Technology) Gizmo: Feel the Heat Lab: Catalase Lab: A Catalyst and the Rate of Reaction Lab: Elephant Toothpaste
Origin of Life			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
How did life emerge on Earth?	7	*Lesson 1: Early Life on Earth* *Lesson 2: Organic Molecules and the Formation of Cells*	Lab: Deep Time Lab: Cohesion of Water Activity: The History of Life in 24 Hours Activity: Life from Not-Life? Activity: A Different Way of Life

			Activity: Life's Operating System
Prokaryotes			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
What are the characteristics of a prokaryote?	10	*Lesson 1: Structure of Bacteria* *Lesson 2: Bacterial Reproduction and Evolution*	Lab: Bacterial Growth Lab: Food Safety Lab: Using a Microscope Lab: Examining Bacteria Under a Microscope Nonfiction Texts: Are Viruses Alive? Gizmo: Paramecium Homeostasis
Eukaryotes			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
What are the characteristics of a eukaryote? **What are the differences between plant and animal cells?**	18	*Lesson 1: Animal and Plant Cells* *Lesson 2: Cellular Reproduction*	Lab: Investigating Cells (Technology) Activity: Cell City Lab: Examining Animal and Plant Cells Under a Microscope (Technology) Gizmo: Cell Structure Gizmo: Cell Types Lab: Observing Mitosis

Unit 2 - Big Life	
Time Frame:	62 Days

Next Generation Science Standards	
MS.LS1.1	Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.
MS.LS1.2	Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.
MS.LS1.3	Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.

MS.LS1.4	Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.
MS.LS1.5	Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.
MS.LS1.6	Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.
MS.LS1.7	Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism.
MS.LS1.8	Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.
MS.LS3.1	Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.
MS.LS3.2	Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.
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.

NJSLS - Computer Science & Design Thinking Standards	
8.1.8.NI.1	Model how information is broken down into smaller pieces, transmitted as addressed packets through multiple devices over networks and the Internet, and reassembled at the destination.
8.1.8.NI.2	Model the role of protocols in transmitting data across networks and the Internet and how they enable secure and errorless communication.
8.2.8.ED.1	Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.
8.2.8.ED.2	Identify the steps in the design process that could be used to solve a problem.
8.2.8.ED.3	Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical

	prototype, graphical/technical sketch).
8.2.8.ED.4	Investigate a malfunctioning system, identify its impact, and explain the step-by-step process used to troubleshoot, evaluate, and test options to repair the product in a collaborative team.
8.2.8.ED.5	Explain the need for optimization in a design process.
8.2.8.ED.6	Analyze how trade-offs can impact the design of a product.
8.2.8.ED.7	Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches).
8.2.8.ITH.1	Explain how the development and use of technology influences economic, political, social, and cultural issues.

Essential Questions
(What questions will the student be able to answer as a result of the instruction?)
1. How do plants and animals create and use energy? 2. How does energy get transferred through an ecosystem? 3. What specialized structures and systems help multicellular organisms function? 4. What role does DNA play in living things? 5. How does DNA get passed on from one generation to the next, and what happens if there is an error in the genetic code? 6. How are traits passed on from parent to offspring? 7. How can we use a Punnett Square to determine the possible traits from a genetic cross of two organisms?

Knowledge & Skills	
(What skills are needed to achieve the desired results?)	
By the end of this unit, students will know: ● How photosynthesis and cellular respiration allow energy to flow through an ecosystem. ● How a food chain displays the flow of energy through an ecosystem. ● The function of specialized cells, organs, and organ systems in the human body. ● The role of DNA in living things and how it gets passed on from one generation to the next. ● How inherited traits get passed on from parents to offspring. ● How to use a Punnett Square to predict possible offspring traits.	By the end of this unit, students will be able to: ● Design food chains and explain how energy is brought into and flows through an ecosystem. ● Explain the roles of the human body's organs and organ systems. ● Describe the function of DNA in living organisms. ● Use the principles of Mendelian Genetics to make predictions and claims regarding heredity.

Scope and Sequence (Pacing Guide)			
Energy Flow in Multicellular Life			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
How do plants and animals create and use energy? **How does energy get transferred through an ecosystem?**	10	*Lesson 1: Photosynthesis and Cellular Respiration* *Lesson 2: The Flow of Energy in an Ecosystem*	Game: Photosynthesis Formula Lab: Cellular Respiration Model Lab: Do Plants Breathe? Lab: Photosynthesis Using Elodea (Alternative) - also found in 6th Grade Gizmo: Photosynthesis Lab - also found in 6th Grade Gizmo: Cell Energy Cycle Gizmo: Food Chain
Structure and Function			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
What specialized structures and systems help multicellular organisms function?	17	*Lesson 1: Cells and Tissues* *Lesson 2: Organs and Organ Systems*	Activity: Build an Organ Lab: Chicken Wing Dissection STEM Challenge: Building a Bionic Hand (Alternative 1) (Technology) Activity: Robot Hand Gizmo: Circulatory System Gizmo: Digestive System Gizmo: Frog Dissection Gizmo: Muscles and Bones Gizmo: Senses Gizmo: Sight vs Sound Reactions Websites: Comparing Brain to

			Computer/Internet (Technology) (Site 2) (Site 3) (Site 4) (Site 5)
Genetic Information Flow			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
What role does DNA play in living things? **How does DNA get passed on from one generation to the next, and what happens if there is an error in the genetic code?**	10	*Lesson 1: DNA and the Human Genetic Code* *Lesson 2: Meiosis, Reproduction, and Mutations*	Lab: DNA Extraction Lab: Transcription, Translation, Mutation Activity: DNA Build Lab: See Your Own DNA Activity: Mitosis vs Meiosis Activity: All Sorts of Mutations Website: Universal Genetic Code
Heredity			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
How are traits passed on from parent to offspring? **How can we use a Punnett Square to determine the possible traits from a genetic cross of two organisms?**	25	*Lesson 1: Mendelian Genetics* *Lesson 2: Punnett Squares (Complete and Incomplete Dominance), Test Crosses, and Pedigrees* *Lesson 3: Inherited Disorders*	Lab: Jane and John Lab: Dragon Crossing Lab: Test Cross Activity: Pedigrees Gizmo: Heredity and Traits STEM Case Gizmo: Inheritance Project: Create a Baby (Alternative) Activity: Making Babies with Punnett Squares Teacher Resource: Teach.Genetics Game: Pigeonetics

Unit 3 - Biodiversity	
Time Frame:	47 Days

Next Generation Science Standards	
MS.LS1.4	Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.
MS.LS1.5	Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.
MS.LS1.6	Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.
MS.LS2.1	Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
MS.LS2.2	Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
MS.LS2.3	Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

MS.LS2.4	Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations
MS.LS2.5	Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
MS.LS4.1	Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.
MS.LS4.2	Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.
MS.LS4.3	Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.
MS.LS4.4	Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.
MS.LS4.5	Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms.
MS.LS4.6	Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.
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.

NJSLS - Computer Science & Design Thinking Standards	
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.5	Test, analyze, and refine computational models.
8.2.8.ED.1	Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.
8.2.8.ED.2	Identify the steps in the design process that could be used to solve a problem.

8.2.8.ED.3	Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).
8.2.8.ED.5	Explain the need for optimization in a design process.
8.2.8.ED.6	Analyze how trade-offs can impact the design of a product.
8.2.8.ED.7	Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches).
8.2.8.ITH.1	Explain how the development and use of technology influences economic, political, social, and cultural issues.
8.2.8.ITH.2	Compare how technologies have influenced society over time.
8.2.8.ITH.3	Evaluate the impact of sustainability on the development of a designed product or system.
8.2.8.ITH.4	Identify technologies that have been designed to reduce the negative consequences of other technologies and explain the change in impact.
8.2.8.ITH.5	Compare the impacts of a given technology on different societies, noting factors that may make a technology appropriate and sustainable in one society but not in another.
8.2.8.ETW.3	Analyze the design of a product that negatively impacts the environment or society and develop possible solutions to lessen its impact.

Essential Questions
(What questions will the student be able to answer as a result of the instruction?)
1. What defines the Earth's biosphere? 2. How is energy transferred within the biosphere? 3. What types of relationships are found among species within an ecosystem and why are these symbiotic relationships important? 4. What are the ingredients necessary to build a balanced ecosystem? 5. How important are individual species to an ecosystem? 6. What is the theory of evolution by natural selection? 7. How can natural selection explain the origin of new species and higher orders of life? 8. Why is biodiversity important to the health and stability of an ecosystem? 9. How can we help maintain and protect an ecosystem's biodiversity?

Knowledge & Skills	
(What skills are needed to achieve the desired results?)	
By the end of this unit, students will know: ● The components of the biosphere and how these biotic and abiotic factors	By the end of this unit, students will be able to: ● Create a food web and form hypotheses about the ripple effects that could occur if there was a disruption to this web's balance.

influence the health and stability of an ecosystem. • How energy flows through an ecosystem. • How important each portion of a food web is to other living things in an ecosystem. • How the balance of a predator/prey relationship affects the rest of an ecosystem. • The theory of evolution based on natural selection. • How natural selection can lead to the creation of new organisms. • The importance of biodiversity in an ecosystem and how this biodiversity can be protected and maintained.	• Explain how the balance of predator and prey helps maintain a healthy and stable ecosystem. • Predict and document changes in population size as a result of limiting factors. • Analyze embryo and skeletal diagrams for anatomical similarities in order to make scientific claims supporting the theory of evolution. • Research ecological, environmental, or human-caused threats to an ecosystem's biodiversity and develop solutions to help protect against them.

Scope and Sequence (Pacing Guide)			
Biosphere			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
What defines the Earth's biosphere? **How is energy transferred within the biosphere?** **What types of relationships are found among species within an ecosystem and why are these symbiotic relationships important?**	12	*Lesson 1: Components of the Biosphere* *Lesson 2: Interactions between Living Things (Food Webs and Symbiosis)*	Gizmo: Coral Reefs - Abiotic Factors Gizmo: Coral Reefs - Biotic Factors Lab: Forest Food Web Gizmo: Forest Ecosystem Gizmo: Pond Ecosystem Gizmo: Prairie Ecosystem
Ecosystems			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
What are the ingredients necessary to build a balanced ecosystem? **How important are individual species to an ecosystem?**	12	*Lesson 1: Maintaining a Balanced Ecosystem*	Game: Food Fight Lab: Prey vs Predator Activity: Howling to Be Heard Activity: Animal Interactions - Pikas and

			their Predators Gizmo: Ecosystems STEM Case Gizmo: Animal Group Behavior STEM Case Gizmo: Rabbit Population by Season Resources: Project WILD Activities
Changes Over Time			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
What is the theory of evolution by natural selection? **How can natural selection explain the origin of new species and higher orders of life?**	14	*Lesson 1: Natural Selection and Evolution* *Lesson 2: Evidence of Evolution*	Lab: Battle of the Beaks Lab: Rock Pocket Mice Activity: Peppered Moths Lab: Natural Selection Lab: Natural Selection Utensils (Alternative 1) (Alternative 2) Gizmo: Rainfall and Bird Beaks Gizmo: Human Evolution - Skull Analysis Gizmo: Embryo Development Gizmo: Cladograms Gizmo: Evolution - Mutation and Selection Gizmo: Natural Selection PhET: Natural Selection Activity: Artificial Selection Gizmo: Genetic Engineering Gizmo: GMOs and the Environment
Maintaining Biodiversity			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**

Why is biodiversity important to the health and stability of an ecosystem? **How can we help maintain and protect an ecosystem's biodiversity?**	9	*Lesson 1: Protecting Biodiversity*	Activity: PLT Invasive Species Activity: Nat Geo Invasive Species Resources: Invasive Species Activity: Ocean Bully Activity: Water Quality and Distribution STEM Challenge: NASA Water Filtration Activity: Acid Rain Effects

8th Grade PSI Year Long Plan with NGSS

Unit 1: Rockets - 62 Days	Unit 2: Roller Coasters - 46 Days
Core Ideas: MS.PS2.1 MS.PS2.2 MS.PS2.4 MS.ETS1.1 MS.ETS1.2 MS.ETS1.3 MS.ETS1.4	**Core Ideas:** MS.PS2.4 MS.PS3.1 MS.PS3.2 MS.PS3.5 MS.ETS1.1 MS.ETS1.2 MS.ETS1.3 MS.ETS1.4
Unit 3: Mobile Phones - 52 Days	[redacted]
Core Ideas: MS.PS4.1 MS.PS4.2 MS.PS4.3 MS.ETS1.1 MS.ETS1.2	

Unit 1 - Rockets	
Time Frame:	62 Days

Next Generation Science Standards	
MS.PS2.1	Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.
MS.PS2.2	Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
MS.PS2.4	Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.
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.

NJSLS - Computer Science & Design Thinking Standards	
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.5	Test, analyze, and refine computational models.
8.1.8.AP.2	Create clearly named variables that represent different data types and perform operations on their values.
8.2.8.ED.2	Identify the steps in the design process that could be used to solve a problem.
8.2.8.ED.3	Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).
8.2.8.ED.5	Explain the need for optimization in a design process.
8.2.8.ED.6	Analyze how trade-offs can impact the design of a product.
8.2.8.ED.7	Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches).
8.2.8.ITH.2	Compare how technologies have influenced society over time.
8.2.8.EC.1	Explain ethical issues that may arise from the use of new technologies.

Essential Questions
(What questions will the student be able to answer as a result of the instruction?)
1. How do balanced and unbalanced forces affect the motion of an object? 2. How are Newton's Three Laws of Motion present in our everyday lives? 3. How can one predict an object's motion? 4. What is friction and how does it affect an object's motion? 5. How can you calculate the speed and velocity of an object? 6. How do we interpret motion graphs? 7. What is the difference between speed and velocity? 8. What happens to the motion of an object as it accelerates? 9. How can you calculate the acceleration of an object? 10. When does an object have momentum, and what factors impact momentum? 11. What happens when two objects collide?

Knowledge & Skills	
(What skills are needed to achieve the desired results?)	
By the end of this unit, students will know: ● How to apply the principles of Newton's Three Laws of Motion. ● How to work algebraically with mathematical formulas and solve real-world problems using them. ● How to plot and interpret graphs of linear equations. ● How to draw and interpret motion diagrams and models.	By the end of this unit, students will be able to: ● Explain an object's motion as a result of the application of unbalanced forces. ● Explain motion using Newton's Laws. ● Interpret motion graphs and use them to explain an object's motion. ● Rearrange mathematical formulas and use them to solve real-world problems. ● Explain collisions using the scientific principles of Newton's Laws of Motion and the Law of the Conservation of Momentum. ● Apply the principles of force, speed, acceleration, and momentum to the concepts of rocketry and spaceflight.

Scope and Sequence (Pacing Guide)			
Force			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
How do balanced and unbalanced forces affect the motion of an object? **How are Newton's Three Laws of Motion present in**	20	*Lesson 1: Determining Net Force* *Lesson 2: Newton's Three Laws of Motion*	PhET: Forces and Motion Basics Demo: The Lazy Coin (1st Law) Demo: Crash Test Dummy (1st Law)

our everyday lives? **How can one predict an object's motion?** **What is friction and how does it affect an object's motion?**		*Lesson 3: Weight* *Lesson 4: Friction*	Demo: A Strange Flame (1st Law) Lab: Controlled Collisions (1st Law) Lab: Pumping the Brakes (1st Law) Lab: Rubber Band Launcher (2nd Law) Activity: Using the F=ma Formula Activity: Balloon Pump Car (2nd Law) Gizmo: Force and Fan Carts Lab: Scooter Push (3rd Law) Lab: Hero Engine (3rd Law) Lab: Balloon Rockets (2nd / 3rd Law) Lab: Stomp Rocket (3rd Law) Resource: NASA Mass vs Weight Activity: Weight Calculator Lab: Friction of Different Surfaces Lab: Friction Board
Constant Speed Motion			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
How can you calculate the speed and velocity of an object? **How do we interpret motion graphs?** **What is the difference between speed and velocity?**	15	*Lesson 1: Speed* *Lesson 2: Velocity*	Activity: Using the Speed / Velocity Formula Activity: Interpreting Distance-Time Graphs Lab: Constant Speed Vehicle Lab: Speed Lab: Bowling Ball Gizmo: Measuring Motion Gizmo: Distance-Time Graphs PhET: Moving Man

			Activity: Finding the Slope of a Line Activity: Drawing Vectors Lab: Running / Throwing Speed
Acceleration			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
What happens to the motion of an object as it accelerates? **How can you calculate the acceleration of an object?**	13	*Lesson 1: Acceleration* *Lesson 2: Free-Fall*	Lab: Hopper Lab Lab: Determining Instantaneous Velocity Lab: Determining Acceleration Lab: Free Fall - Acceleration due to Gravity Gizmo: Free-Fall Laboratory Gizmo: Free-Fall Tower Demo: Shoot-n-Drop Activity: Using the Acceleration Formula PhET: Moving Man PhET: Forces and Motion Basics
Momentum			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
When does an object have momentum, and what factors impact momentum? **What happens when two objects collide?**	14		PhET: Collision Lab Gizmo: Crumple Zones Gizmo: Sled Wars Gizmo: Air Track Gizmo - 2D Collisions STEM Challenge: Straw Rockets

Unit 2 - Roller Coasters	
Time Frame:	46 Days

Next Generation Science Standards	
MS.PS2.4	Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.
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.PS3.5	Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
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.

NJSLS - Computer Science & Design Thinking Standards	
8.1.8.DA.5	Test, analyze, and refine computational models.
8.1.8.AP.2	Create clearly named variables that represent different data types and perform operations on their values.
8.2.8.ED.1	Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.
8.2.8.ED.2	Identify the steps in the design process that could be used to solve a problem.
8.2.8.ED.3	Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).
8.2.8.ED.5	Explain the need for optimization in a design process.
8.2.8.ED.6	Analyze how trade-offs can impact the design of a product.
8.2.8.ED.7	Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches).

Essential Questions
(What questions will the student be able to answer as a result of the instruction?)
1. What is energy? 2. What are the various forms of energy, and how does one form transform into another? 3. How can we determine if work has been done on an object? 4. What is kinetic energy, and how can we calculate how much kinetic energy an object has? 5. How is gravitational potential energy impacted by factors such as height, mass, and gravity?

6. How does the amount of potential energy an object has affect the amount of kinetic energy it moves with?
7. How can conservation of energy be used to predict an object's motion?
8. How do the concepts of kinetic energy and gravitational potential energy apply to the motion of a roller coaster?

Knowledge & Skills	
(What skills are needed to achieve the desired results?)	
By the end of this unit, students will know: ● How to identify various types of energy. ● How to work algebraically with mathematical formulas and solve real-world problems using them. ● How to increase or decrease kinetic and gravitational potential energy.	By the end of this unit, students will be able to: ● Identify the various types of energy and create maps to represent the flow of energy in a system. ● Explain how factors such as height, mass, and velocity impact kinetic and gravitational potential energy, and manipulate these factors to adjust the amount of energy in a system. ● Rearrange mathematical formulas and use them to solve real-world problems. ● Apply the concept of the Law of the Conservation of Energy to successfully complete a design challenge.

Scope and Sequence (Pacing Guide)			
What is Energy?			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
What is energy? **What are the various forms of energy, and how does one form transform into another?** **How can we determine if work has been done on an object?**	7	*Lesson 1: Types of Energy* *Lesson 2: Work*	Activity: Energy Forms and States Demonstrations Activity: Energy Detectives Gizmo: Energy Conversions Resource: Energy Minilabs Demo: Hand Crank Generator Gizmo: Energy Conversion in a System
Kinetic Energy			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
What is kinetic energy, and	11	*Lesson 1: Kinetic Energy*	Activity: Calculating Kinetic Energy

how can we calculate how much kinetic energy an object has?			Lab: Kinetic Energy Gizmo: Inclined Plane - Sliding Objects Gizmo: Air Track
Gravitational Potential Energy			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
How is gravitational potential energy impacted by factors such as height, mass, and gravity?	11	*Lesson 1: Gravitational Potential Energy*	Activity: Calculating Gravitational Potential Energy Lab: Gravitational Potential Energy Lab: Ball Bounce Gizmo: Potential Energy on Shelves
Conservation of Energy			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
How does the amount of potential energy an object has affect the amount of kinetic energy it moves with? **How can conservation of energy be used to predict an object's motion?**	9	*Lesson 1: Conservation of Energy*	Gizmo: Trebuchet Lab: Conservation of Energy PhET: Energy Skate Park Gizmo: Energy of a Pendulum
Designing and Building Roller Coasters			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
How do the concepts of kinetic energy and gravitational potential energy apply to the motion of a roller coaster?	8	*Lesson 1: Design a Roller Coaster*	Gizmo: Roller Coaster Physics (Technology) STEM Challenge: Marble Roller Coaster (Technology)

Unit 3 - Mobile Phones	
Time Frame:	52 Days

Next Generation Science Standards	
MS.PS4.1	Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave.
MS.PS4.2	Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.
MS.PS4.3	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.
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.

NJSLS - Computer Science & Design Thinking Standards	
8.1.8.CS.1	Recommend improvements to computing devices in order to improve the ways users interact with the devices.
8.1.8.CS.2	Design a system that combines hardware and software components to process data.
8.1.8.CS.3	Justify design decisions and explain potential system trade-offs.
8.1.8.CS.4	Systematically apply troubleshooting strategies to identify and resolve hardware and software problems in computing systems.
8.1.8.NI.1	Model how information is broken down into smaller pieces, transmitted as addressed packets through multiple devices over networks and the Internet, and reassembled at the destination.
8.1.8.DA.2	Explain the difference between how the computer stores data as bits and how the data is displayed.
8.1.8.AP.1	Design and illustrate algorithms that solve complex problems using flowcharts and/or pseudocode.
8.1.8.AP.3	Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals.
8.1.8.AP.4	Decompose problems and sub-problems into parts to facilitate the design, implementation, and review of programs.
8.1.8.AP.5	Create procedures with parameters to organize code and make it easier to reuse.
8.1.8.AP.6	Refine a solution that meets users' needs by incorporating feedback from team members and users.
8.1.8.AP.7	Design programs, incorporating existing code, media, and libraries, and give attribution.
8.1.8.AP.8	Systematically test and refine programs using a range of test cases and users.
8.1.8.AP.9	Document programs in order to make them easier to follow, test, and debug.
8.1.8.ITH.2	Compare how technologies have influenced society over time.

Essential Questions
(What questions will the student be able to answer as a result of the instruction?)
1. What makes up a wave? 2. How does the amplitude of a wave relate to the amount of energy in the wave? 3. How are waves reflected by, absorbed by, or transmitted through various materials?

4. How does sound travel?
5. What factors impact the sounds that we hear?
6. What are the differences between mechanical waves and electromagnetic waves?
7. What causes electricity and magnetism?
8. How do analog signals differ from digital signals?
9. Why are digitized signals a more reliable way to encode and transmit information than analog signals?
10. How do cell phones utilize digital signals to transmit and display data?

Knowledge & Skills	
(What skills are needed to achieve the desired results?)	
By the end of this unit, students will know: ● What makes up a wave. ● How the amplitude of a wave is related to the energy of the wave. ● How waves behave when they come into contact with various surfaces. ● The differences between mechanical and electromagnetic waves. ● The differences between analog and digital signals. ● The benefits of transmitting information digitally.	By the end of this unit, students will be able to: ● Explain the relationship between the amplitude of a wave and the wave's energy. ● Develop and use models to describe how waves behave when they come in contact with various surfaces. ● Make and support the claim that digital signals are a more reliable way to transmit data than analog signals. ● Design and debug a mobile app.

Scope and Sequence (Pacing Guide)			
What are Waves?			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
What makes up a wave? **How does the amplitude of a wave relate to the amount of energy in the wave?** **How are waves reflected by, absorbed by, or transmitted through various materials?**	15	*Lesson 1: Types of Waves and Their Parts* *Lesson 2: Wave Behavior*	Lab: Waves Lab: Underwater Go Pro Activity: Using Prisms Activity: Homemade Spectroscope (About Spectroscopes) Lab: Light Maze Lab: Mirror Maze Lab: Light Absorption and Color Filters

			Gizmo: Waves Gizmo: Basic Prism Gizmo: Color Absorption Gizmo: Eyes and Vision - Seeing Color Gizmo: Heat Absorption Gizmo: Laser Reflection Gizmo: Longitudinal Waves Gizmo: Radiation Gizmo: Refraction Gizmo: Ripple Tank PhET: Wave on a String PhET: Waves Intro PhET: Wave Interference PhET: Bending Light PhET: Color Vision
Sound Waves			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
How does sound travel? **What factors impact the sounds that we hear?**	10	*Lesson 1: Sound and Mechanical Waves* *Lesson 2: Properties of Sound Waves* *Lesson 3: Behavior of Sound Waves - Interference and the Doppler Effect*	Lab: Guitar Lab Ideas: Acoustics Activity: String Telephone Activity: Tuning Fork Video: TEDTalk - How to truly listen Activity: Calculating the Speed of Sound Activity: Echolocation Demo: Tuning Fork Interference (Video Reference) Demo: Doppler Ball

Electromagnetic Waves			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
What are the differences between mechanical waves and electromagnetic waves? **What causes electricity and magnetism?**	10	*Lesson 1: What are Electromagnetic Waves?* *Lesson 2: Electricity & Magnetism*	Research: Electromagnetic Waves (Teacher 1) (Teacher 2) (Student) Activity: Solar Oven PhET: John Travoltage PhET: Charges & Fields PhET: Balloons & Static Electricity Activities: Electric Circuits Activity: Electricity & Magnetism - Whose Field Line Is It, Anyway? Gizmo: Circuit Builder Gizmo: Magnetism
Digital Signals			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
How do analog signals differ from digital signals? **Why are digitized signals a more reliable way to encode and transmit information than analog signals?**	9	*Lesson 1: Analog Signals* *Lesson 2: Digital Signals*	Lab: Telegraph Demo: Digital Signals Lab: Analog v Digital Signals WKST: Binary Code Activity: Digital v Analog Signals
Mobile Phones			
NJCTL Documents			
Essential Questions	**Days**	**Lessons**	**Suggested Activities**
How do cell phones utilize digital signals to transmit and display data?	8	*Lesson 1: Mobile Apps*	Activity: Create Your Own Mobile App - Thunkable