Biology, Chemistry & Physics Curriculum

Middle Township Public Schools
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High School Science Curriculum Work Committee

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Introduction

This document serves to meet all requirements for curriculum as per the Middle Township Board of Education and the New Jersey Department of Education and will serve as a guide for lesson planning. Units within the curricular framework for science are designed to be taught in the order in which they are presented. Within the units, the teachers have flexibility of what order to present the standards. Suggested Science and Engineering Practice Standards and Cross-Cutting Concepts are listed in each unit to be imbedded regularly in daily science instruction.

Course Description

Biology is focused on the use of life science principles as powerful tools to make sense of the complexity, diversity, and interconnectedness of life on earth. Students engage in laboratory and authentic learning experiences that encourage the application of biological knowledge to make decisions and solve problems. Biology fulfills the New Jersey science requirements for high school graduation. Application of the Next Generation Science Standards results in a balance of the three dimensions of the standards along with a focus on the interdisciplinary nature of all science domains among one another as well as with the New Jersey Student Learning Standards for Mathematics and English Language Arts.

Three Dimensions of the Next Generation Science Standards

The National Research Council's (NRC) *Framework* describes a vision of what it means to be proficient in science; it rests on a view of science as both a body of knowledge and an evidence-based, model and theory building enterprise that continually extends, refines, and revises knowledge. It presents three dimensions that will be combined to form each standard:

Dimension 1: Practices

The practices describe behaviors that scientists engage in as they investigate and build models and theories about the natural world and the key set of engineering practices that engineers use as they design and build models and systems. The NRC uses the term practices instead of a term like “skills” to emphasize that engaging in scientific investigation requires not only skill but also knowledge that is specific to each practice. Part of the NRC’s intent is to better explain and extend what is meant by “inquiry” in science and the range of cognitive, social, and physical practices that it requires.

Although engineering design is similar to scientific inquiry, there are significant differences. For example, scientific inquiry involves the formulation of a question that can be answered through investigation, while engineering design involves the formulation of a problem that can be solved through design. Strengthening the engineering aspects of the Next Generation Science Standards will clarify for students the relevance of science, technology, engineering and mathematics (the four STEM fields) to everyday life.

Dimension 2: Crosscutting Concepts

Crosscutting concepts have application across all domains of science. As such, they are a way of linking the different domains of science. They include: Patterns, similarity, and diversity; Cause and effect; Scale, proportion and quantity; Systems and system models; Energy and matter; Structure and function; Stability and change. The Framework emphasizes that these concepts need to be made explicit for students because they

provide an organizational schema for interrelating knowledge from various science fields into a coherent and scientifically-based view of the world.

Dimension 3: Disciplinary Core Ideas

Disciplinary core ideas have the power to focus K–12 science curriculum, instruction and assessments on the most important aspects of science. To be considered core, the ideas should meet at least two of the following criteria and ideally all four:

- Have **broad importance** across multiple sciences or engineering disciplines or be a **key organizing concept** of a single discipline;
- Provide a **key tool** for understanding or investigating more complex ideas and solving problems;
- Relate to the **interests and life experiences of students** or be connected to **societal or personal concerns** that require scientific or technological knowledge;
- Be **teachable** and **learnable** over multiple grades at increasing levels of depth and sophistication.

Disciplinary ideas are grouped in four domains: the physical sciences; the life sciences; the earth and space sciences; and engineering, technology and applications of science.

Content Area:	Biology	Grade(s) 9, 10
Unit Plan Title:	Unit 1 - Matter and Energy Transformation in Ecosystems	

Overview/Rationale

In this unit of study, students construct explanations for the role of energy in the cycling of matter in organisms and ecosystems. They apply mathematical concepts to develop evidence to support explanations of the interactions of photosynthesis and cellular respiration, and they will develop models to communicate these explanations. Students also understand organisms' interactions with each other and their physical environment and how organisms obtain resources. Students utilize the crosscutting concepts of matter and energy and systems, and system models to make sense of ecosystem dynamics. Students are expected to construct explanations for the role of energy in the cycling of matter in organisms and ecosystems. They apply mathematical concepts to develop evidence to support explanations as they demonstrate their understanding of the disciplinary core ideas.

Science Standards (Established Goals)

Disciplinary Core Ideas

LS1.C – Organization for Matter and Energy Flow in Organisms

- The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. (HS-LS1-1)

LS2.B – Cycles of Matter and Energy Transfer in Ecosystems

- Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. (HS-LS2-3)
- Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. (HS-LS2-4)

- Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. (HS-LS2-5)

Science and Engineering Practices

SEP-2: Developing and Using Models
- Develop a model based on evidence to illustrate the relationships between systems or components of a system. (HS-LS1-5),(HS-LS2-5)

SEP-5: Using Mathematics and Computational Thinking
- Use mathematical representations of phenomena or design solutions to support claims. (HS-LS2-4)

SEP-6: Constructing Explanations and Designing Solutions
- Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-LS2-3)

Cross-Cutting Concepts

CCC-4: Systems and System Models
- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. (HS-LS2-5)

CCC-5: Energy and Matter
- Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-LS1-1)
- Energy drives the cycling of matter within and between systems. (HS-LS2-3)
- Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems. (HS-LS2-4)

CCC-6: Structure and Function

CCC-7: Stability and Change

Technology Standard(s)

8.1.12.C.1 – Develop an innovative solution to a real world problem or issue in collaboration with peers and experts, and present ideas for feedback through social media or in an online community.

8.1.12.E.1 – Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts synthesizing information from multiple sources.

Interdisciplinary Standard(s)

English Language Arts

RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-LS2-3)
SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-LS1-5)

Mathematics

MP.2 Reason abstractly and quantitatively. (HS-LS2-4)
MP.4 Model with mathematics (HS-LS2-4)
HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-LS2-4)
HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. (HS-LS2-4)
HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HSLS2-4)

Enduring Understandings: (What are the big ideas? What specific understandings about them are desired? What misunderstandings are predictable?)

What molecules are important for life?
How does sunlight energy move through and ecosystem?

Essential Question(s) : (What provocative questions will foster inquiry, understanding, and transfer of learning?)

What are organic molecules?
How are organic molecules put together?

How is ATP used for energy transfer?
What are carbohydrates?
How are proteins arranged and assembled?
What makes lipids effective energy storage compounds?
What is a nucleic acid?
How are organic molecules used by living organisms?
How are producers adapted to capture sunlight energy?
How is sunlight energy captured?
How do organisms break down food to release energy?

In this unit plan, the following 21st Century themes and skills are addressed:

Check all that apply.	**21st Century Themes**	*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*	**21st Century Skills**
	Global Awareness	**A**	**Critical Thinking & Problem Solving**
	Environmental Literacy	**E**	**Creativity and Innovation**
X	**Health Literacy**	**E**	**Collaboration, Teamwork and Leadership**
	Civic Literacy	**E**	**Cross-Cultural and Interpersonal Communication**
	Financial, Economic, Business and Entrepreneurial Literacy	**E**	**Communication and Media Fluency**
		E	**Accountability, Productivity and Ethics**

In this unit plan, the following Career Ready Practices are addressed:

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

	CRP1. Act as a responsible and contributing citizen and employee
	CRP2. Apply appropriate academic and technical skills

		CRP3. Attend to personal health and financial well-being
		CRP4. Communicate clearly and effectively with reason
	A	**CRP5. Consider the environmental, social and economic impacts of decisions**
		CRP6. Demonstrate creativity and innovation
		CRP7. Employ valid and reliable research strategies
		CRP8. Utilize critical thinking to make sense of problems and persevere in solving them
		CRP9. Model integrity, ethical leadership and effective management
		CRP10. Plan education and career paths aligned to personal goals
		CRP11. Use technology to enhance productivity
		CRP12. Work productively in teams while using cultural global competence

Student Learning Goals/Objectives: (What key knowledge and skills will students acquire as a result of this unit? What should they eventually be able to do as a result of such knowledge and skill?)

Students will know…	***Students will be able to (do)…***
The structure and function of different organic molecules. How sunlight energy is captured and how it provides energy for all life.	Explain how organisms use organic molecules for life processes and relate the importance of protecting all levels of an ecosystem to maintain a healthy environment

Assessment Evidence:

Performance Tasks: *(Through what authentic performance tasks will students demonstrate the desired understandings? By what criteria will performances of understanding be judged?)*	**Other Assessment Measures*:*** *(Through what other evidence (E.g. quizzes, tests, academic prompts, observations, homework, journals, etc.) will students demonstrate achievement of the desired results? How will students reflect upon and self- assess their learning?)* ******Attach all Benchmarks***
Lab activities/reports will be used to assess student performance. Lab	

activities will include a photosynthesis lab, peanut calorie lab, pH and buffer lab, identifying organic compounds lab, diffusion lab, and osmosis lab. These labs will require students to use apparatuses and models that show how photosynthesis works and is affected by environmental conditions.	Tests/quizzes, homework, closure activities

Teaching and Learning Actions: (What learning experiences and instruction will enable students to achieve the desired results?

Instructional Strategies and Activities *D*	***Consider how will the design will:*** **W** = Help the students know Where the unit is going and What is expected? Help the teacher know Where the students are coming from (prior knowledge and interests)? **H**= Hook all students and Hold their interest? **E**= Equip students, help the Experience the key ideas and Explore the issue? **R**=Provide opportunities to Rethink and Revise their understandings and work? **E**=Allow students to Evaluate their work and its implications? **T**=be Tailored (personalized to the different needs, interests and abilities of learners? **O**=be Organized to maximize initial and sustained engagement as well as effective learning? The classroom will have a student learning map posted. This will outline the unit and provide the Unit Essential questions and all Lesson Essential Questions. With this, students will know the sequence of objectives they will be following. Each lesson will begin with a warm up activity designed to tie previous learning with information about to be covered. All lessons will include opportunities for guided practice, independent practice, group work, and a lab activity designed to encourage questions that guide students to delve deeper into a topic. Students will receive differentiated instruction to meet their different needs. Each lesson will conclude with a closure activity to allow students to evaluate their learning. Other modifications as needed *- See NGSS Appendix D: All Standards, All Students/Case Studies for vignettes and explanations of the modifications.)* • Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and

	biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable phenomena. • Structure the learning around explaining or solving a social or community-based issue. • Provide ELL students with multiple literacy strategies. • Collaborate with after-school programs or clubs to extend learning opportunities. • Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA).
Resources	
Textbook and online video sources	
Suggested Time Frame:	30 Days

D – Indicates differentiation at the Lesson Level (Identify Modifications for ELL, Gifted and Talented, Title 1, Special Education)

Content Area:	**Biology**	**Grade(s)**
Unit Plan Title:	**Unit 2 - Interdependent Relationships in Ecosystems**	
Overview/Rationale		
In this unit of study, students formulate answers to the question "how and why do organisms interact with each other (biotic factors) and relationships in ecosystems; dynamics of ecosystems; and functioning, resilience, and social interactions, including group behavior. Students use mathematical reasoning and models to make sense of carrying capacity, factors affecting biodiversity and populations, the cycling of matter and flow of energy through systems. The crosscutting concepts of scale, proportion, and quantity and stability and change are called out as organizing concepts for the disciplinary core ideas. Students are expected to use mathematical reasoning and models to demonstrate proficiency with the disciplinary core ideas.		
Science Standards (Established Goals)		

DCIs
LS2.A: Interdependent Relationships in Ecosystems LS2.C: Ecosystem Dynamics, Functioning, and Resilience
SEPs
Practice 2 – Using Mathematics and Computational Thinking **Practice 7 – Engaging in Argument from Evidence**
CCCs
3 – Scale, Proportion, and Quantity **7 – Stability and Change**
Technology Standard(s)
8.1.12.C.1 – Develop an innovative solution to a real world problem or issue in collaboration with peers and experts, and present ideas for feedback through social media or in an online community. 8.1.12.E.1 – Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts synthesizing information from multiple sources.
Interdisciplinary Standard(s)
Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps

or inconsistencies in the account. **RST.11-12.1** (HS-LS2-1),(HS-LS2-2),(HS-LS2-6)

Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. **RST.11-12.7** (HS-LS2-6)

Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. **RST.11-12.8** (HS-LS2-6)

Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. **WHST.9-12.2** (HS-LS2-1),(HS-LS2-2)

Reason abstractly and quantitatively. **MP.2** (HS-LS2-1),(HS-LS2-2),(HS-LS2-6)

Model with mathematics. **MP.4 (**HS-LS2-1),(HS-LS2-2)

Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays**. HSN.Q.A.1** (HS-LS2-1),(HS-LS2-2)

Define appropriate quantities for the purpose of descriptive modeling. **HSN.Q.A.2** (HS-LS2-1),(HS-LS2-2)

Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. **HSN.Q.A.3** (HS-LS2-1),(HS-LS2-2)

Represent data with plots on the real number line. HSS-ID.A.1 (HS-LS2-6)

Understand statistics as a process for making inferences about population parameters based on a random sample from that population. **HSS-IC.A.1** (HS-LS2-6)

Enduring Understandings: (What are the big ideas? What specific understandings about them are desired? What misunderstandings are predictable?)

How are ecosystems organized to provide energy flow?

Essential Question(s) : (What provocative questions will foster inquiry, understanding, and transfer of learning?)

How are ecosystems organized?
What are producers, consumers, and decomposers?
How does an energy pyramid explain energy flow through an ecosystem?
What types of interactions between different species are in ecosystems?
How are populations of different species arranged?
What are the major biomes of the world?
How are temperature and precipitation important in determining a biome?

In this unit plan, the following 21st Century themes and skills are addressed:

Check all that apply.

21st Century Themes

X	**Global Awareness**
X	**Environmental Literacy**
	Health Literacy
X	**Civic Literacy**

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

21st Century Skills

A	**Critical Thinking & Problem Solving**
E	**Creativity and Innovation**
E	**Collaboration, Teamwork and Leadership**
E	**Cross-Cultural and Interpersonal Communication**

	Financial, Economic, Business and Entrepreneurial Literacy	E	Communication and Media Fluency
		E	Accountability, Productivity and Ethics

In this unit plan, the following Career Ready Practices are addressed:

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

	CRP1. Act as a responsible and contributing citizen and employee
	CRP2. Apply appropriate academic and technical skills
	CRP3. Attend to personal health and financial well-being
	CRP4. Communicate clearly and effectively with reason
E	**CRP5. Consider the environmental, social and economic impacts of decisions**
	CRP6. Demonstrate creativity and innovation
	CRP7. Employ valid and reliable research strategies
	CRP8. Utilize critical thinking to make sense of problems and persevere in solving them
	CRP9. Model integrity, ethical leadership and effective management
	CRP10. Plan education and career paths aligned to personal goals
	CRP11. Use technology to enhance productivity
	CRP12. Work productively in teams while using cultural global competence

Student Learning Goals/Objectives: (What key knowledge and skills will students acquire as a result of this unit? What should they eventually be able to do as a result of such knowledge and skill?)

Students will know….	***Students will be able to (do)…***
There are different levels of organization in ecosystems. Energy moves through ecosystems from producers to top level consumers and onto decomposers.	Explain why it is important to have producers for an ecosystem to exist. Explain why it is important to care for all levels of an ecosystem

Temperature and precipitation control variety/abundance of life in an area.	to ensure the health of that ecosystem.
Assessment Evidence:	
Performance Tasks: *(Through what authentic performance tasks will students demonstrate the desired understandings? By what criteria will performances of understanding be judged?)* Lab activities will include a project to examine our specific ecosystem involving the salt marsh. They will also participate in activities that investigate the relationship between climate of different areas and the life that is found there. Another activity will be a detailed list of related organisms in an ecosystem and how energy flows among them.	**Other Assessment Measures:** *(Through what other evidence (E.g. quizzes, tests, academic prompts, observations, homework, journals, etc.) will students demonstrate achievement of the desired results? How will students reflect upon and self- assess their learning?)* ******Attach all Benchmarks*** Tests/quizzes, homework, closure activities
Teaching and Learning Actions: (What learning experiences and instruction will enable students to achieve the desired results?	
Instructional Strategies and Activities *D*	***Consider how will the design will:*** **W** = Help the students know Where the unit is going and What is expected? Help the teacher know Where the students are coming from (prior knowledge and interests)? **H**= Hook all students and Hold their interest? **E**= Equip students, help the Experience the key ideas and Explore the issue? **R**=Provide opportunities to Rethink and Revise their understandings and work? **E**=Allow students to Evaluate their work and its implications? **T**=be Tailored (personalized to the different needs, interests and abilities of learners? **O**=be Organized to maximize initial and sustained engagement as well as effective learning?

	The classroom will have a student learning map posted. This will outline the unit and provide the Unit Essential questions and all Lesson Essential Questions. With this, students will know the sequence of objectives they will be following. Each lesson will begin with a warm up activity designed to tie previous learning with information about to be covered. All lessons will include opportunities for guided practice, independent practice, group work, and a lab activity designed to encourage questions that guide students to delve deeper into a topic. Students will receive differentiated instruction to meet their different needs. Each lesson will conclude with a closure activity to allow students to evaluate their learning.
Resources	
Textbook and online video sources	
Suggested Time Frame:	20 days

D – Indicates differentiation at the Lesson Level (Identify Modifications for ELL, Gifted and Talented, Title 1, Special Education)

Content Area:	**Biology**	**Grade(s)**
Unit Plan Title:	**Unit 3 - Human Activity and Climate**	
Overview/Rationale		
In this unit of study, students examine factors that have influenced the distribution and development of human society; these factors include climate, natural resource availability, and natural disasters. Students use computational representations to analyze how earth systems and their relationships are being modified by human activity. Students also develop an understanding of how human activities affect natural resources and of the interdependence between humans and Earth's systems, which affect the availability of natural resources. Students will apply their engineering capabilities to reduce human impacts on earth systems and improve social and environmental cost–benefit ratios. The crosscutting concepts of cause and effect, systems and systems models, stability and change, and the influence of engineering, technology, and science on society and the natural world are called out as organizing concepts for the disciplinary core ideas. Students will analyze and interpret data, use mathematical and computational thinking, and construct explanations as they demonstrate understanding of the disciplinary core ideas.		

Science Standards (Established Goals)
DCIs
ESS3.A Natural Resources ESS3.B Natural Hazards ESS2.D Weather and Climate ESS3.D Global Climate Change ETS1.B Developing Possible Solutions
SEPs
4 – Analyze and Interpret Data 5 – Using Mathematics and Computational Thinking 6 – Constructing Explanations and Designing Solutions
CCCs
2 – Cause and Effect: Mechanisms and Explanations 4 – Systems and System Models 7 – Stability and Change
Technology Standard(s)
8.1.12.C.1 – Develop an innovative solution to a real world problem or issue in collaboration with peers and experts, and present ideas for feedback through social media or in an online community. 8.1.12.E.1 – Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts synthesizing information from multiple sources.
Interdisciplinary Standard(s)
Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps

or inconsistencies in the account. **RST.11-12.1** (HS-ETS1-3)

Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. **RST.11-12.7** (HS-ETS1-3)

Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. **RST.11-12.8** (HS-ETS1-3)

Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. **RST.11-12.9** (HS-ETS1-3).

Reason abstractly and quantitatively. **MP.2** (HS-LS2-1),(HS-LS2-2),(HS-LS2-6),(HS-LS2-7)

Model with mathematics. **MP.4** (HS-ETS1-3)

Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays**. HSN.Q.A.1** (HS-ETS1-3).

Define appropriate quantities for the purpose of descriptive modeling. **HSN.Q.A.2** (HS-ETS1-3).

Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. **HSN.Q.A.3** (HS-ETS1-3).

Enduring Understandings: (What are the big ideas? What specific understandings about them are desired? What misunderstandings are predictable?)

How do humans depend on Earth's resources?
How and why do humans interact with their environment and what are the effects of these interactions?

Essential Question(s) : (What provocative questions will foster inquiry, understanding, and transfer of learning?)

What types of resources do humans use from their environment?
What types of actions do humans undertake to harvest resources from the environment?
What impact do actions such as fishing, mining, farming, etc. have on ecosystems?
How can human actions be mitigated to reduce environmental impact?
How would mitigating actions affect local economies around the world?

In this unit plan, the following 21st Century themes and skills are addressed:

Check all that apply. 21st Century Themes		*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* 21st Century Skills	
X	Global Awareness	A	Critical Thinking & Problem Solving
	Environmental Literacy	A	Creativity and Innovation
X	Health Literacy	A	Collaboration, Teamwork and Leadership
	Civic Literacy	A	Cross-Cultural and Interpersonal Communication
X	Financial, Economic, Business and Entrepreneurial Literacy		Communication and Media Fluency
		A	Accountability, Productivity and Ethics

In this unit plan, the following Career Ready Practices are addressed:

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

	CRP1. Act as a responsible and contributing citizen and employee
	CRP2. Apply appropriate academic and technical skills

	CRP3. Attend to personal health and financial well-being
	CRP4. Communicate clearly and effectively with reason
E	**CRP5. Consider the environmental, social and economic impacts of decisions**
	CRP6. Demonstrate creativity and innovation
	CRP7. Employ valid and reliable research strategies
	CRP8. Utilize critical thinking to make sense of problems and persevere in solving them
	CRP9. Model integrity, ethical leadership and effective management
	CRP10. Plan education and career paths aligned to personal goals
	CRP11. Use technology to enhance productivity
	CRP12. Work productively in teams while using cultural global competence

Student Learning Goals/Objectives: (What key knowledge and skills will students acquire as a result of this unit? What should they eventually be able to do as a result of such knowledge and skill?)

Students will know….	***Students will be able to (do)…***
How their lifestyles create a burden on Earth's resources. How the harvest of those resources can affect Earth's climate.	Create solutions to problems caused by overuse of Earth's resources.

Assessment Evidence:

Performance Tasks: *(Through what authentic performance tasks will students demonstrate the desired understandings? By what criteria will performances of understanding be judged?)*	**Other Assessment Measures***: (Through what other evidence (E.g. quizzes, tests, academic prompts, observations, homework, journals, etc.) will students demonstrate achievement of the*

Students will work in groups to complete a webquest that focuses on a specific issue of resource overuse. They will report on how it is done, what impact it has, and what can be done to lessen that impact.	*desired results? How will students reflect upon and self- assess their learning?)* ******Attach all Benchmarks*** Tests/quizzes, homework, closure activities
Teaching and Learning Actions: (What learning experiences and instruction will enable students to achieve the desired results?	
Instructional Strategies and Activities *D*	***Consider how will the design will:*** **W** = Help the students know Where the unit is going and What is expected? Help the teacher know Where the students are coming from (prior knowledge and interests)? **H**= Hook all students and Hold their interest? **E**= Equip students, help the Experience the key ideas and Explore the issue? **R**=Provide opportunities to Rethink and Revise their understandings and work? **E**=Allow students to Evaluate their work and its implications? **T**=be Tailored (personalized to the different needs, interests and abilities of learners? **O**=be Organized to maximize initial and sustained engagement as well as effective learning? The classroom will have a student learning map posted. This will outline the unit and provide the Unit Essential questions and all Lesson Essential Questions. With this, students will know the sequence of objectives they will be following. Each lesson will begin with a warm up activity designed to tie previous learning with information about to be covered. All lessons will include opportunities for guided practice, independent practice, group work, and a lab activity designed to encourage questions that guide students to delve deeper into a topic. Students will receive differentiated instruction to meet their different needs. Each lesson will conclude with a closure activity to allow students to evaluate their learning.
Resources	

Textbook and online access	
Suggested Time Frame:	15 days

D – Indicates differentiation at the Lesson Level (Identify Modifications for ELL, Gifted and Talented, Title 1, Special Education)

Content Area:	**Biology**	**Grade(s)**
Unit Plan Title:	**Unit 4- Human Activity and Biodiversity**	

Overview/Rationale

In this unit of study, mathematical models provide support for students' conceptual understanding of systems and students' ability to design, evaluate, and refine solutions for reducing the impact of human activities on the environment and maintaining biodiversity. Students create or revise a simulation to test solutions for mitigating adverse impacts of human activity on biodiversity. Crosscutting concepts of systems and system models play a central role in students' understanding of science and engineering practices and core ideas of ecosystems. Mathematical models also provide support for students' conceptual understanding of systems and their ability to develop design solutions for reducing the impact of human activities on the environment and maintaining biodiversity.

Science Standards (Established Goals)

DCIs

ESS3.C – Human Impacts on Earth Systems
LS2.C – Ecosystem Dynamics, Functioning, and Resilience
LS4.C – Adaptation
LS4.D – Biodiversity and Humans
ETS1B – Developing Possible Solutions
ETS1.C – Optimizing the Design Solution

SEPs

1 – Asking Questions and Defining Problems
5 – Using Mathematics and Computational Thinking

CCCs

4 – Systems and System Models
7 – Stability and Change

Technology Standard(s)

8.1.12.C.1 – Develop an innovative solution to a real world problem or issue in collaboration with peers and experts, and present ideas for feedback through social media or in an online community.
8.1.12.E.1 – Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts synthesizing information from multiple sources.

Interdisciplinary Standard(s)

Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. **RST.11-12.7** (HS-LS2-7)

Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. **RST.11-12.8** (HS-ETS1-3)

Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. **RST.11-12.9** (HS-ETS1-3).

Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most

significant for a specific purpose and audience. WHST.9-12.5 (HSLS4-6).

Reason abstractly and quantitatively. **MP.2** (HS-LS2-7), (HS-ETS1-3)

Model with mathematics. **MP.4** (HS-ETS1-3)

Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. **HSN.Q.A.1** (HS-LS2-7)

Define appropriate quantities for the purpose of descriptive modeling. **HSN.Q.A.2** (HS-ETS1-3)

Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. **HSN.Q.A.3** (HS-ETS1-3)

Enduring Understandings: (What are the big ideas? What specific understandings about them are desired? What misunderstandings are predictable?)

Life on Earth is a finite and fragile resource and we need to understand that human activity can irreparably upset a system that has taken eons to produce.

Essential Question(s) : (What provocative questions will foster inquiry, understanding, and transfer of learning?)

How does habitat destruction, pollution, introduction of invasive species, overexploitation and climate change disrupt ecosystems?
How do humans depend on their environment to live?
What changes will need to be made for humans to live in an environment that we do great damage to?
How can the problems we have created be turned around?

In this unit plan, the following 21st Century themes and skills are addressed:

Check all that apply. 21st Century Themes			*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* 21st Century Skills	
X	Global Awareness		T	Critical Thinking & Problem Solving
X	Environmental Literacy		T	Creativity and Innovation
X	Health Literacy		T	Collaboration, Teamwork and Leadership
X	Civic Literacy			Cross-Cultural and Interpersonal Communication
X	Financial, Economic, Business and Entrepreneurial Literacy			Communication and Media Fluency
			E	Accountability, Productivity and Ethics

In this unit plan, the following Career Ready Practices are addressed:

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

T	CRP1. Act as a responsible and contributing citizen and employee
	CRP2. Apply appropriate academic and technical skills
	CRP3. Attend to personal health and financial well-being
	CRP4. Communicate clearly and effectively with reason
	CRP5. Consider the environmental, social and economic impacts of decisions
	CRP6. Demonstrate creativity and innovation
	CRP7. Employ valid and reliable research strategies
	CRP8. Utilize critical thinking to make sense of problems and persevere in solving them
	CRP9. Model integrity, ethical leadership and effective management

		CRP10. Plan education and career paths aligned to personal goals
		CRP11. Use technology to enhance productivity
		CRP12. Work productively in teams while using cultural global competence

Student Learning Goals/Objectives: (What key knowledge and skills will students acquire as a result of this unit? What should they eventually be able to do as a result of such knowledge and skill?)

Students will know….	***Students will be able to (do)…***
How human activity can alter biodiversity	Offer solutions to limit problems with biodiversity

Assessment Evidence:

Performance Tasks: *(Through what authentic performance tasks will students demonstrate the desired understandings? By what criteria will performances of understanding be judged?)*	**Other Assessment Measures*:*** *(Through what other evidence (E.g. quizzes, tests, academic prompts, observations, homework, journals, etc.) will students demonstrate achievement of the desired results? How will students reflect upon and self- assess their learning?)* ******Attach all Benchmarks***
Students will work in groups to complete a webquest that focuses on a specific issue of biodiversity loss. They will report on how it is occurs, what the impact it has, and what can be done to lessen that impact.	Tests, Quizzes, Homework, Closure Activities

Teaching and Learning Actions: (What learning experiences and instruction will enable students to achieve the desired results?	
Instructional Strategies and Activities *D*	***Consider how will the design will:*** **W** = Help the students know Where the unit is going and What is expected? Help the teacher know Where the students are coming from (prior knowledge and interests)? **H**= Hook all students and Hold their interest? **E**= Equip students, help the Experience the key ideas and Explore the issue? **R**=Provide opportunities to Rethink and Revise their understandings and work? **E**=Allow students to Evaluate their work and its implications? **T**=be Tailored (personalized to the different needs, interests and abilities of learners? **O**=be Organized to maximize initial and sustained engagement as well as effective learning? The classroom will have a student learning map posted. This will outline the unit and provide the Unit Essential questions and all Lesson Essential Questions. With this, students will know the sequence of objectives they will be following. Each lesson will begin with a warm up activity designed to tie previous learning with information about to be covered. All lessons will include opportunities for guided practice, independent practice, group work, and a lab activity designed to encourage questions that guide students to delve deeper into a topic. Students will receive differentiated instruction to meet their different needs. Each lesson will conclude with a closure activity to allow students to evaluate their learning.
Resources	
Textbook and online access	
Suggested Time Frame:	15 days

D – Indicates differentiation at the Lesson Level (Identify Modifications for ELL, Gifted and Talented, Title 1, Special Education)

Content Area:	**Biology**	**Grade(s)**
Unit Plan Title:	**Unit 5 - Cell Specialization and Homeostasis**	

Overview/Rationale
Students formulate an answer to the question “How do the structures of organisms enable life’s functions?” Students investigate explanations for the structure and functions of cells as the basic unit of life, of hierarchical organization of interacting organ systems, and of the role of specialized cells for maintenance and growth. The crosscutting concepts of structure and function, matter and energy, and systems and system models are called out as organizing concepts for the disciplinary core ideas. Students use critical reading, modeling, and conducting investigations. Students also use the science and engineering practices to demonstrate understanding of the disciplinary core ideas
Science Standards (Established Goals)
DCIs
LS1.A: Structure and Function
SEPs
Constructing Explanations and Designing Solutions Developing and Using Models Planning and Carrying Out Investigations
CCCs
Systems and System Models Stability and Change
Technology Standard(s)
8.1.12.C.1 – Develop an innovative solution to a real world problem or issue in collaboration with peers and experts, and present ideas for feedback

through social media or in an online community.
8.1.12.E.1 – Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts synthesizing information from multiple sources.

Interdisciplinary Standard(s)

Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. **WHST.9-12.7** (HS-LS1-3)

Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. **WHST.11-12.8** (HS-LS1-3)

Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. **SL.11-12.5** (HS-LS1-2)

Enduring Understandings: (What are the big ideas? What specific understandings about them are desired? What misunderstandings are predictable?)

How do the structures of organisms enable life's functions?

Essential Question(s) : (What provocative questions will foster inquiry, understanding, and transfer of learning?)

What are organic molecules?
How are organic molecules put together?

How is ATP used for energy transfer?
What are carbohydrates?
How are proteins arranged and assembled?
What makes lipids effective energy storage compounds?
What is a nucleic acid?
How are organic molecules used by living organisms?

In this unit plan, the following 21st Century themes and skills are addressed:

Check all that apply.		**21st Century Themes**	*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*	**21st Century Skills**
		Global Awareness	**A**	**Critical Thinking & Problem Solving**
		Environmental Literacy	**E**	**Creativity and Innovation**
	X	**Health Literacy**	**E**	**Collaboration, Teamwork and Leadership**
		Civic Literacy	**E**	**Cross-Cultural and Interpersonal Communication**
		Financial, Economic, Business and Entrepreneurial Literacy	**T**	**Communication and Media Fluency**
			T	**Accountability, Productivity and Ethics**

In this unit plan, the following Career Ready Practices are addressed:

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

		CRP1. Act as a responsible and contributing citizen and employee
		CRP2. Apply appropriate academic and technical skills
		CRP3. Attend to personal health and financial well-being
		CRP4. Communicate clearly and effectively with reason

		CRP5. Consider the environmental, social and economic impacts of decisions
		CRP6. Demonstrate creativity and innovation
	T	**CRP7. Employ valid and reliable research strategies**
		CRP8. Utilize critical thinking to make sense of problems and persevere in solving them
		CRP9. Model integrity, ethical leadership and effective management
		CRP10. Plan education and career paths aligned to personal goals
		CRP11. Use technology to enhance productivity
		CRP12. Work productively in teams while using cultural global competence

Student Learning Goals/Objectives: (What key knowledge and skills will students acquire as a result of this unit? What should they eventually be able to do as a result of such knowledge and skill?)

Students will know….	***Students will be able to (do)…***
The structure and function of different organic molecules.	Explain the connection between the sequence and the subcomponents of a biomolecule and its properties Create representations that explain how genetic information flows from a sequence of nucleotides in a gene to a sequence of amino acids in a protein.

Assessment Evidence:

Performance Tasks: *(Through what authentic performance tasks will students demonstrate the desired understandings? By what criteria will performances of understanding be judged?)*	**Other Assessment Measures*:*** *(Through what other evidence (E.g. quizzes, tests, academic prompts, observations, homework, journals, etc.) will students demonstrate achievement of the desired results? How will students reflect upon and self- assess their learning?)* ******Attach all Benchmarks***
Lab activities/reports will be used to assess student performance. Lab activities will include, peanut calorie lab, pH and buffer lab, identifying organic compounds lab, diffusion lab, and osmosis lab.	

	Tests, Quizzes, Homework, and Closure Activities
Teaching and Learning Actions: (What learning experiences and instruction will enable students to achieve the desired results?	
Instructional Strategies and Activities *D*	***Consider how will the design will:*** **W** = Help the students know Where the unit is going and What is expected? Help the teacher know Where the students are coming from (prior knowledge and interests)? **H**= Hook all students and Hold their interest? **E**= Equip students, help the Experience the key ideas and Explore the issue? **R**=Provide opportunities to Rethink and Revise their understandings and work? **E**=Allow students to Evaluate their work and its implications? **T**=be Tailored (personalized to the different needs, interests and abilities of learners? **O**=be Organized to maximize initial and sustained engagement as well as effective learning? The classroom will have a student learning map posted. This will outline the unit and provide the Unit Essential questions and all Lesson Essential Questions. With this, students will know the sequence of objectives they will be following. Each lesson will begin with a warm up activity designed to tie previous learning with information about to be covered. All lessons will include opportunities for guided practice, independent practice, group work, and a lab activity designed to encourage questions that guide students to delve deeper into a topic. Students will receive differentiated instruction to meet their different needs. Each lesson will conclude with a closure activity to allow students to evaluate their learning.
Resources	
Textbook and online access	

Suggested Time Frame:	20

D – Indicates differentiation at the Lesson Level (Identify Modifications for ELL, Gifted and Talented, Title 1, Special Education)

Content Area:	**Biology**	**Grade(s)**
Unit Plan Title:	**Unit 6 - DNA and Inheritance**	

Overview/Rationale

Students analyze data develop models to make sense of the relationship between DNA and chromosomes in the process of cellular division, which passes traits from one generation to the next. Students determine why individuals of the same species vary in how they look, function, and behave. Students develop conceptual models of the role of DNA in the unity of life on Earth and use statistical models to explain the importance of variation within populations for the survival and evolution of species. Ethical issues related to genetic modification of organisms and the nature of science are described. Students explain the mechanisms of genetic inheritance and describe the environmental and genetic causes of gene mutation and the alteration of gene expressions. The crosscutting concepts of structure and function, patterns, and cause and effect are used as organizing concepts for the disciplinary core ideas. Students also use the science and engineering practices to demonstrate understanding of the disciplinary core ideas.

Science Standards (Established Goals)

DCIs

LS1.A: Structure and Function
LS3.A: Inheritance of Traits
LS3.B: Variation of Traits

SEPs

Asking Questions and Defining Problems
Constructing Explanations and Designing Solutions
Engaging in Argument from Evidence

CCCs

Cause and Effect
Scale, Proportion, and Quantity

Technology Standard(s)

8.1.12.C.1 – Develop an innovative solution to a real world problem or issue in collaboration with peers and experts, and present ideas for feedback through social media or in an online community.
8.1.12.E.1 – Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts synthesizing information from multiple sources.

Interdisciplinary Standard(s)

Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. **WHST.9-12.7** (HS-LS1-3)

Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. **WHST.11-12.8** (HS-LS1-3)

Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. **SL.11-12.5** (HS-LS1-2)

Enduring Understandings: (What are the big ideas? What specific understandings about them are desired? What misunderstandings are predictable?)

Students will understand that…

Characteristics from one generation are related to the previous generation

Essential Question(s) : (What provocative questions will foster inquiry, understanding, and transfer of learning?)

How can you use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms?

What is the relationship between the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring?

How does the process of meiosis results in the passage of traits from parent to offspring, and how that results in increased genetic diversity necessary for evolution?

How do changes in a DNA nucleotide sequence result in a change in the polypeptide produced?

What evidence is there that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors?

In this unit plan, the following 21st Century themes and skills are addressed:

Check all that apply. 21st Century Themes		*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* 21st Century Skills	
	Global Awareness	A	Critical Thinking & Problem Solving
	Environmental Literacy	E	Creativity and Innovation
X	Health Literacy	A	Collaboration, Teamwork and Leadership
	Civic Literacy		Cross-Cultural and Interpersonal Communication
	Financial, Economic, Business and Entrepreneurial Literacy		Communication and Media Fluency
			Accountability, Productivity and Ethics

In this unit plan, the following Career Ready Practices are addressed:

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

	CRP1. Act as a responsible and contributing citizen and employee
	CRP2. Apply appropriate academic and technical skills
	CRP3. Attend to personal health and financial well-being
X	CRP4. Communicate clearly and effectively with reason

	CRP5. Consider the environmental, social and economic impacts of decisions
	CRP6. Demonstrate creativity and innovation
	CRP7. Employ valid and reliable research strategies
	CRP8. Utilize critical thinking to make sense of problems and persevere in solving them
	CRP9. Model integrity, ethical leadership and effective management
	CRP10. Plan education and career paths aligned to personal goals
	CRP11. Use technology to enhance productivity
	CRP12. Work productively in teams while using cultural global competence

Student Learning Goals/Objectives: (What key knowledge and skills will students acquire as a result of this unit? What should they eventually be able to do as a result of such knowledge and skill?)

Students will know….	***Students will be able to (do)…***
• All cells contain genetic information in the form of DNA molecules. • Genes are regions in the DNA that contain the instructions that code for the formation of proteins. • Each chromosome consists of a single, very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. • The instructions for forming species' characteristics are carried in the DNA. • All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. • Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have, as yet, no known function. Empirical evidence is required to differentiate between cause and correlation and to make claims about the role of DNA and chromosomes in coding the instructions for the characteristic traits passed from parents to offspring.	Explain the role DNA plays in determining traits in succeeding generations. Explain the processes by which DNA codes for traits in individuals.

Assessment Evidence:	
Performance Tasks: *(Through what authentic performance tasks will students demonstrate the desired understandings? By what criteria will performances of understanding be judged?)* Several variances of performance tasks are based on DNA and its role in heredity. They all are based on the activity of taking a nucleotide sequence and using it, as the cell does, to create a protein capable of performing a function. Students will also do research and presentations on the field of genetics in the news today.	**Other Assessment Measures:** *(Through what other evidence (E.g. quizzes, tests, academic prompts, observations, homework, journals, etc.) will students demonstrate achievement of the desired results? How will students reflect upon and self- assess their learning?)* ******Attach all Benchmarks*** Tests, Quizzes, homework, and closure activities.
Teaching and Learning Actions: (What learning experiences and instruction will enable students to achieve the desired results?	

Instructional Strategies and Activities *D*	***Consider how will the design will:*** **W** = Help the students know Where the unit is going and What is expected? Help the teacher know Where the students are coming from (prior knowledge and interests)? **H**= Hook all students and Hold their interest? **E**= Equip students, help the Experience the key ideas and Explore the issue? **R**=Provide opportunities to Rethink and Revise their understandings and work? **E**=Allow students to Evaluate their work and its implications? **T**=be Tailored (personalized to the different needs, interests and abilities of learners? **O**=be Organized to maximize initial and sustained engagement as well as effective learning? The classroom will have a student learning map posted. This will outline the unit and provide the Unit Essential questions and all Lesson Essential Questions. With this, students will know the sequence of objectives they will be following. Each lesson will begin with a warm up activity designed to tie previous learning with information about to be covered. All lessons will include opportunities for guided practice, independent practice, group work, and a lab activity designed to encourage questions that guide students to delve deeper into a topic. Students will receive differentiated instruction to meet their different needs. Each lesson will conclude with a closure activity to allow students to evaluate their learning.
Resources	
Textbook and online access	
Suggested Time Frame:	20 Days

D – Indicates differentiation at the Lesson Level (Identify Modifications for ELL, Gifted and Talented, Title 1, Special Education)

Content Area:	**Biology**	**Grade(s)**
Unit Plan Title:	**Unit 7 - Natural Selection**	
Overview/Rationale		
Students constructing explanations and designing solutions, analyzing and interpreting data, and engaging in argument from evidence investigate to		

make sense of the relationship between the environment and natural selection. Students also develop an understanding of the factors causing natural selection of species over time. They also demonstrate and understandings of how multiple lines of evidence contribute to the strength of scientific theories of natural selection. The crosscutting concepts of patterns and cause and effect serve as organizing concepts for the disciplinary core ideas. Students also use the science and engineering practices to demonstrate understanding of the disciplinary core ideas.

Science Standards (Established Goals)

DCIs

LS1.A: Structure and Function
LS4.B: Natural Selection
LS4.C: Adaptation
LS2.D: Social Interactions and Group Behavior

SEPs

Analyzing and Interpreting Data
Constructing Explanations and Designing Solutions
Engaging in Argument from Evidence

CCCs

Cause and Effect
Patterns

Technology Standard(s)

8.1.12.C.1 – Develop an innovative solution to a real world problem or issue in collaboration with peers and experts, and present ideas for feedback through social media or in an online community.
8.1.12.E.1 – Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts

synthesizing information from multiple sources.

Interdisciplinary Standard(s)

Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. **WHST.9-12.7** (HS-LS4-5)

Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. **SL.11-12.5** (HS-LS1-2)

Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. **RST.11-12.8** (HS-LS4-5)
Draw evidence from informational texts to support analysis, reflection, and research. **WHST.9-12.9** (HS-LS4-5)
Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem **RST.9-10.8**. (HS-LS2-8)

Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. **RST.11-12.1** (HS-LS2-8)

Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. **RST.11-12.7** (HS-LS2-8)

Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or

challenging conclusions with other sources of information. **RST.11-12.8** (HS-LS2-8)

Reason abstractly and quantitatively. **MP.2** (HS-LS4-5)

Enduring Understandings: (What are the big ideas? What specific understandings about them are desired? What misunderstandings are predictable?)

Students will understand that…

Nature selects which organisms will survive and pass on their genes based on how well they fit into an environment.

Essential Question(s) : (What provocative questions will foster inquiry, understanding, and transfer of learning?)

How does natural selection lead to adaptations?
What does artificial selection to do populations?
How can probability be used to explain that organisms with advantageous heritable traits will tend to increase over time?
How do changes in environment affect species over time?

In this unit plan, the following 21st Century themes and skills are addressed:

Check all that apply. 21st Century Themes		*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* 21st Century Skills	
X	Global Awareness	A	Critical Thinking & Problem Solving
X	Environmental Literacy		Creativity and Innovation
	Health Literacy	A	Collaboration, Teamwork and Leadership
	Civic Literacy		Cross-Cultural and Interpersonal Communication
	Financial, Economic, Business and Entrepreneurial Literacy		Communication and Media Fluency
			Accountability, Productivity and Ethics

In this unit plan, the following Career Ready Practices are addressed:

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

	CRP1. Act as a responsible and contributing citizen and employee
	CRP2. Apply appropriate academic and technical skills
	CRP3. Attend to personal health and financial well-being
X	**CRP4. Communicate clearly and effectively with reason**
	CRP5. Consider the environmental, social and economic impacts of decisions
	CRP6. Demonstrate creativity and innovation
	CRP7. Employ valid and reliable research strategies
	CRP8. Utilize critical thinking to make sense of problems and persevere in solving them
	CRP9. Model integrity, ethical leadership and effective management
	CRP10. Plan education and career paths aligned to personal goals
	CRP11. Use technology to enhance productivity
	CRP12. Work productively in teams while using cultural global competence

Student Learning Goals/Objectives: (What key knowledge and skills will students acquire as a result of this unit? What should they eventually be able to do as a result of such knowledge and skill?)

Students will know….	***Students will be able to (do)…***
How an environment can drive the change in a species as that species attempts to survive.	Explain how organisms with the best traits to fit into an environment will survive and pass on those traits, thus potentially causing evolution of the species.

Assessment Evidence:	
Performance Tasks: *(Through what authentic performance tasks will students demonstrate the desired understandings? By what criteria will performances of understanding be judged?)* Students will run through simulated natural selection activities done on a computer to observe how species change. They will do this after being presented with future environmental changes and predict what the future species will be. They will also create a presentation to show how different species will have to evolve based on a changing climate.	**Other Assessment Measures:** *(Through what other evidence (E.g. quizzes, tests, academic prompts, observations, homework, journals, etc.) will students demonstrate achievement of the desired results? How will students reflect upon and self- assess their learning?)* ******Attach all Benchmarks*** Tests, Quizzes, Homework, and closure activities.
Teaching and Learning Actions: (What learning experiences and instruction will enable students to achieve the desired results?	
Instructional Strategies and Activities *D*	***Consider how will the design will:*** **W** = Help the students know Where the unit is going and What is expected? Help the teacher know Where the students are coming from (prior knowledge and interests)? **H**= Hook all students and Hold their interest? **E**= Equip students, help the Experience the key ideas and Explore the issue? **R**=Provide opportunities to Rethink and Revise their understandings and work? **E**=Allow students to Evaluate their work and its implications? **T**=be Tailored (personalized to the different needs, interests and abilities of learners? **O**=be Organized to maximize initial and sustained engagement as well as effective learning? The classroom will have a student learning map posted. This will outline the unit and provide the Unit Essential questions and all Lesson Essential Questions. With this, students will know the sequence of objectives they will be following. Each lesson will begin with a warm up activity designed to tie previous learning with information about to be covered. All lessons will include opportunities for guided practice, independent practice, group work, and a lab activity designed to encourage questions that guide students to delve deeper into a topic.

	Students will receive differentiated instruction to meet their different needs. Each lesson will conclude with a closure activity to allow students to evaluate their learning.
Resources	
Textbook and online video sources	
Suggested Time Frame:	20 days

D – Indicates differentiation at the Lesson Level (Identify Modifications for ELL, Gifted and Talented, Title 1, Special Education)

Content Area:	**Biology**	**Grade(s)**
Unit Plan Title:	**Unit 8 - Evolution**	
Overview/Rationale		
Students construct explanations for the processes of natural selection and evolution and then communicate how multiple lines of evidence support these explanations. Students evaluate evidence of the conditions that may result in new species and understand the role of genetic variation in natural selection. Additionally, students can apply concepts of probability to explain trends in population as those trends relate to advantageous heritable traits in a specific environment. Students demonstrate an understanding of these concepts by obtaining, evaluating, and communicating information and constructing explanations and designing solutions. The crosscutting concepts of patterns and cause and effect support the development of a deeper understanding.		
Science Standards (Established Goals)		

DCIs

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

SEPs

Obtaining, Evaluating, and Communicating Information
Constructing Explanations and Designing Solutions

CCCs

Patterns
Cause and Effect

Technology Standard(s)

8.1.12.C.1 – Develop an innovative solution to a real world problem or issue in collaboration with peers and experts, and present ideas for feedback through social media or in an online community.
8.1.12.E.1 – Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts synthesizing information from multiple sources.

Interdisciplinary Standard(s)

Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. **RST-11.12.1** (HS-LS4-1),(HS-LS4-2)

Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. **WHST.9-12.2** (HS-LS4-1),(HS-LS4-2)

Draw evidence from informational texts to support analysis, reflection, and research. **WHST.9-12.9** (HS-LS4-1),(HS-LS4-2)

Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. **SL.11-12.4** (HS-LS4-1),(HS-LS4-2)

Reason abstractly and quantitatively. **MP.2** (HS-LS4-1),(HS-LS4-2)

Model with mathematics. **MP.4** (HS-LS4-2)

Enduring Understandings: (What are the big ideas? What specific understandings about them are desired? What misunderstandings are predictable?)

Students will understand that…

Evolution is supported by evidence such as the fossil record, DNA, and homologous structures.

Essential Question(s) : (What provocative questions will foster inquiry, understanding, and transfer of learning?)

What is evolution?
What drives evolution?
What types of evolution are there?
What evidence is there that supports evolution?

In this unit plan, the following 21st Century themes and skills are addressed:

Check all that apply. **21st Century Themes**	*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* **21st Century Skills**

		Global Awareness		A	Critical Thinking & Problem Solving
		Environmental Literacy		E	Creativity and Innovation
	X	Health Literacy		E	Collaboration, Teamwork and Leadership
		Civic Literacy			Cross-Cultural and Interpersonal Communication
		Financial, Economic, Business and Entrepreneurial Literacy			Communication and Media Fluency
					Accountability, Productivity and Ethics

In this unit plan, the following Career Ready Practices are addressed:

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

		CRP1. Act as a responsible and contributing citizen and employee
		CRP2. Apply appropriate academic and technical skills
		CRP3. Attend to personal health and financial well-being
		CRP4. Communicate clearly and effectively with reason
		CRP5. Consider the environmental, social and economic impacts of decisions
		CRP6. Demonstrate creativity and innovation
		CRP7. Employ valid and reliable research strategies
	X	**CRP8. Utilize critical thinking to make sense of problems and persevere in solving them**
		CRP9. Model integrity, ethical leadership and effective management
		CRP10. Plan education and career paths aligned to personal goals
		CRP11. Use technology to enhance productivity
		CRP12. Work productively in teams while using cultural global competence

Student Learning Goals/Objectives: (What key knowledge and skills will students acquire as a result of this unit? What should they eventually be able to do as a result of such knowledge and skill?)	
Students will know…. Evolution is caused by natural selection. Support for evolution comes in the form of evidence from the fossil record, DNA analysis, and similar structures among different species.	***Students will be able to (do)…*** Explain how evolution occurs and how evidence demonstrates that, although it takes place over long periods of time, it does occur.
Assessment Evidence:	
Performance Tasks: *(Through what authentic performance tasks will students demonstrate the desired understandings? By what criteria will performances of understanding be judged?)* Students will present a PowerPoint project that shows different species, their ancestors, how they are related, and how the environment caused them to evolve over time.	**Other Assessment Measures***: (Through what other evidence (E.g. quizzes, tests, academic prompts, observations, homework, journals, etc.) will students demonstrate achievement of the desired results? How will students reflect upon and self- assess their learning?)* ******Attach all Benchmarks*** Tests, Quizzes, Homework, and Closure activities
Teaching and Learning Actions: (What learning experiences and instruction will enable students to achieve the desired results?	

Instructional Strategies and Activities *D*	***Consider how will the design will:*** **W** = Help the students know Where the unit is going and What is expected? Help the teacher know Where the students are coming from (prior knowledge and interests)? **H**= Hook all students and Hold their interest? **E**= Equip students, help the Experience the key ideas and Explore the issue? **R**=Provide opportunities to Rethink and Revise their understandings and work? **E**=Allow students to Evaluate their work and its implications? **T**=be Tailored (personalized to the different needs, interests and abilities of learners? **O**=be Organized to maximize initial and sustained engagement as well as effective learning? The classroom will have a student learning map posted. This will outline the unit and provide the Unit Essential questions and all Lesson Essential Questions. With this, students will know the sequence of objectives they will be following. Each lesson will begin with a warm up activity designed to tie previous learning with information about to be covered. All lessons will include opportunities for guided practice, independent practice, group work, and a lab activity designed to encourage questions that guide students to delve deeper into a topic. Students will receive differentiated instruction to meet their different needs. Each lesson will conclude with a closure activity to allow students to evaluate their learning.
Resources	
Textbooks and online access	
Suggested Time Frame:	20 days

D – Indicates differentiation at the Lesson Level (Identify Modifications for ELL, Gifted and Talented, Title 1, Special Education)

Chemistry Curriculum

Board of Education Approval: August 18, 2016

Table of Contents

High School Science Curriculum Work Committee

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Laura Lambert

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Introduction

This document serves to meet all requirements for curriculum as per the Middle Township Board of Education and the New Jersey Department of Education and will serve as a guide for lesson planning. Units within the curricular framework for science are designed to be taught in the order in which they are presented. Within the units, the teachers have flexibility of what order to present the standards. Suggested Science and Engineering Practice Standards and Cross-Cutting Concepts are listed in each unit to be imbedded regularly in daily science instruction.

Course Description

Elements, substances and compounds make up our entire physical environment. Students need an understanding of Chemistry to fully appreciate the complexity and interactions present in their world. The main focus of this course is properties of matter, changes in matter, and how energy is related. Upon completion of this course, students should not only understand the subject matter of chemistry, but also appreciate the interrelationship between physics, biology and chemistry. Chemistry fulfills the New Jersey science requirements for high school graduation. Students will use measurement and observation tools to refine their problem solving skills and gain experience in using mathematics as a tool in science investigations. Application of the Next Generation Science Standards results in a balance of the three dimensions of the standards along with a focus on the interdisciplinary nature of all science domains among one another as well as with the New Jersey Student Learning Standards for Mathematics and English Language Arts.

Three Dimensions of the Next Generation Science Standards

The National Research Council's (NRC) *Framework* describes a vision of what it means to be proficient in science; it rests on a view of science as both a body of knowledge and an evidence-based, model and theory building enterprise that continually extends, refines, and revises knowledge. It presents three dimensions that will be combined to form each standard:

Dimension 1: Practices

The practices describe behaviors that scientists engage in as they investigate and build models and theories about the natural world and the key set of engineering practices that engineers use as they design and build models and systems. The NRC uses the term practices instead of a term like "skills" to emphasize that engaging in scientific investigation requires not only skill but also knowledge that is specific to each practice. Part of the NRC's intent is to better explain and extend what is meant by "inquiry" in science and the range of cognitive, social, and physical practices that it requires.

Although engineering design is similar to scientific inquiry, there are significant differences. For example, scientific inquiry involves the formulation of a question that can be answered through investigation, while engineering design involves the formulation of a problem that can be solved through design. Strengthening the engineering aspects of the Next Generation Science Standards will clarify for students the relevance of science, technology, engineering and mathematics (the four STEM fields) to everyday life.

Dimension 2: Crosscutting Concepts

Crosscutting concepts have application across all domains of science. As such, they are a way of linking the different domains of science. They include: Patterns, similarity, and diversity; Cause and effect; Scale, proportion and quantity; Systems and system models; Energy and matter; Structure and function; Stability and change. The Framework emphasizes that these concepts need to be made explicit for students because they provide an organizational schema for interrelating knowledge from various science fields into a coherent and scientifically-based view of the world.

Dimension 3: Disciplinary Core Ideas

Disciplinary core ideas have the power to focus K–12 science curriculum, instruction and assessments on the most important aspects of science. To be considered core, the ideas should meet at least two of the following criteria and ideally all four:

- Have **broad importance** across multiple sciences or engineering disciplines or be a **key organizing concept** of a single discipline;
- Provide a **key tool** for understanding or investigating more complex ideas and solving problems;
- Relate to the **interests and life experiences of students** or be connected to **societal or personal concerns** that require scientific or technological knowledge;
- Be **teachable** and **learnable** over multiple grades at increasing levels of depth and sophistication.

Disciplinary ideas are grouped in four domains: the physical sciences; the life sciences; the earth and space sciences; and engineering, technology and applications of science.

Pacing Guide

UNIT TITLE	ENDURING UNDERSTANDINGS	NGSS	TIMEFRAME
Unit 1 - Introduction to Chemistry and the Atomic Theory	• There are certain procedures they must follow in order to maintain a safe environment during labs • The scientific method is a set of steps scientists can use to solve a problem • Accuracy, precision and percent error can be used to evaluate the success of an experiment • A substance can be identified by its density • The current model of the atom has evolved over time based off of available technology • Light can be described through the wave model and the particle model • Each atom contains protons, neutrons and electrons • Nuclear processes involve changes in nuclear binding energies	**HS-PS1-1** **HS-PS1-8** **HS-PS4-1** **HS-PS4-3** **HS-PS2-6**	**30 – 40 days**
Unit 2 - Periodic Table	• The Periodic Table organizes the elements based on atomic number and chemical properties. • Characteristics of elements can be inferred based on the location of the element within the Periodic Table. • There are also trends of atomic radii, ionization energy, and electronegativity that can be used to explain the chemical behavior of the elements. • The valence electrons of an atom determine the chemical reactivity of the element. • Electron configurations can be used to predict the chemical behavior of atoms.	**HS-PS1-1** **HS-PS1-2** **HS-PS1-3**	**15 days**

Unit 3 - Chemical Bonding	• The atoms of solid ionic compounds are arranged in an orderly fashion. The crystalline structure of these solids is the result of ionic bonding between atoms. • Ionic bonding gives ionic compounds their unique physical properties. Molecular compounds consists of two or more nonmetallic atoms bound by a covalent bond. • There are many variations of molecular compounds because of the chemical bonding found within the molecules. • The Octet Rule governs how atoms are bound and arranged within a molecular compound. • Molecular compounds may have an even or uneven distribution of electrons within the molecule. • This distribution of electrons within the molecule determines its shape, which in turn, affect the physical properties of molecular substances.	**HS-PS1-2** **HS-PS1-3** **HS-PS1-4** **HS-PS2-6**	**20 days**
Unit 4 - Representing Chemical Substances	• Students will learn to differentiate between a physical change and a chemical change. • Students will also write chemical reactions using elemental symbols. These skills will be used in subsequent units. • The concept of the mole enables scientists to measure the mass, volume, and number of particles of a substance. • The mole was developed as to tool to relate the number of particles of a substance to its mass and volume. • Dimensional Analysis is used in order to perform these conversions. • Students will learn to predict the products and write five classes of chemical reactions; synthesis reactions, decomposition reactions, combustion reactions, single replacement reactions, and double replacement reactions. • Stoichiometry is the science of the quantification of matter in chemical reactions.	**HS-PS1-2** **HS-PS1-4** **HS-PS1-6** **HS-PS1-7**	**30 – 40 days**

	• The mole concept and Dimensional Analysis is used to quantify the substances involved in chemical reactions. • In a chemical reaction, the total mass of the reactants must equal the total mass of the products.		
Unit 5 - States of Matter	• There is a relationship between the pressure, temperature and volume of a substance and the gas laws can be used to calculate just how these affect one another. • Pressure is a result of molecular collisions and if those collisions increase, then the pressure exerted by the substance will also increase. If thermal energy is added to a substance the substance will undergo a change of phase. • Phase diagrams can be used to determine the state of a matter a substance is in.	**HS-PS 1-3** **HS-PS1-5**	**20 – 30 days**
Unit 6 - Solutions Chemistry	• Many chemical reactions occur in aqueous solutions, therefore it is important to be able to quantify the amount of solute dissolved in a solvent. • The concentration of a solute can be measured in terms of molarity, molality, percent by mass, percent by volume, and mole fraction. • The amount of solute that can be dissolved in a given amount of solvent can be affected by the temperature and / or pressure of the solution. There are also factors that affect the rate at which a solute may dissolve.	**HS-PS1-2** **HS-PS1-3** **HS-PS1-5** **HS-PS1-6**	**20 - 30 days**

Content Area:	Chemistry	Grade(s) 10
Unit Plan Title:	Unit 1 - Introduction to Chemistry and the Atomic Theory	

Overview/Rationale

Chemistry is a hands-on course. Students will first learn the safety procedures they must follow throughout this course, how to apply the scientific method to solve a problem and how to use dimensional analysis to convert between units of measure. Students will also learn how to evaluate the success of their experiments by using accuracy, precision and percent error. Finally, students will understand what density is and how it can be used to identify a substance.

Many scientists have contributed to the development of the Atomic Model. Each scientist used discoveries by their predecessors to improve the Atomic Model. The current view of the atom still contains some of the same elements of models before it. The Quantum Model of the atom describes how electrons are organized around the atom. Each atom consists of protons, neutrons, and electrons. Some atoms of the same element vary by the number of neutrons they contain. Neutral atoms have the same number of protons and electrons while ions do not. Ions are atoms with an electrical charge. The Atomic Emission Spectra of atoms helps us understand how electrons are arranged around the atom. The composition of an atom's nucleus changes during the processes of fission, fusion and radioactive decay.

Science Standards (Established Goals)

PS1.A: structure and properties of matter
PS1.C: nuclear processes
PS4.A: wave properties
PS4.B: electromagnetic radiation

Disciplinary Core Ideas

HS-PS1-1: use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
HS-PS1-8: develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.
HS-PS4-1: use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
HS-PS4-3: evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.
HS-PS2-6: communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed

materials.

Science and Engineering Practices

SEP-2: Developing and using models

- Use a model to predict the relationships between systems or between components of a system. (HS-PS1-1)
- Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-8)
- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. (HS-PS4-3)

SEP-3: Planning and carrying out investigations

SEP-7: Engaging In Argument from Evidence

- Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-PS4-3)

SEP-8: Obtaining, evaluating and communication of information

Cross-Cutting Concepts

CCC-1: Patterns

- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-1)

CCC-5: Energy and Matter

- In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. (HS-PS1-8)

Technology Standard(s)

8.1.12.F.1: evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and/or social needs.

Interdisciplinary Standard(s)

English Language Arts

RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. (HS-PS4-3), (HS-PS4-4),(HS-PS4-2)
RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-PS4-3), (HS-PS4-4),(HS-PS4-2)

RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-PS4-1)
RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-PS4-3)

Mathematics

MP2: Reason abstractly and quantitatively. (HS-PS1-8), (HS-PS4-1), (HS-PS4-3),
MP4: Model with mathematics. (HS-PS4-1)
HSA.CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. (HS-PS4-1)
HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context. (HS-PS4-1)
HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. (HS-PS4-1), (HS-PS4-3)

Enduring Understandings: (What are the big ideas? What specific understandings about them are desired? What misunderstandings are predictable?)

Students will understand that…
There are certain procedures they must follow in order to maintain a safe environment during labs
The scientific method is a set of steps scientists can use to solve a problem
The density of a substance is unique to that substance and can be used to identify a substance
The current model of the atom has evolved over time based off of available technology
Light can be described through the wave model and the particle model
Each atom contains protons, neutrons and electrons
Nuclear processes involve changes in nuclear binding energies

Essential Question(s) : (What provocative questions will foster inquiry, understanding, and transfer of learning?)

What safety procedures must be followed in order to maintain a safe environment during labs?
How is the scientific method used to solve a problem?
How did the atomic theory evolve from ancient Greece to modern day, and which key scientists made which contributions?
How can one explain the structure, properties and interactions of matter?
What forces hold together and mediate nuclear processes?
What is light?

In this unit plan, the following 21st Century themes and skills are addressed:

Check all that apply. 21st Century Themes		*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* 21st Century Skills	
	Global Awareness	T	Critical Thinking & Problem Solving
X	Environmental Literacy	E	Creativity and Innovation
	Health Literacy	E	Collaboration, Teamwork and Leadership
	Civic Literacy		Cross-Cultural and Interpersonal Communication
	Financial, Economic, Business and Entrepreneurial Literacy		Communication and Media Fluency
			Accountability, Productivity and Ethics

In this unit plan, the following Career Ready Practices are addressed:

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

	CRP1. Act as a responsible and contributing citizen and employee
E	**CRP2. Apply appropriate academic and technical skills**
	CRP3. Attend to personal health and financial well-being
E	**CRP4. Communicate clearly and effectively with reason**

		CRP5. Consider the environmental, social and economic impacts of decisions
	E	**CRP6. Demonstrate creativity and innovation**
		CRP7. Employ valid and reliable research strategies
		CRP8. Utilize critical thinking to make sense of problems and persevere in solving them
		CRP9. Model integrity, ethical leadership and effective management
		CRP10. Plan education and career paths aligned to personal goals
		CRP11. Use technology to enhance productivity
		CRP12. Work productively in teams while using cultural global competence

Student Learning Goals/Objectives: (What key knowledge and skills will students acquire as a result of this unit? What should they eventually be able to do as a result of such knowledge and skill?)

Students will know….	***Students will be able to (do)…***
Safety procedures	Follow safety procedures
The steps to the scientific method	Apply the scientific method to solve a problem
How to calculate density	Calculate the density of a substance
How light is described	Describe light and the importance of the double slit experiment
The model of the atom	Determine the number of subatomic particles in an atom
What an isotope is	Write isotopes
The mass of an element is the average of all its isotopes	Calculate average atomic mass
The different types of radioactive decay	Write radiation equations

Assessment Evidence:

Performance Tasks: *(Through what authentic performance tasks will students demonstrate the desired understandings? By what criteria will performances of understanding be judged?)*	**Other Assessment Measures***: (Through what other evidence (E.g. quizzes, tests, academic prompts, observations, homework, journals, etc.) will students demonstrate achievement of the desired results? How will*

Labs/Activities: Scientific method lab Density lab Build an atom webquest Radioactive decay activity Isotopes of pennium lab Atomic emission spectra lab Atomic structure lab	*students reflect upon and self- assess their learning?)* ******Attach all Benchmarks*** Quizzes: Safety/scientific method Development of the atomic model Subatomic particles Isotopes Radiation equations Tests Lab reports Homework

Teaching and Learning Actions: (What learning experiences and instruction will enable students to achieve the desired results?

Instructional Strategies and Activities *D*	***Consider how will the design will:*** **W** = Help the students know Where the unit is going and What is expected? Help the teacher know Where the students are coming from (prior knowledge and interests)? **H**= Hook all students and Hold their interest? **E**= Equip students, help the Experience the key ideas and Explore the issue? **R**=Provide opportunities to Rethink and Revise their understandings and work? **E**=Allow students to Evaluate their work and its implications? **T**=be Tailored (personalized to the different needs, interests and abilities of learners? **O**=be Organized to maximize initial and sustained engagement as well as effective learning?
Scientific method/inquiry lab - 20-30 minutes - Honors: 7-55 minute classes Density lab - 1 class period Thermal energy lab series (Honors) - 4-5, 55 minute periods Build an atom webquest - 20-30 minutes Radioactive decay lab - 30-40 minutes	Higher level classes will learn how to calculate the average atomic mass of an element. Honors class will also discuss thermal energy and run a lab series. The higher level classes will also run a discovery Rutherford lab. Build an Atom**:** This simulation allows students to create different illustrations of atoms and provides evidence that protons determine the identity of the element. **Wave on a string**: Students will watch a wave on a string. Adjusting the amplitude, frequency, damping and tension will demonstrate wave properties.

Isotopes of pennies lab - 30-40 minutes Atomic emission spectra lab - 30-40 minutes Flame test - 30-55 minutes ID unknown shapes (Adv & Honors) - 30 minutes	**Slinky Lab**: Students will observe patterns of waves and their interactions using a slinky. **Ripple Tank**: Students will investigate wave properties (speed in a medium, reflection, diffraction, interference) using the PhET virtual ripple tank, or use an actual ripple tank. **Introduction to the Electromagnetic Spectrum:** NASA background resource Additional differentiation activities as needed include: • Restructure lessons using Universal Design for Learning (UDL) principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA) • Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable phenomena. • Structure the learning around explaining or solving a social or community-based issue. • Provide English Language Learners students with multiple literacy strategies. • Collaborate with after-school programs or clubs to extend learning opportunities.
Resources	
Chemistry textbook NJCTL.org http://phet.colorado.edu/en/simulation/	
Suggested Time Frame:	30-40 days

D – Indicates differentiation at the Lesson Level (Identify Modifications for ELL, Gifted and Talented, Title 1, Special Education)

Content Area:	**Chemistry**	**Grade(s)** 10
Unit Plan Title:	**Unit 2 - Periodic Table**	

Overview/Rationale

The Periodic Table organizes the elements based on atomic number and chemical properties. Characteristics of elements can be inferred based on the location of the element within the Periodic Table. There are also trends of atomic radii, ionization energy, and electronegativity that can be used to explain the chemical behavior of the elements.

Science Standards (Established Goals)

PS1.A: Structure and Properties of Matter
PS1.B: Chemical Reactions
PS2.B: Types of Interactions

Disciplinary Core Ideas

HS-PS1-1: use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
HS-PS1-2: construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties
HS-PS1-3: plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles

Science and Engineering Practices

SEP2: Developing and using models
SEP3: Planning and carrying out investigations
SEP6: Constructing explanations and designing solutions
SEP8: Obtaining, evaluating and communication of information

Cross-Cutting Concepts

CCC1: Patterns
CCC6: Structure and function

Technology Standard(s)

8.1.12.F.1: evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and/or social needs.

Interdisciplinary Standard(s)

M2: reason abstractly and quantitatively
E2: they build strong content knowledge
E5: they value evidence

Enduring Understandings: (What are the big ideas? What specific understandings about them are desired? What misunderstandings are predictable?)

Students will understand that…
The Periodic Table organizes the elements based on atomic number and chemical properties.
Characteristics of elements can be inferred based on the location of the element within the Periodic Table.
There are also trends of atomic radii, ionization energy, and electronegativity that can be used to explain the chemical behavior of the elements.
The valence electrons of an atom determine the chemical reactivity of the element.
Electron configurations can be used to predict the chemical behavior of atoms.

Essential Question(s) : (What provocative questions will foster inquiry, understanding, and transfer of learning?)

How is the periodic table organized?
How can the chemical behavior of an element be determined based off of its location on the periodic table?

How is an electron configuration written?

In this unit plan, the following 21st Century themes and skills are addressed:

Check all that apply. 21st Century Themes		*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* 21st Century Skills	
	Global Awareness	T	Critical Thinking & Problem Solving
X	Environmental Literacy	E	Creativity and Innovation
	Health Literacy	E	Collaboration, Teamwork and Leadership
	Civic Literacy		Cross-Cultural and Interpersonal Communication
	Financial, Economic, Business and Entrepreneurial Literacy		Communication and Media Fluency
			Accountability, Productivity and Ethics

In this unit plan, the following Career Ready Practices are addressed:

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

	CRP1. Act as a responsible and contributing citizen and employee
E	**CRP2. Apply appropriate academic and technical skills**
	CRP3. Attend to personal health and financial well-being
E	**CRP4. Communicate clearly and effectively with reason**
	CRP5. Consider the environmental, social and economic impacts of decisions
E	**CRP6. Demonstrate creativity and innovation**
	CRP7. Employ valid and reliable research strategies
	CRP8. Utilize critical thinking to make sense of problems and persevere in solving them
	CRP9. Model integrity, ethical leadership and effective management

	E	**CRP10. Plan education and career paths aligned to personal goals** **CRP11. Use technology to enhance productivity** **CRP12. Work productively in teams while using cultural global competence**

Student Learning Goals/Objectives: (What key knowledge and skills will students acquire as a result of this unit? What should they eventually be able to do as a result of such knowledge and skill?)

Students will know….	***Students will be able to (do)…***
The scientists behind the organization of the periodic table How to apply the trends in the periodic table to determine the chemical behavior of an element How to write an electron configuration	Determine if an element is a metal, nonmetal or metalloid based on its location Determine how many valence electrons an element has Write an electron configuration for an element Apply the periodic trends to elements

Assessment Evidence:

Performance Tasks: *(Through what authentic performance tasks will students demonstrate the desired understandings? By what criteria will performances of understanding be judged?)*	**Other Assessment Measures*:*** *(Through what other evidence (E.g. quizzes, tests, academic prompts, observations, homework, journals, etc.) will students demonstrate achievement of the desired results? How will students reflect upon and self- assess their learning?)* ******Attach all Benchmarks***
Labs: Periodic table lab Trends lab	Quizzes: Electron configuration Trends Tests Lab reports Homework

Teaching and Learning Actions: (What learning experiences and instruction will enable students to achieve the desired results?

Instructional Strategies and Activities *D* Periodic table lab - 1 class period Periodic trends activity (honors) - 2-40 minute periods	***Consider how will the design will:*** **W** = Help the students know Where the unit is going and What is expected? Help the teacher know Where the students are coming from (prior knowledge and interests)? **H**= Hook all students and Hold their interest? **E**= Equip students, help the Experience the key ideas and Explore the issue? **R**=Provide opportunities to Rethink and Revise their understandings and work? **E**=Allow students to Evaluate their work and its implications? **T**=be Tailored (personalized to the different needs, interests and abilities of learners? **O**=be Organized to maximize initial and sustained engagement as well as effective learning? The higher level classes will learn how quantum numbers give rise to electron configurations. Lower level classes will deal mostly with the concepts behind the quantum numbers. The higher level classes will learn several different ways to write an electron configuration. Periodic Table Trends**:** This is a virtual investigation of the periodic trends. Path to Periodic Table**:** This investigation provides students with the opportunity to make sense of how and why the periodic table is organized the way that it is. Students will re-create the thought process that Dmitri Mendeleev and Julius Lothar Meyer went through to devise their early periodic tables. Castle of Mendeleev**:** Students engage in a fantasy world that requires them to make claims, based on evidence, regarding the identity of unknown materials. Additional differentiation activities as needed include: • Restructure lessons using Universal Design for Learning (UDL) principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA) • Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).

	• Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable phenomena. • Structure the learning around explaining or solving a social or community-based issue. • Provide English Language Learners students with multiple literacy strategies. Collaborate with after-school programs or clubs to extend learning opportunities.
Resources	
Chemistry textbook NJCTL.org http://phet.colorado.edu/en/simulation/	
Suggested Time Frame:	15 days

D – Indicates differentiation at the Lesson Level (Identify Modifications for ELL, Gifted and Talented, Title 1, Special Education)

Content Area:	**Chemistry**	**Grade(s)** 10
Unit Plan Title:	**Unit 3 - Chemical Bonding**	
Overview/Rationale		
Chemical bonding predicts and explains the formation of chemical compounds. Physical and chemical properties of substances are determined by the type of chemical bond that exists between the particles in a substance. Ionic bonding and covalent bonding are found among a wide array of chemical compounds.		
Science Standards (Established Goals)		
PS1.A: structure and properties of matter PS1.B: chemical reactions PS2.B: types of interactions		

Disciplinary Core Ideas
HS-PS1-2: construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties HS-PS1-3: plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles HS-PS1-4: develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy HS-PS2-6: communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.
Science and Engineering Practices
SEP2: Developing and using models SEP3: Planning and carrying out investigations SEP6: Constructing explanations and designing solutions
Cross-Cutting Concepts
CCC1: Patterns CCC5: Energy and matter CCC6: Structure and function
Technology Standard(s)
8.1.12.F.1: evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and/or social needs.
Interdisciplinary Standard(s)
M2: reason abstractly and quantitatively E2: they build strong content knowledge E5: they value evidence

Enduring Understandings: (What are the big ideas? What specific understandings about them are desired? What misunderstandings are predictable?)

Students will understand that…

The atoms of solid ionic compounds are arranged in an orderly fashion. The crystalline structure of these solids is the result of ionic bonding between atoms. Ionic bonding gives ionic compounds their unique physical properties. Molecular compounds consists of two or more nonmetallic atoms bound by a covalent bond. There are many variations of molecular compounds because of the chemical bonding found within the molecules. The Octet Rule governs how atoms are bound and arranged within a molecular compound. Molecular compounds may have an even or uneven distribution of electrons within the molecule. This distribution of electrons within the molecule determines its shape, which in turn, affect the physical properties of molecular substances.

Essential Question(s) : (What provocative questions will foster inquiry, understanding, and transfer of learning?)

What is the difference between an ionic and a covalent bond?
How does a chemical bond affect the physical properties of a substance?
How are formulas written?
How are substances named?
How does an atoms' electronegativity affect the electron distribution within a molecule?
How can VSEPR theory be used to predict the shape of a molecule?
How do intermolecular forces affect the boiling point of a substance?

In this unit plan, the following 21st Century themes and skills are addressed:

Check all that apply. 21st Century Themes		*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* 21st Century Skills	
	Global Awareness	T	Critical Thinking & Problem Solving
X	Environmental Literacy	E	Creativity and Innovation
	Health Literacy	E	Collaboration, Teamwork and Leadership
	Civic Literacy		Cross-Cultural and Interpersonal Communication
	Financial, Economic, Business and		Communication and Media Fluency

	Entrepreneurial Literacy		**Accountability, Productivity and Ethics**

In this unit plan, the following Career Ready Practices are addressed:

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

	CRP1. Act as a responsible and contributing citizen and employee
E	**CRP2. Apply appropriate academic and technical skills**
	CRP3. Attend to personal health and financial well-being
E	**CRP4. Communicate clearly and effectively with reason**
	CRP5. Consider the environmental, social and economic impacts of decisions
E	**CRP6. Demonstrate creativity and innovation**
	CRP7. Employ valid and reliable research strategies
	CRP8. Utilize critical thinking to make sense of problems and persevere in solving them
	CRP9. Model integrity, ethical leadership and effective management
	CRP10. Plan education and career paths aligned to personal goals
E	**CRP11. Use technology to enhance productivity**
	CRP12. Work productively in teams while using cultural global competence

Student Learning Goals/Objectives: (What key knowledge and skills will students acquire as a result of this unit? What should they eventually be able to do as a result of such knowledge and skill?)

Students will know….	***Students will be able to (do)…***
the difference between an ionic and a covalent bond	Determine if a substance is ionic or covalent
the properties of ionic and covalent molecules	Write the name for a chemical substance
how to name and write a formula for chemical substances	Write a formula for a chemical substance

how to predict the shape of a molecule how electronegativity affects the polarity of a molecule the differences between the types of intermolecular forces	Predict the shape of a molecule using VSEPR Determine the polarity of a substance based off of its electronegativity Predict the type of intermolecular force within a substance
Assessment Evidence:	
Performance Tasks: *(Through what authentic performance tasks will students demonstrate the desired understandings? By what criteria will performances of understanding be judged?)* Labs: Conductivity lab VSEPR lab Intermolecular forces lab	**Other Assessment Measures*:*** *(Through what other evidence (E.g. quizzes, tests, academic prompts, observations, homework, journals, etc.) will students demonstrate achievement of the desired results? How will students reflect upon and self- assess their learning?)* ******Attach all Benchmarks*** Quizzes: Ionic vs covalent bonds Naming and formula writing VSEPR Intermolecular forces Tests Lab reports Homework
Teaching and Learning Actions: (What learning experiences and instruction will enable students to achieve the desired results?	
Instructional Strategies and Activities *D* Conductivity lab - 1 class period VSEPR lab - 1 class period	***Consider how will the design will:*** **W** = Help the students know Where the unit is going and What is expected? Help the teacher know Where the students are coming from (prior knowledge and interests)? **H**= Hook all students and Hold their interest? **E**= Equip students, help the Experience the key ideas and Explore the issue? **R**=Provide opportunities to Rethink and Revise their understandings and work? **E**=Allow students to Evaluate their work and its implications? **T**=be Tailored (personalized to the different needs, interests and abilities of learners? **O**=be Organized to maximize initial and sustained engagement as well as effective learning?

	Higher level classes will have to memorize polyatomic ions, while the lower level classes will be given a list to use throughout the chapter. Higher level classes will also get into more details with VSEPR, polarity, equation writing and boding. Additional differentiation activities as needed include: • Restructure lessons using Universal Design for Learning (UDL) principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA) • Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable phenomena. • Structure the learning around explaining or solving a social or community-based issue. • Provide English Language Learners students with multiple literacy strategies. Collaborate with after-school programs or clubs to extend learning opportunities.
Resources	
Chemistry textbook NJCTL.org http://phet.colorado.edu/en/simulation/	
Suggested Time Frame:	20 days

D – Indicates differentiation at the Lesson Level (Identify Modifications for ELL, Gifted and Talented, Title 1, Special Education)

Content Area:	Chemistry	Grade(s) 10
Unit Plan Title:	Unit 4 - Representing Chemical Substances	

Overview/Rationale

Chemistry is the study of the behavior of various types of matter. Students will differentiate among the different types of matter and identify the physical and chemical changes such matter goes through. The students will differentiate between a physical change in matter and a chemical change of matter. Changes in matter can be written using chemical symbols when writing chemical reactions. Students will write various types of chemical reactions using such symbols.

The concept of the mole is the basis for enabling scientists to relate mass, volume, and the number of particles of substance. Dimensional Analysis is used to perform these conversions. Chemistry involves predicting whether a chemical reaction will occur between two substances. In order to do so, students must learn a systematic way to identifying the type of chemical reaction that may potentially occur. Being able to quantify the amount of products produced or reagents used in a chemical reaction is an important skill to master in chemistry. Students will be able to predict the amount of product that should be produced in a chemical reaction.

Science Standards (Established Goals)

PS1.A: structure and properties of matter
PS1.B: chemical reactions

Disciplinary Core Ideas

HS-PS1-2: construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties
HS-PS1-4: develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy
HS-PS1-6: refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.
HS-PS1-7: use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Science and Engineering Practices

SEP2: Developing and using models
SEP6: Constructing explanations and designing solutions

Cross-Cutting Concepts

CCC1: Patterns
CCC5: Energy and matter

Technology Standard(s)

8.1.12.F.1: evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and/or social needs.

Interdisciplinary Standard(s)

M2: reason abstractly and quantitatively
M4: model with mathematics
E2: they build strong content knowledge

Enduring Understandings: (What are the big ideas? What specific understandings about them are desired? What misunderstandings are predictable?)

Students will understand that…
Students will learn to differentiate between a physical change and a chemical change.
Students will also write chemical reactions using elemental symbols. These skills will be used in subsequent units.
The concept of the mole enables scientists to measure the mass, volume, and number of particles of a substance.
The mole was developed as to tool to relate the number of particles of a substance to its mass and volume.
Dimensional Analysis is used in order to perform these conversions.
Students will learn to predict the products and write five classes of chemical reactions; synthesis reactions, decomposition reactions, combustion reactions, single replacement reactions, and double replacement reactions.
Stoichiometry is the science of the quantification of matter in chemical reactions.

The mole concept and Dimensional Analysis is used to quantify the substances involved in chemical reactions.
In a chemical reaction, the total mass of the reactants must equal the total mass of the products.

Essential Question(s) : (What provocative questions will foster inquiry, understanding, and transfer of learning?)

What is the difference between a chemical change and a physical change?
How is a chemical reaction represented?
What are the five general types of chemical reactions?
How can one predict the products of the five general types of chemical reactions?
How is the mass of one mole of a compound calculated?
How is the mole used to calculate the number of particles and the mass of a compound?
How is the process of stoichiometry used to convert between different substances in a chemical reaction?
How is percent yield calculated?

In this unit plan, the following 21st Century themes and skills are addressed:

Check all that apply. 21st Century Themes		*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* 21st Century Skills	
	Global Awareness	**T**	**Critical Thinking & Problem Solving**
X	**Environmental Literacy**	**E**	**Creativity and Innovation**
	Health Literacy	**E**	**Collaboration, Teamwork and Leadership**
	Civic Literacy		**Cross-Cultural and Interpersonal Communication**
	Financial, Economic, Business and Entrepreneurial Literacy		**Communication and Media Fluency**
			Accountability, Productivity and Ethics

In this unit plan, the following Career Ready Practices are addressed:

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

		CRP1. Act as a responsible and contributing citizen and employee

E	**CRP2. Apply appropriate academic and technical skills**
	CRP3. Attend to personal health and financial well-being
E	**CRP4. Communicate clearly and effectively with reason**
	CRP5. Consider the environmental, social and economic impacts of decisions
E	**CRP6. Demonstrate creativity and innovation**
	CRP7. Employ valid and reliable research strategies
	CRP8. Utilize critical thinking to make sense of problems and persevere in solving them
	CRP9. Model integrity, ethical leadership and effective management
	CRP10. Plan education and career paths aligned to personal goals
E	**CRP11. Use technology to enhance productivity**
	CRP12. Work productively in teams while using cultural global competence

Student Learning Goals/Objectives: (What key knowledge and skills will students acquire as a result of this unit? What should they eventually be able to do as a result of such knowledge and skill?)

Students will know….	***Students will be able to (do)…***
The differences between chemical and physical changes The symbols used in a chemical equation the differences between the types of reactions how mass is conserved in a chemical reaction how to predict the products from a reaction how to balance a chemical reaction how to use the concept of the mole to determine the number of particles and the mass of a substance how to use stoichiometry to convert between different substances and to calculate the percent yield of a reaction	Differentiate between a chemical change and a physical change Write a chemical equation Classify a chemical reaction Determine the products of a chemical reaction Balance a chemical reaction Calculate the number of particles, moles, and mass of a substance Convert between different substances using stoichiometry Calculate the percent yield of a reaction

Assessment Evidence:	
Performance Tasks: *(Through what authentic performance tasks will students demonstrate the desired understandings? By what criteria will performances of understanding be judged?)* Labs/Activities: Chemical vs. physical change videos Conservation of mass activity Balancing equations activity Chemical reactions labs Stoichiometry labs	**Other Assessment Measures:** *(Through what other evidence (E.g. quizzes, tests, academic prompts, observations, homework, journals, etc.) will students demonstrate achievement of the desired results? How will students reflect upon and self- assess their learning?)* ******Attach all Benchmarks*** Quizzes: Chemical vs. physical change Balancing equations Chemical reactions Stoichiometry Tests Lab reports Homework
Teaching and Learning Actions: (What learning experiences and instruction will enable students to achieve the desired results?	
Instructional Strategies and Activities *D*	***Consider how will the design will:*** **W** = Help the students know Where the unit is going and What is expected? Help the teacher know Where the students are coming from (prior knowledge and interests)? **H**= Hook all students and Hold their interest? **E**= Equip students, help the Experience the key ideas and Explore the issue? **R**=Provide opportunities to Rethink and Revise their understandings and work? **E**=Allow students to Evaluate their work and its implications? **T**=be Tailored (personalized to the different needs, interests and abilities of learners? **O**=be Organized to maximize initial and sustained engagement as well as effective learning? Higher level classes will learn how to apply the conservation of mass to an equation, while the lower level classes will learn about this concept and not do the math. Higher level classes will do more involved

	problems/equations dealing with balancing, predicting products and stoichiometry. Additional differentiation activities as needed include: • Restructure lessons using Universal Design for Learning (UDL) principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA) • Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable phenomena. • Structure the learning around explaining or solving a social or community-based issue. • Provide English Language Learners students with multiple literacy strategies. Collaborate with after-school programs or clubs to extend learning opportunities.
Resources	
Chemistry Book Various websites/Youtube for videos NJCTL.org http://phet.colorado.edu/en/simulation/	
Suggested Time Frame:	30-40 days

D – Indicates differentiation at the Lesson Level (Identify Modifications for ELL, Gifted and Talented, Title 1, Special Education)

Content Area:	**Chemistry**	**Grade(s)** 10

Unit Plan Title:	Unit 5 - States of Matter

Overview/Rationale

Students will understand the relationship between the pressure, temperature and volume of a substance through the application of the gas laws. Students will also understand where pressure comes from and how it is measured. The state of matter of a substance can be altered by changing the pressure and/or temperature of the substance.

Science Standards (Established Goals)

PS1.A: structure and properties of matter
PS1.B: chemical reactions

Disciplinary Core Ideas

HS-PS1-3: plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles
HS-PS1-5: apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs

Science and Engineering Practices

SEP3: planning and carrying out investigations
SEP6: Constructing explanations and designing solutions

Cross-Cutting Concepts

CCC1: Patterns

Technology Standard(s)

8.1.12.F.1: evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and/or social needs.

Interdisciplinary Standard(s)

M1: make sense of problems and persevere in solving them
M2: reason abstractly and quantitatively
M4: model with mathematics
E2: they build strong content knowledge

Enduring Understandings: (What are the big ideas? What specific understandings about them are desired? What misunderstandings are predictable?)

Students will understand that…

There is a relationship between the pressure, temperature and volume of a substance and the gas laws can be used to calculate just how these affect one another.
Pressure is a result of molecular collisions and if those collision increase, then the pressure exerted by the substance will also increase. If thermal energy is added to a substance the substance will undergo a change of phase.
Phase diagrams can be used to determine the state of a matter a substance is in.

Essential Question(s) : (What provocative questions will foster inquiry, understanding, and transfer of learning?)

How are the gas laws used to calculate the pressure, temperature and/or volume of a substance?
What is pressure and how can it be measured?
What happens to a substance if its temperature and/or pressure changes?

In this unit plan, the following 21st Century themes and skills are addressed:

Check all that apply. **21st Century Themes**		*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* **21st Century Skills**	
	Global Awareness	**T**	**Critical Thinking & Problem Solving**
X	**Environmental Literacy**	**E**	**Creativity and Innovation**
	Health Literacy	**E**	**Collaboration, Teamwork and Leadership**
	Civic Literacy		**Cross-Cultural and Interpersonal Communication**

	Financial, Economic, Business and Entrepreneurial Literacy		Communication and Media Fluency
			Accountability, Productivity and Ethics

In this unit plan, the following Career Ready Practices are addressed:

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

	CRP1. Act as a responsible and contributing citizen and employee
E	**CRP2. Apply appropriate academic and technical skills**
	CRP3. Attend to personal health and financial well-being
E	**CRP4. Communicate clearly and effectively with reason**
	CRP5. Consider the environmental, social and economic impacts of decisions
E	**CRP6. Demonstrate creativity and innovation**
	CRP7. Employ valid and reliable research strategies
E	**CRP8. Utilize critical thinking to make sense of problems and persevere in solving them**
	CRP9. Model integrity, ethical leadership and effective management
	CRP10. Plan education and career paths aligned to personal goals
E	**CRP11. Use technology to enhance productivity**
	CRP12. Work productively in teams while using cultural global competence

Student Learning Goals/Objectives: (What key knowledge and skills will students acquire as a result of this unit? What should they eventually be able to do as a result of such knowledge and skill?)

Students will know….	***Students will be able to (do)…***

Temperature, pressure and volume of a substance are related to each other. How to apply the gas laws How to read and interpret a phase diagram How a manometer and barometer measure pressure	Use the gas laws to calculate the temperature, pressure or volume of a substance Interpret a phase diagram Explain how a manometer and barometer work
Assessment Evidence:	
Performance Tasks: *(Through what authentic performance tasks will students demonstrate the desired understandings? By what criteria will performances of understanding be judged?)* Labs/Activities: Gas laws Phase diagrams	**Other Assessment Measures*:*** *(Through what other evidence (E.g. quizzes, tests, academic prompts, observations, homework, journals, etc.) will students demonstrate achievement of the desired results? How will students reflect upon and self- assess their learning?)* ******Attach all Benchmarks*** Quizzes: Gas laws Phase changes/phase diagrams Pressure units conversion Tests Lab reports Homework
Teaching and Learning Actions: (What learning experiences and instruction will enable students to achieve the desired results?	
Instructional Strategies and Activities *D*	***Consider how will the design will:*** **W** = Help the students know Where the unit is going and What is expected? Help the teacher know Where the students are coming from (prior knowledge and interests)? **H**= Hook all students and Hold their interest? **E**= Equip students, help the Experience the key ideas and Explore the issue? **R**=Provide opportunities to Rethink and Revise their understandings and work? **E**=Allow students to Evaluate their work and its implications? **T**=be Tailored (personalized to the different needs, interests and abilities of learners? **O**=be Organized to maximize initial and sustained engagement as well as effective learning?

	Higher level classes will learn how to calculate the pressure of a gas from a manometer, while the lower level classes will only learn how a manometer works. Higher level classes will get more involved with the gas laws. Additional differentiation activities as needed include: • Restructure lessons using Universal Design for Learning (UDL) principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA) • Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable phenomena. • Structure the learning around explaining or solving a social or community-based issue. • Provide English Language Learners students with multiple literacy strategies. Collaborate with after-school programs or clubs to extend learning opportunities.
Resources	
Chemistry textbook NJCTL.org http://phet.colorado.edu/en/simulation/	
Suggested Time Frame:	20-30 days

D – Indicates differentiation at the Lesson Level (Identify Modifications for ELL, Gifted and Talented, Title 1, Special Education)

Content Area:	**Chemistry**	**Grade(s)** 10

Unit Plan Title:	Unit 6 - Solutions Chemistry

Overview/Rationale

It is important to be able to quantify the amount the solute that can dissolve in a given amount of solvent. The concentration of dissolved substances in water can be expressed as molarity, molality, percent by mass, percent by volume, and mole fraction. Expressing concentration in units of molarity is an important skill students must master when dealing with the concept of equilibrium and acid / base chemistry

Science Standards (Established Goals)

PS1.B: chemical reactions

Disciplinary Core Ideas

HS-PS1-2: construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties
HS-PS1-3: plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles
HS-PS1-5: apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs
HS-PS1-6: refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.

Science and Engineering Practices

SEP3: planning and carrying out investigations
SEP6: Constructing explanations and designing solutions
SEP8: Obtaining, evaluating, and communicating information

Cross-Cutting Concepts

CCC1: Patterns
CCC7: Stability and change

Technology Standard(s)

8.1.12.F.1: evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and/or social needs.

Interdisciplinary Standard(s)

M1: make sense of problems and persevere in solving them
M2: reason abstractly and quantitatively
M4: model with mathematics
E2: they build strong content knowledge

Enduring Understandings: (What are the big ideas? What specific understandings about them are desired? What misunderstandings are predictable?)

Students will understand that…

Many chemical reactions occur in aqueous solutions, therefore it is important to be able to quantify the amount of solute dissolved in a solvent. The concentration of a solute can be measured in terms of molarity, molality, percent by mass, percent by volume, and mole fraction.

The amount of solute that can be dissolved in a given amount of solvent can be affected by the temperature and / or pressure of the solution. There are also factors that affect the rate at which a solute may dissolve.

Essential Question(s) : (What provocative questions will foster inquiry, understanding, and transfer of learning?)

Which factors determine the rate a solute dissolves in a solvent?
How is the solubility of a substance measured?
How can the concentration of a substance be measured in a solution?
What affect does diluting a solution have on the concentration of the substance?
What is a colligative property?
How do solvated particles affect the colligative properties of a solution?
How is the freezing point and boiling point of a solution related to its molality?
What is the difference between an acid and a base?

In this unit plan, the following 21st Century themes and skills are addressed:

	Check all that apply. **21st Century Themes**		*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* **21st Century Skills**
		Global Awareness	**Critical Thinking & Problem Solving**
	X	**Environmental Literacy**	**Creativity and Innovation**
		Health Literacy	**Collaboration, Teamwork and Leadership**
		Civic Literacy	**Cross-Cultural and Interpersonal Communication**
		Financial, Economic, Business and Entrepreneurial Literacy	**Communication and Media Fluency**
			Accountability, Productivity and Ethics

In this unit plan, the following Career Ready Practices are addressed:

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

		CRP1. Act as a responsible and contributing citizen and employee
	E	**CRP2. Apply appropriate academic and technical skills**
		CRP3. Attend to personal health and financial well-being
	E	**CRP4. Communicate clearly and effectively with reason**
		CRP5. Consider the environmental, social and economic impacts of decisions
	E	

		CRP6. Demonstrate creativity and innovation
	E	**CRP7. Employ valid and reliable research strategies**
		CRP8. Utilize critical thinking to make sense of problems and persevere in solving them
		CRP9. Model integrity, ethical leadership and effective management
	E	**CRP10. Plan education and career paths aligned to personal goals**
		CRP11. Use technology to enhance productivity
		CRP12. Work productively in teams while using cultural global competence

Student Learning Goals/Objectives: (What key knowledge and skills will students acquire as a result of this unit? What should they eventually be able to do as a result of such knowledge and skill?)

Students will know….	***Students will be able to (do)…***
Temperature, pressure, solute surface area, and agitation affect the rate at which a substance may dissolve. Molarity, molality, percent by mass, percent by volume, and mole fraction are units of concentration. The solubility of a substance is measured in the mass of the solute per mass of solvent. The concentration of a substance is lowered when water is added to a solution. Colligative properties are physical properties of a solution that are affected by the number of dissolved solute particles. An increase in the number of solvated particles in a solution will increase the boiling point, lower the freezing point, and lower the vapor pressure of the pure solvent. As the molality of a solution increases, the boiling point of a solution increases and the freezing point of a solution decreases The difference between an acid and a base How the equilibrium constant is determined	Calculate the reaction rate of a reaction Calculate the concentration of a solution Calculate the boiling point and freezing point of a solution when the concentration changes Determine if a solution is an acid or a base Calculate the equilibrium constant for a reaction

Assessment Evidence:	
Performance Tasks: *(Through what authentic performance tasks will students demonstrate the desired understandings? By what criteria will performances of understanding be judged?)* Labs/Activities: Solutions lab Colligative properties activity	**Other Assessment Measures:** *(Through what other evidence (E.g. quizzes, tests, academic prompts, observations, homework, journals, etc.) will students demonstrate achievement of the desired results? How will students reflect upon and self- assess their learning?)* ******Attach all Benchmarks*** Quizzes: Concentrations Colligative properties Acids/bases Equilibrium constant Tests Lab reports Homework
Teaching and Learning Actions: (What learning experiences and instruction will enable students to achieve the desired results?	
Instructional Strategies and Activities *D*	***Consider how will the design will:*** **W** = Help the students know Where the unit is going and What is expected? Help the teacher know Where the students are coming from (prior knowledge and interests)? **H**= Hook all students and Hold their interest? **E**= Equip students, help the Experience the key ideas and Explore the issue? **R**=Provide opportunities to Rethink and Revise their understandings and work? **E**=Allow students to Evaluate their work and its implications? **T**=be Tailored (personalized to the different needs, interests and abilities of learners? **O**=be Organized to maximize initial and sustained engagement as well as effective learning? Higher level classes will get more involved with the math in this chapter, while the lower level classes will stick with more concepts instead of the math.

	Additional differentiation activities as needed include: • Restructure lessons using Universal Design for Learning (UDL) principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA) • Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable phenomena. • Structure the learning around explaining or solving a social or community-based issue. • Provide English Language Learners students with multiple literacy strategies. Collaborate with after-school programs or clubs to extend learning opportunities.
Resources	
Chemistry textbook NJCTL.org http://phet.colorado.edu/en/simulation/	
Suggested Time Frame:	20-30 days

D – Indicates differentiation at the Lesson Level (Identify Modifications for ELL, Gifted and Talented, Title 1, Special Education)

Content Area:	**Physics**	**Grade(s)** 11
Unit Plan Title:	**Unit 7 - Electromagnetic Radiation**	
Overview/Rationale		
Students will apply their understanding of wave properties to make sense of how electromagnetic radiation can be used to transfer information across long distances, store information, and be used to investigate nature on many scales.		

Science Standards (Established Goals)

PS4.A: wave properties
PS4.B: Electromagnetic radiation
PS3.D: Energy in chemical processes
PS4.C: information technologies and instrumentation
ETS1.A: Defining and delimiting engineering problems
ETS1.B: Developing possible solutions

Disciplinary Core Ideas

HS-PS4-2: Evaluate questions about the advantages of using a digital transmission and storage of information.
HS-PS4-3: Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.
HS-PS4-4: Evaluate the validity of reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
HS-PS4-5: Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.
HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

Science and Engineering Practices

SEP1: Asking questions and defining problems
SEP6: Constructing explanations and designing solutions
SEP7: Engaging in argument from evidence
SEP8: Obtaining, evaluating and communicating information

Cross-Cutting Concepts

CCC2: Cause and effect
CCC4: Systems and system models
CCC7: Stability and change

Technology Standard(s)

8.1.12.F.1: evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and/or social needs.

Interdisciplinary Standard(s)

M2: Reason abstractly and quantitatively
M4: Model with mathematics
E4: They comprehend as well as critique

Enduring Understandings: (What are the big ideas? What specific understandings about them are desired? What misunderstandings are predictable?)

Students will understand that…
Waves can add or cancel one another as they cross, depending on their relative phase
Electromagnetic radiation can be modeled as a wave of changing electric and magnetic fields or as particles
How polarization is used in sunglasses, cell phones, etc.
How ray diagrams are drawn

Essential Question(s) : (What provocative questions will foster inquiry, understanding, and transfer of learning?)

How can electromagnetic radiation be both a wave and a particle at the same time?
How do astronauts communicate with people on the ground?
Why has digital technology replaced analog technology?

In this unit plan, the following 21st Century themes and skills are addressed:

Check all that apply.	**21st Century Themes**	*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*	**21st Century Skills**
X	**Global Awareness**	E	**Critical Thinking & Problem Solving**

X	Environmental Literacy	E	Creativity and Innovation
	Health Literacy	E	Collaboration, Teamwork and Leadership
	Civic Literacy		Cross-Cultural and Interpersonal Communication
	Financial, Economic, Business and Entrepreneurial Literacy		Communication and Media Fluency
			Accountability, Productivity and Ethics

In this unit plan, the following Career Ready Practices are addressed:

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

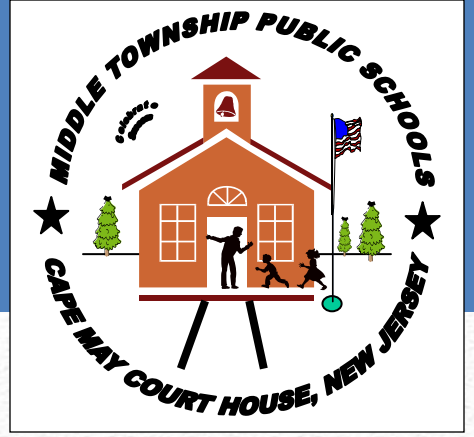
	CRP1. Act as a responsible and contributing citizen and employee
E	**CRP2. Apply appropriate academic and technical skills**
	CRP3. Attend to personal health and financial well-being
	CRP4. Communicate clearly and effectively with reason
E	**CRP5. Consider the environmental, social and economic impacts of decisions**
E	**CRP6. Demonstrate creativity and innovation**
	CRP7. Employ valid and reliable research strategies
A	**CRP8. Utilize critical thinking to make sense of problems and persevere in solving them**
	CRP9. Model integrity, ethical leadership and effective management
	CRP10. Plan education and career paths aligned to personal goals
E	**CRP11. Use technology to enhance productivity**
	CRP12. Work productively in teams while using cultural global competence

Student Learning Goals/Objectives: (What key knowledge and skills will students acquire as a result of this unit? What should they eventually be able to do as a result of such knowledge and skill?)	
Students will know…. What happens when waves meet That light is a wave and a particle The difference between diffraction, refraction and reflection How to draw a ray diagram What happens when light colors mix and how they are made	***Students will be able to (do)…*** Demonstrate the principle of superposition Draw ray diagrams: lenses and mirrors Apply the additive/subtractive color processes
Assessment Evidence:	
Performance Tasks: *(Through what authentic performance tasks will students demonstrate the desired understandings? By what criteria will performances of understanding be judged?)* Labs/Activities: Ray diagrams Light labs Polarization activity	**Other Assessment Measures*:*** *(Through what other evidence (E.g. quizzes, tests, academic prompts, observations, homework, journals, etc.) will students demonstrate achievement of the desired results? How will students reflect upon and self- assess their learning?)* ******Attach all Benchmarks*** Quizzes: Diffraction, refraction and reflection Ray diagrams Combining colors Homework Tests Lab reports
Teaching and Learning Actions: (What learning experiences and instruction will enable students to achieve the desired results?	

Instructional Strategies and Activities *D*	***Consider how will the design will:*** **W** = Help the students know Where the unit is going and What is expected? Help the teacher know Where the students are coming from (prior knowledge and interests)? **H**= Hook all students and Hold their interest? **E**= Equip students, help the Experience the key ideas and Explore the issue? **R**=Provide opportunities to Rethink and Revise their understandings and work? **E**=Allow students to Evaluate their work and its implications? **T**=be Tailored (personalized to the different needs, interests and abilities of learners? **O**=be Organized to maximize initial and sustained engagement as well as effective learning? The higher level classes will learn how to draw ray diagrams or lenses and mirrors and how to apply the lens and mirror equations to objects. They will also learn about the additive/subtractive color processes. The lower level classes will learn about ray diagrams but not about the equations. Additional differentiation activities as needed include: • Restructure lessons using Universal Design for Learning (UDL) principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA) • Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable phenomena. • Structure the learning around explaining or solving a social or community-based issue. • Provide English Language Learners students with multiple literacy strategies. Collaborate with after-school programs or clubs to extend learning opportunities.

Resources	
Chemistry textbook NJCTL.org http://phet.colorado.edu/en/simulation/	
Suggested Time Frame:	30 days

D – Indicates differentiation at the Lesson Level (Identify Modifications for ELL, Gifted and Talented, Title 1, Special Education)



Physics Curriculum

Middle Township Public Schools *216 S. Main Street*
Cape May Court House, NJ 08210

Born on: August 2016 Updated: August 2019

Table of Contents

Acknowledgements

Dr. David Salvo	Superintendent
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High School Science Curriculum Work Committee

Kristina Ortman

Introduction

This document serves to meet all requirements for curriculum as per the Middle Township Board of Education and the New Jersey Department of Education and will serve as a guide for lesson planning. Units within the curricular framework for science are designed to be taught in the order in which they are presented. Within the units, the teachers have flexibility of what order to present the standards. Suggested Science and Engineering Practice Standards and Cross-Cutting Concepts are listed in each unit to be imbedded regularly in daily science instruction.

Course Description

Physics is defined as the science that involves the study of energy, matter and how they are related. Students will investigate and explore sound, light, energy, forces, motion, Newton's Laws, gravity, electricity, and nuclear physics. Upon completion of this course, students should not only understand the subject matter of physics, but also appreciate the interrelationship between physics, biology and chemistry. Physics fulfills the New Jersey science requirements for high school graduation. Application of the Next Generation Science Standards results in a balance of the three dimensions of the standards along with a focus on the

interdisciplinary nature of all science domains among one another as well as with the New Jersey Student Learning Standards for Mathematics and English Language Arts.

Three Dimensions of the Next Generation Science Standards

The National Research Council's (NRC) *Framework* describes a vision of what it means to be proficient in science; it rests on a view of science as both a body of knowledge and an evidence-based, model and theory building enterprise that continually extends, refines, and revises knowledge. It presents three dimensions that will be combined to form each standard:

Dimension 1: Practices

The practices describe behaviors that scientists engage in as they investigate and build models and theories about the natural world and the key set of engineering practices that engineers use as they design and build models and systems. The NRC uses the term practices instead of a term like "skills" to emphasize that engaging in scientific investigation requires not only skill but also knowledge that is specific to each practice. Part of the NRC's intent is to better explain and extend what is meant by "inquiry" in science and the range of cognitive, social, and physical practices that it requires.

Although engineering design is similar to scientific inquiry, there are significant differences. For example, scientific inquiry involves the formulation of a question that can be answered through investigation, while engineering design involves the formulation of a problem that can be solved through design. Strengthening the engineering aspects of the Next Generation Science Standards will clarify for students the relevance of science, technology, engineering and mathematics (the four STEM fields) to everyday life.

Dimension 2: Crosscutting Concepts

Crosscutting concepts have application across all domains of science. As such, they are a way of linking the different domains of science. They include: Patterns, similarity, and diversity; Cause and effect; Scale, proportion and quantity; Systems and system models; Energy and matter; Structure and function; Stability and change. The Framework emphasizes that these

concepts need to be made explicit for students because they provide an organizational schema for interrelating knowledge from various science fields into a coherent and scientifically-based view of the world.

Dimension 3: Disciplinary Core Ideas

Disciplinary core ideas have the power to focus K–12 science curriculum, instruction and assessments on the most important aspects of science. To be considered core, the ideas should meet at least two of the following criteria and ideally all four:

- Have **broad importance** across multiple sciences or engineering disciplines or be a **key organizing concept** of a single discipline;
- Provide a **key tool** for understanding or investigating more complex ideas and solving problems;
- Relate to the **interests and life experiences of students** or be connected to **societal or personal concerns** that require scientific or technological knowledge;
- Be **teachable** and **learnable** over multiple grades at increasing levels of depth and sophistication.

Disciplinary ideas are grouped in four domains: the physical sciences; the life sciences; the earth and space sciences; and engineering, technology and applications of science.

Pacing Guide

UNIT TITLE	ENDURING UNDERSTANDINGS	NGSS	TIMEFRAME
Unit 1 - Introduction to Physics, Forces and Motion	• There are certain procedures they must follow in order to maintain a safe environment during labs • The scientific method is a set of steps scientists can use to solve a problem • Principles of measurement • How to interpret the motion of an on object (kinematics, graphs, free-fall and projectile motion) • How a force moves an object (including circular motion and periodic motion) • Newton's laws • What happens when objects collide • How friction affects an object • How momentum is conserved during a collision	**HS-PS2-1** **HS-PS2-2** **HS-PS2-3** **HS-ETS1-2** **HS-ETS1-3**	**25 – 35 days** **SPED: 55-65 days**
Unit 2 - Fundamental Forces	• Gravitational and electrostatic forces change between objects according to Newton	**HS-PS2-4**	**10 days**
Unit 3 - Kepler's Laws	• Use mathematical or computational representations to predict the motion of orbiting objects in the solar system	**HS-ESS1-4**	**15 days**
Unit 4 - Energy	• Energy is understood as a quantitative property of a system that depends on the motion and interactions of matter • The total change of energy in a system is equal to the total energy transferred into and out of the system	**HS-PS3-1** **HS-PS3-2** **HS-PS3-3** **HS-ETS1-1,2,3** **HS-ETS1-14**	**30 days**
Unit 5 - Fluids	• Energy is transferred using several different methods • The state of matter of an object can be determined by the amount of energy it absorbs/releases	**HS-PS3-2**	**15 days**

Unit 6- Wave Properties	• The fundamental measures of a wave are related to one another • Interactions of waves affect the properties of waves • How sound waves are different from light waves	**HS-PS4-1**	**20 days**
Unit 7 – Electromagentic Radiation	• Electromagnetic radiation is both a wave and a particle • How astronauts communicate with people on the ground • Why digital technology has replaced analog technology • How ray diagrams can be used to determine information	**HS-PS4-2:** **HS-PS4-3** **HS-PS4-4** **HS-PS4-5** **HS-ETS1-1** **HS-ETS1-3**	**30 days**
Unit 8 - Electricity and Magnetism	• Magnets or electric currents cause magnetic fields and that electric charges or changing magnetic fields cause electric fields • When two objects interacting through a field change relative position, the energy stored in the field is changed • How electric and magnetic fields are related	**HS-PS2-5** **HS-PS3-5**	**15 days**

Content Area:	Physics	Grade(s) 11 - 12
Unit Plan Title:	Unit 1 - Introduction to Physics, Forces and Motion	

Overview/Rationale

Physics is a hands-on class. Students will first learn the safety procedures they must follow throughout this course, how to apply the scientific method to solve a problem and how to use dimensional analysis to convert between units of measure.

Students will develop an understanding of ideas related to why some objects keep moving and some objects fall to the ground. They will also build an understanding of forces and Newton's laws, develop an understanding that the total momentum of a system of objects is conserved when there is no net force on the system, and have an understanding of collisions.

Science Standards (Established Goals)

PS2.A: Forces and motion
ETS1.A: Defining and delimiting an engineer problem
ETS1.B: Developing possible solutions
ETS1.C: Optimizing the design solution
PS-2-1, PS2-2, PS2-3, ETS1-2, ETS1-3

Disciplinary Core Ideas

HS-PS2-1: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
HS-PS2-2: Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.
HS-PS2-3: Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural and environmental impacts.

Science and Engineering Practices

SEP-4: Analyzing and interpreting data

- Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (HS-PS2-1)

SEP-5: Using mathematics and computational thinking

- Use mathematical representations of phenomena to describe explanations. (HS-PS2-2)

SEP-6: Constructing explanations and design solutions

- Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects. (HSPS2-3)
- Design a solution to a complex real world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-2)
- Evaluate a solution to a complex real world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-3)

Cross-Cutting Concepts

CCC-1: Patterns

CCC-2: Cause and effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS2-1)
- Systems can be designed to cause a desired effect. (HS-PS2-3)

CCC-4: Systems and systems models

- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined. (HS-PS2-2)

Technology Standard(s)

8.1.12.F.1: evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and/or social needs

Interdisciplinary Standard(s)

English Language Arts

RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and

to any gaps or inconsistencies in the account. (HS-PS2-1)
RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-PS2-1)
RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-ETS1-3)
RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. (HS-ETS1-3)
WHST.11-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.(HS-PS2-3),(HS-ETS1-3)
WHST.11-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-PS2-1)

Mathematics
MP.2 Reason abstractly and quantitatively. (HS-PS2-1),(HS-PS2-2),(HS-ETS1-1),(HS-ETS1-3),(HS-ETS1-4)
MP.4 Model with mathematics. (HS-PS2-1),(HS-PS2-2),(HS-ETS1-2),(HS-ETS1-3),(HS-ETS1-4)
HSN.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-PS2-1),(HS-PS2-2)
HSN.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. (HS-PS2-1),(HS-PS2-2)
HSN.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-PS2-1),(HS-PS2-2)
HSA.SSE.A.1 Interpret expressions that represent a quantity in terms of its context. (HS-PS2-1)
HSA.SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. (HS-PS2-1)
HSA.CED.A.1 Create equations and inequalities in one variable and use them to solve problems. (HS-PS2-1),(HS-PS2-2)
HSA.CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. (HS-PS2-1),(HS-PS2-2)
HSA.CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. (HS-PS2-1),(HS-PS2-2)
HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by in hand in simple cases and using technology for more complicated cases. (HS-PS2-1)
HSS-IS.A.1 Represent data with plots on the real number line (dot plots, histograms, and box plots). (HS-PS2-1)

Enduring Understandings: (What are the big ideas? What specific understandings about them are desired? What misunderstandings are predictable?)

Students will understand that…

There are certain procedures they must follow in order to maintain a safe environment during labs
The scientific method is a set of steps scientists can use to solve a problem
The metric system is used to take measurements and solve equations
All objects have the same acceleration due to gravity
Motion can be interpreted through graphs and mathematical equations
How a force moves an object
Newton's laws
What happens when objects collide
How friction affects an object
How momentum is conserved during a collision

Essential Question(s) : (What provocative questions will foster inquiry, understanding, and transfer of learning?)

What safety procedures must be followed in order to maintain a safe environment during labs?
How is the scientific method used to solve a problem?
How are metric prefixes converted?
Why do some objects keep moving while others fall to the ground?
How do Newton's laws pertain to an object in periodic motion?
How does a force affect an object?
What happens when objects collide?

In this unit plan, the following 21st Century themes and skills are addressed:

Check all that apply. **21st Century Themes**	*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* **21st Century Skills**

	X	Global Awareness		A	Critical Thinking & Problem Solving
		Environmental Literacy		E	Creativity and Innovation
		Health Literacy		E	Collaboration, Teamwork and Leadership
		Civic Literacy			Cross-Cultural and Interpersonal Communication
		Financial, Economic, Business and Entrepreneurial Literacy			Communication and Media Fluency
					Accountability, Productivity and Ethics

In this unit plan, the following Career Ready Practices are addressed:

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

	CRP1. Act as a responsible and contributing citizen and employee
E	**CRP2. Apply appropriate academic and technical skills**
	CRP3. Attend to personal health and financial well-being
E	**CRP4. Communicate clearly and effectively with reason**
	CRP5. Consider the environmental, social and economic impacts of decisions
	CRP6. Demonstrate creativity and innovation
	CRP7. Employ valid and reliable research strategies
A	**CRP8. Utilize critical thinking to make sense of problems and persevere in solving them**
	CRP9. Model integrity, ethical leadership and effective management
	CRP10. Plan education and career paths aligned to personal goals
	CRP11. Use technology to enhance productivity
	CRP12. Work productively in teams while using cultural global competence

Student Learning Goals/Objectives: (What key knowledge and skills will students acquire as a result of this unit? What should they eventually

be able to do as a result of such knowledge and skill?)	
Students will know…. Safety procedures The steps to the scientific method How to apply kinematics equations to solve problems Newton's laws How Newton's laws affect an object in periodic motion How a force affects an object How momentum is conserved during a collision How to determine the center of mass of an object	***Students will be able to (do)…*** Follow safety procedures Apply the scientific method to solve a problem Apply the principles of measurement Solve problems involving motion (algebraically and graphically) 1-dimension and 2-dimension Apply Newton's laws to everyday situations Calculate force of friction
Assessment Evidence:	
Performance Tasks: *(Through what authentic performance tasks will students demonstrate the desired understandings? By what criteria will performances of understanding be judged?)* Labs: Scientific method (30-40 minutes) Motion in 1-D (1 class period) Motion in 2-D (projectile motion: 1 class period) Newton's Laws activity (1-2 class periods) Friction (1 class period) Acceleration due to gravity (1 class period) Circular motion (1 class period) Pendulum lab (1 class period) Conservation of momentum (collisions) Center of mas (1 period)	**Other Assessment Measures*:*** *(Through what other evidence (E.g. quizzes, tests, academic prompts, observations, homework, journals, etc.) will students demonstrate achievement of the desired results? How will students reflect upon and self- assess their learning?)* ******Attach all Benchmarks*** Quizzes: Safety/scientific method Kinematic equation Newton's laws Friction Circular motion Momentum and collisions Homework Tests Lab reports
Teaching and Learning Actions: (What learning experiences and instruction will enable students to achieve the desired results?	

Instructional Strategies and Activities *D* Measuring metric lab (SPED) - 1 class period Scientific Method Lab - ½ class period Motion in 1-D lab - 1 class period (2 for SPED) - Matchbox cars lab (SPED) - Acceleration activity (SPED) - Paper airplanes (SPED) Motion in 2-D lab: projectile motion - Dart guns: 1 class period - Launcher lab: 1 class period Gravity Labs - 1 class period (1-2 for SPED) - Air resistance (SPED: 2 periods) Friction lab - 1 class period (1-2 for SPED) Newton's laws - Activity (1-2 periods) - Labs (SPED: 2 periods)	***Consider how will the design will:*** **W** = Help the students know Where the unit is going and What is expected? Help the teacher know Where the students are coming from (prior knowledge and interests)? **H**= Hook all students and Hold their interest? **E**= Equip students, help the Experience the key ideas and Explore the issue? **R**=Provide opportunities to Rethink and Revise their understandings and work? **E**=Allow students to Evaluate their work and its implications? **T**=be Tailored (personalized to the different needs, interests and abilities of learners? **O**=be Organized to maximize initial and sustained engagement as well as effective learning? In addition to the above objectives, the honors class will also learn about friction along incline planes, while the lower level classes will only learn about friction on a horizontal surface. The higher level classes will learn how to use the kinematic equations for projectile motion, using the trig functions to solve problems in 2-D. They will also learn how to solve problems using vectors, how to calculate the center of mass of an object, and about the different types of collisions. The lower level classes will also not do as much math with these concepts. The special education classes will stick with more conceptual physics versus more math oriented. Additional Modifications as Needed: • Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA) • Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable phenomena. • Structure the learning around explaining or solving a social or community-based issue. • Provide ELL students with multiple literacy strategies. • Collaborate with after-school programs or clubs to extend learning opportunities.

Circular motion - 1 class period Pendulum discover lab - 1 class period Collisions labs - 1 class period	
Resources	
Physics Book, NJCTL.org , Sciencespot.com, pHet.com, Vernier.com, physlab.com	
Suggested Time Frame:	25-35 days (55-65 days for SPED)

D – Indicates differentiation at the Lesson Level (Identify Modifications for ELL, Gifted and Talented, Title 1, Special Education)

Content Area:	Physics	Grade(s) 11
Unit Plan Title:	Unit 2 - Fundamental Forces	

Overview/Rationale

Make sense of Newton's law of gravitation and Coulomb's law

Science Standards (Established Goals)

PS2.B: Types of interactions

Disciplinary Core Ideas

HS-PS2-4: Use mathematical representations of Newton's law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

Science and Engineering Practices

SEP-5: Using mathematics and computational thinking

- Use mathematical representations of phenomena to describe explanations. (HS-PS2-4)

Cross-Cutting Concepts

CCC-1: Patterns

- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS2-4)

Technology Standard(s)

8.1.12.F.1: Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and/or social needs

Interdisciplinary Standard(s)

English Language Arts
N/A
Mathematics
HSN.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-PS2-4)
HSA.SSE.A.1 Interpret expressions that represent a quantity in terms of its context. (HS-PS2-4)
HSA.SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. (HS-PS2-4)
MP.2 Reason abstractly and quantitatively. (HS-PS2-4)
MP.4 Model with mathematics. (HS-PS2-4)
HSN.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-PS2-4)
HSN.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. (HS-PS2-4)

Enduring Understandings: (What are the big ideas? What specific understandings about them are desired? What misunderstandings are predictable?)

Students will understand that…
Gravitational and electrostatic forces change between objects according to Newton and Coulomb's law
Newton's laws can be applied to objects in uniform circular motion
There are different types of friction

Essential Question(s) : (What provocative questions will foster inquiry, understanding, and transfer of learning?)

How are the gravitational and electrostatic forces between two objects determined?
How is Newton's law of gravitation applied to objects in uniform circular motion?
How are Newton's laws applied to both frictional and non-friction equilibrium and non-equilibrium problems?

In this unit plan, the following 21st Century themes and skills are addressed:

Check all that apply. **21st Century Themes**	*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* **21st Century Skills**

	X	Global Awareness		E	Critical Thinking & Problem Solving
		Environmental Literacy			Creativity and Innovation
		Health Literacy		E	Collaboration, Teamwork and Leadership
		Civic Literacy			Cross-Cultural and Interpersonal Communication
		Financial, Economic, Business and Entrepreneurial Literacy			Communication and Media Fluency
					Accountability, Productivity and Ethics

In this unit plan, the following Career Ready Practices are addressed:

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

		CRP1. Act as a responsible and contributing citizen and employee
	E	**CRP2. Apply appropriate academic and technical skills**
		CRP3. Attend to personal health and financial well-being
		CRP4. Communicate clearly and effectively with reason
		CRP5. Consider the environmental, social and economic impacts of decisions
	E	**CRP6. Demonstrate creativity and innovation**
		CRP7. Employ valid and reliable research strategies
	A	**CRP8. Utilize critical thinking to make sense of problems and persevere in solving them**
		CRP9. Model integrity, ethical leadership and effective management
		CRP10. Plan education and career paths aligned to personal goals
		CRP11. Use technology to enhance productivity
		CRP12. Work productively in teams while using cultural global competence

Student Learning Goals/Objectives: (What key knowledge and skills will students acquire as a result of this unit? What should they eventually be able to do as a result of such knowledge and skill?)

Students will know….	***Students will be able to (do)…***
How to make sense of Newtons' laws, Newton's law of gravitation and Coulomb's law How to apply Newton's law of gravity to objects in uniform circular motion How to solve problems involving friction	Plan and conduct investigations and apply scientific ideas to make sense of Newton's law of gravitation and Coulomb's law Apply these laws to describe and predict the gravitational and electrostatic forces between objects. Determine how forces move objects

Assessment Evidence:

Performance Tasks: *(Through what authentic performance tasks will students demonstrate the desired understandings? By what criteria will performances of understanding be judged?)*	**Other Assessment Measures*:*** *(Through what other evidence (E.g. quizzes, tests, academic prompts, observations, homework, journals, etc.) will students demonstrate achievement of the desired results? How will students reflect upon and self- assess their learning?)* ******Attach all Benchmarks***
Labs: Graphical relationships in electric fields lab Gravity force lab Uniform circular motion	Quizzes: Newton's law of universal attraction Coulomb's law Homework Tests Lab reports

Teaching and Learning Actions: (What learning experiences and instruction will enable students to achieve the desired results?	
Instructional Strategies and Activities *D* Gravity force lab - 1 class period Graphical relationships lab - 1 class period	***Consider how will the design will:*** **W** = Help the students know Where the unit is going and What is expected? Help the teacher know Where the students are coming from (prior knowledge and interests)? **H**= Hook all students and Hold their interest? **E**= Equip students, help the Experience the key ideas and Explore the issue? **R**=Provide opportunities to Rethink and Revise their understandings and work? **E**=Allow students to Evaluate their work and its implications? **T**=be Tailored (personalized to the different needs, interests and abilities of learners? **O**=be Organized to maximize initial and sustained engagement as well as effective learning? The honors classes will do more math in this chapter, while the lower levels will learn more about the relationships instead of focusing on the equations. The honors class will also learn how friction impacts object on an incline and about objects in uniform circular motion. Gravity Force Lab: Visualize the gravitational force that two objects exert on each other. Adjust properties of the objects to see how changing the properties affect the gravitational attraction. Graphical Relationships in Electric Fields: Activity uses the simulations to generate data to be analyzed. Allows for graphical analysis and equations related to voltage and Coulombs Law. Electrostatics: Use a series of interactive models and games to explore electrostatics. Learn about the effects positive and negative charges have on one another, and investigate these effects further through games. Learn about Coulomb's law and the concept that both the distance between the charges and the difference in the charges affect the strength of the force. Explore polarization at an atomic level, and learn how a material that does not hold any net charge can be attracted to a charged object.

	Additional Modifications as Needed: • Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA) • Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable phenomena. • Structure the learning around explaining or solving a social or community-based issue. • Provide ELL students with multiple literacy strategies. • Collaborate with after-school programs or clubs to extend learning opportunities.
Resources	
Physics Book, NJCTL.org , Sciencespot.com, pHet.com, Vernier.com, physlab.com	
Suggested Time Frame:	20 days

D – Indicates differentiation at the Lesson Level (Identify Modifications for ELL, Gifted and Talented, Title 1, Special Education)

Content Area:	Physics	Grade(s) 11
Unit Plan Title:	Unit 3 - Kepler's Laws	

Overview/Rationale

Examine the processes governing the workings of the solar system and universe

Science Standards (Established Goals)

ESS1.B: Earth and Solar System

Disciplinary Core Ideas

HS-ESS1-4: Use mathematical or computational representations to predict the motion of orbiting objects in the solar system

Science and Engineering Practices

SEP-5: Using mathematics and computational thinking

- Use mathematical or computational representations of phenomena to describe explanations. (HS-ESS1-4)

Cross-Cutting Concepts

CCC-3: Scale, proportion and quantity

- Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth). (HS-ESS1-4)

Technology Standard(s)

8.1.12.F.1: evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and/or social needs.

Interdisciplinary Standard(s)

English Language Arts

N/A

Mathematics

MP.2 Reason abstractly and quantitatively. (HS-ESS1-4)
MP.4 Model with mathematics. (HS-ESS1-4)
HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-ESS1-4)
HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. (HS-ESS1-4)
HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-ESS1-4)
HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context. (HS-ESS1-4)
HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. (HS-ESS1-4)
HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. (HS-ESS1-4)

Enduring Understandings: (What are the big ideas? What specific understandings about them are desired? What misunderstandings are predictable?)

Students will understand that…
Use mathematical or computational representations to predict the motion of orbiting objects in the solar system

Essential Question(s) : (What provocative questions will foster inquiry, understanding, and transfer of learning?)

How was it possible for NASA to intentionally fly into Comet Tempel 1?

In this unit plan, the following 21st Century themes and skills are addressed:

Check all that apply. **21st Century Themes**	*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* **21st Century Skills**

	X	Global Awareness		E	Critical Thinking & Problem Solving
		Environmental Literacy			Creativity and Innovation
		Health Literacy		E	Collaboration, Teamwork and Leadership
		Civic Literacy			Cross-Cultural and Interpersonal Communication
		Financial, Economic, Business and Entrepreneurial Literacy			Communication and Media Fluency
					Accountability, Productivity and Ethics

In this unit plan, the following Career Ready Practices are addressed:

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

	CRP1. Act as a responsible and contributing citizen and employee
E	CRP2. Apply appropriate academic and technical skills
	CRP3. Attend to personal health and financial well-being
	CRP4. Communicate clearly and effectively with reason
E	CRP5. Consider the environmental, social and economic impacts of decisions
E	CRP6. Demonstrate creativity and innovation
	CRP7. Employ valid and reliable research strategies
A	CRP8. Utilize critical thinking to make sense of problems and persevere in solving them
	CRP9. Model integrity, ethical leadership and effective management
	CRP10. Plan education and career paths aligned to personal goals
	CRP11. Use technology to enhance productivity
	CRP12. Work productively in teams while using cultural global competence

Student Learning Goals/Objectives: (What key knowledge and skills will students acquire as a result of this unit? What should they eventually be able to do as a result of such knowledge and skill?)	
Students will know…. How Kepler's laws are used to determine the motion of orbiting objects in the solar system	***Students will be able to (do)…*** Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. Use mathematical and computational representations of Newtonian gravitational laws governing orbital motion that apply to moons and human-made satellites. Use algebraic thinking to examine scientific data and predict the motion of orbiting objects in the solar system.
Assessment Evidence:	
Performance Tasks: *(Through what authentic performance tasks will students demonstrate the desired understandings? By what criteria will performances of understanding be judged?)* Kepler's law graphing activity	**Other Assessment Measures*:*** *(Through what other evidence (E.g. quizzes, tests, academic prompts, observations, homework, journals, etc.) will students demonstrate achievement of the desired results? How will students reflect upon and self- assess their learning?)* ******Attach all Benchmarks*** Quizzes: Kepler's 3 laws Orbital velocity and period Homework Tests Lab reports
Teaching and Learning Actions: (What learning experiences and instruction will enable students to achieve the desired results?	

Instructional Strategies and Activities *D* Kepler's graphing activity - 30-40 minutes	***Consider how will the design will:*** **W** = Help the students know Where the unit is going and What is expected? Help the teacher know Where the students are coming from (prior knowledge and interests)? **H**= Hook all students and Hold their interest? **E**= Equip students, help the Experience the key ideas and Explore the issue? **R**=Provide opportunities to Rethink and Revise their understandings and work? **E**=Allow students to Evaluate their work and its implications? **T**=be Tailored (personalized to the different needs, interests and abilities of learners? **O**=be Organized to maximize initial and sustained engagement as well as effective learning? The honors classes will not only focus on the math behind Kepler's laws but also on the equations to calculate orbital velocity and orbital period of a satellite. The lower level classes will focus more on the relationships within the equations and basic concepts of Kepler's laws. • Planetary Orbits Lab - Understanding and utilizing Kepler's laws of motion plus the effects of velocity and force on a satellites' orbit • Gravity Force Lab **-** Students will use the Gravity Force Lab PhET Simulation to investigate what the gravitational force between two objects depends on and experimentally determine the Universal Gravitational constant, G. Lab Sheet • Period of Jupiter's moons - Students use a series of 31 images of Jupiter's 4 Galilean moons to find their orbit periods and orbit radii. They compare their results with known data for those moons. Finally they test various mathematical expressions to find a "constant" relationship between orbit period (T) and orbit radius (R) to arrive at Kepler's 3rd Law. (All activities Kepler's NASA) • Periodic Planetary Orbits - This activity will show how to calculate the period of the orbit (length of the year) for planets in the Solar System. • Curtate of Planetary Orbits - Calculate and plot orbits of Planets in Solar System • Exploring Kepler's Laws and the Universal Law of Gravitation - Using Interactive Physics to explore **Kepler's laws of planetary motion** and the universal **law** of gravitation. • Basic Kepler Activity - This activity will discuss the properties of ellipses and Kepler's laws of orbital motion. Additional Modifications as Needed:

	• Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA) • Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable phenomena. • Structure the learning around explaining or solving a social or community-based issue. • Provide ELL students with multiple literacy strategies. • Collaborate with after-school programs or clubs to extend learning opportunities.
Resources	
Physics Book, NJCTL.org , Sciencespot.com, pHet.com, Vernier.com, physlab.com	
Suggested Time Frame:	15 days

D – Indicates differentiation at the Lesson Level (Identify Modifications for ELL, Gifted and Talented, Title 1, Special Education)

Content Area:	Physics	Grade(s) 11
Unit Plan Title:	Unit 4 – Work and Energy	

Overview/Rationale

Students will be able to differentiate between different types of energy, understand how energy is conserved and transferred, and the relationship between energy and forces.

Science Standards (Established Goals)

PS3.A: Definitions of energy
PS3.B: Conservation of energy and energy transfer
PS3.D: Energy in chemical processes
ETS1.A: Defining and delimiting an engineering problem
ETS1.B: Developing possible solutions
ETS1.C: Optimizing the design solution

Disciplinary Core Ideas

HS-PS3-1: Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
HS-PS3-2: Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects)
HS-PS3-3: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy
HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants
HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering
HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
HS-ETS1-4: Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem

Science and Engineering Practices

SEP-1: Asking questions and defining problems

- Analyze complex real-world problems by specifying criteria and constraints for successful solutions. (HS-ETS1-1)

SEP-2: Developing and using models

- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS3-2)

SEP-5: Using mathematical and computational thinking

- Create a computational model or simulation of a phenomenon, designed device, process, or system. (HS-PS3-1)
- Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems. (HS-ETS1-4)

SEP-6: Constructing explanations and designing solutions

- Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-PS3-3)
- Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-2)
- Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-3)

Cross-Cutting Concepts

CCC-4: Systems and system models

- Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. (HS-PS3-1)
- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows— within and between systems at different scales. (HS-ETS1-4)

CCC-5: Energy and matter

- Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-PS3-3)
- Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems. (HS-PS3-2)

Technology Standard(s)

8.1.12.F.1: evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and/or social needs.

Interdisciplinary Standard(s)

English Language Arts

RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-PS1-3)
WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-PS1-2)
WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (HS-PS1-2),(HS-ETS1-3)
WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-PS1-3),(HS-ETS1-1),(HS-ETS1-3)
WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (HS-PS1-3),(HS-ETS1-3),(HS-ETS1-1),(HS-ETS1-3)
WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-PS1-3),(HS-ETS1-1),(HS-ETS1-3)
SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-PS1-4)

Mathematics

MP.2 Reason abstractly and quantitatively. (HS-ETS1-1),(HS-ETS1-3),(HS-ETS1-4)
MP.4 Model with mathematics. (HS-ETS1-1),(HS-ETS1-2),(HS-ETS1-3),(HS-ETS1-4)
HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-PS1-2),(HS-PS1-3)

Enduring Understandings: (What are the big ideas? What specific understandings about them are desired? What misunderstandings are predictable?)

Students will understand that…

Energy is understood as a quantitative property of a system that depends on the motion and interactions of matter
The total change of energy in a system is equal to the total energy transferred into and out of the system
There is a relationship between rotational motion and linear motion

Essential Question(s) : (What provocative questions will foster inquiry, understanding, and transfer of learning?)

What is work and how is it calculated?
How is energy transferred and conserved?
How are changes in energy calculated?
What is rotational kinematics/dynamics?

In this unit plan, the following 21st Century themes and skills are addressed:

Check all that apply. 21st Century Themes			*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* 21st Century Skills	
X	Global Awareness		E	Critical Thinking & Problem Solving
X	Environmental Literacy			Creativity and Innovation
	Health Literacy		E	Collaboration, Teamwork and Leadership
	Civic Literacy			Cross-Cultural and Interpersonal Communication
	Financial, Economic, Business and Entrepreneurial Literacy			Communication and Media Fluency
				Accountability, Productivity and Ethics

In this unit plan, the following Career Ready Practices are addressed:

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

	CRP1. Act as a responsible and contributing citizen and employee
E	**CRP2. Apply appropriate academic and technical skills**
	CRP3. Attend to personal health and financial well-being
	CRP4. Communicate clearly and effectively with reason
E	**CRP5. Consider the environmental, social and economic impacts of decisions**
E	**CRP6. Demonstrate creativity and innovation**
	CRP7. Employ valid and reliable research strategies
A	**CRP8. Utilize critical thinking to make sense of problems and persevere in solving them**
	CRP9. Model integrity, ethical leadership and effective management
	CRP10. Plan education and career paths aligned to personal goals
	CRP11. Use technology to enhance productivity
	CRP12. Work productively in teams while using cultural global competence

Student Learning Goals/Objectives: (What key knowledge and skills will students acquire as a result of this unit? What should they eventually be able to do as a result of such knowledge and skill?)

Students will know….	***Students will be able to (do)…***
The differences in the types of energy How work and power are related to energy What conservation means That energy can't be created or destroyed Energy is a quantitative property of a system that depends on the motion and interactions of matter within that system The difference between angular quantities and linear quantities	Calculate changes in kinetic energy and gravitational energy of a system Calculate the amount of work/power in a system Identify the various types of energy within a system Apply the conservation of energy to real-world problems - Linear and rotational

Assessment Evidence:	
Performance Tasks: *(Through what authentic performance tasks will students demonstrate the desired understandings? By what criteria will performances of understanding be judged?)* Labs: Work and power Kinetic energy Potential energy Hooke's law Conservation of energy Roller Coaster project Rotational motion	**Other Assessment Measures:** *(Through what other evidence (E.g. quizzes, tests, academic prompts, observations, homework, journals, etc.) will students demonstrate achievement of the desired results? How will students reflect upon and self- assess their learning?)* ******Attach all Benchmarks*** Quizzes: Work and power Kinetic and potential energy Conservation of energy Homework Tests Lab reports
Teaching and Learning Actions: (What learning experiences and instruction will enable students to achieve the desired results?	
Instructional Strategies and Activities *D* Power lab - 30-40 minutes	***Consider how will the design will:*** **W** = Help the students know Where the unit is going and What is expected? Help the teacher know Where the students are coming from (prior knowledge and interests)? **H**= Hook all students and Hold their interest? **E**= Equip students, help the Experience the key ideas and Explore the issue? **R**=Provide opportunities to Rethink and Revise their understandings and work? **E**=Allow students to Evaluate their work and its implications? **T**=be Tailored (personalized to the different needs, interests and abilities of learners? **O**=be Organized to maximize initial and sustained engagement as well as effective learning? The honors classes will do more problems where the object has some potential energy and some kinetic energy at the same time while the lower levels the objects will have one or the other. The roller coaster project will be more involved for the higher level classes. The higher level classes will also learn how angles can affect the amount of work done, while the lower level classes won't have problems as involved as the higher levels. The honors class will also learn about rotational motion including angular quantities, rotational kinematics, torque

and conservation of angular momentum. The special education classes will also learn about how simple machines work.

Energy Skate Park: Basics: Learn about conservation of energy with a skater gal! Explore different tracks and view the kinetic energy, potential energy and friction as she moves. Build your own tracks, ramps, and jumps for the skater.

Work and Energy Workbook Labs: The lab description pages describe the question and purpose of each lab and provide a short description of what should be included in the student lab report.

Build a Solar House: Construct and measure the energy efficiency and solar heat gain of a cardboard model house. Use a light bulb heater to imitate a real furnace and a temperature sensor to monitor and regulate the internal temperature of the house. Use a bright bulb in a gooseneck lamp to model sunlight at different times of the year, and test the effectiveness of windows for passive solar heating.

Additional Modifications as Needed:

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

Resources

Physics Book, NJCTL.org , Sciencespot.com, pHet.com, Vernier.com, physlab.com	
Suggested Time Frame:	30 days

D – Indicates differentiation at the Lesson Level (Identify Modifications for ELL, Gifted and Talented, Title 1, Special Education)

Content Area:	**Physics**	**Grade(s)** 11
Unit Plan Title:	**Unit 5 - Fluids**	

Overview/Rationale

Students will be able to differentiate between fluid statics and fluid dynamics. Students will understand how energy affects the state of matter a substance is in.

Science Standards (Established Goals)

PS3.A: Definitions of energy
PS3.B: Conservation of energy and energy transfer
PS3.D: Energy in chemical processes

Disciplinary Core Ideas

HS-PS3-2: Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles and energy associated with the relative positions of particles
HS-PS3-4: Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system

Science and Engineering Practices

SEP-2: Developing and using models
- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS3-2)

SEP-3: Planning and carrying out investigations
SEP-5: Using mathematical and computational thinking

Cross-Cutting Concepts

CCC-4: System and system models
CCC-5: Energy and matter
- Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems. (HS-PS3-2)

Technology Standard(s)

8.1.12.F.1: evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and/or social needs.

Interdisciplinary Standard(s)

M2: Reason abstractly and quantitatively
M4: Model with mathematics
E4: They comprehend as well as critique

Enduring Understandings: (What are the big ideas? What specific understandings about them are desired? What misunderstandings are predictable?)

Students will understand that…
Thermal energy is transferred using several different methods
The state of matter of an object can be determined by the amount of energy it absorbs/releases

Essential Question(s) : (What provocative questions will foster inquiry, understanding, and transfer of learning?)

How can thermal energy be transferred?
What is specific heat?
What is the difference between fluid statics and fluid dynamics?

In this unit plan, the following 21st Century themes and skills are addressed:

Check all that apply.	**21st Century Themes**	*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*	**21st Century Skills**
X	**Global Awareness**	E	**Critical Thinking & Problem Solving**
X	**Environmental Literacy**	E	**Creativity and Innovation**
	Health Literacy	E	**Collaboration, Teamwork and Leadership**
	Civic Literacy		**Cross-Cultural and Interpersonal Communication**
	Financial, Economic, Business and Entrepreneurial Literacy		**Communication and Media Fluency**
			Accountability, Productivity and Ethics

In this unit plan, the following Career Ready Practices are addressed:

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

	CRP1. Act as a responsible and contributing citizen and employee
E	**CRP2. Apply appropriate academic and technical skills**

	CRP3. Attend to personal health and financial well-being
	CRP4. Communicate clearly and effectively with reason
E	**CRP5. Consider the environmental, social and economic impacts of decisions**
E	**CRP6. Demonstrate creativity and innovation**
	CRP7. Employ valid and reliable research strategies
A	**CRP8. Utilize critical thinking to make sense of problems and persevere in solving them**
	CRP9. Model integrity, ethical leadership and effective management
	CRP10. Plan education and career paths aligned to personal goals
	CRP11. Use technology to enhance productivity
	CRP12. Work productively in teams while using cultural global competence

Student Learning Goals/Objectives: (What key knowledge and skills will students acquire as a result of this unit? What should they eventually be able to do as a result of such knowledge and skill?)

Students will know….	***Students will be able to (do)…***
How thermal energy is transferred between objects How the amount of energy affects the state of matter a substance is in The difference between fluid statics and fluid dynamics	Calculate specific heat Apply the idea of calorimetry to two substances Apply Pascal's principle Calculate the buoyant force on an object Apply Archimede's and Bernoulli's principles to an object

Assessment Evidence:

Performance Tasks: *(Through what authentic performance tasks will students demonstrate the desired understandings? By what criteria will performances of understanding be judged?)*	**Other Assessment Measures*:*** *(Through what other evidence (E.g. quizzes, tests, academic prompts, observations, homework, journals, etc.) will students demonstrate achievement of the desired results? How will students reflect upon and self- assess their learning?)* ******Attach all Benchmarks***
Labs: Calorimetry Archimede's principle	Quizzes:

Airplane lab	Calorimetry and specific heat Buoyancy Homework Tests Lab reports
Teaching and Learning Actions: (What learning experiences and instruction will enable students to achieve the desired results?	
Instructional Strategies and Activities *D*	***Consider how will the design will:*** **W** = Help the students know Where the unit is going and What is expected? Help the teacher know Where the students are coming from (prior knowledge and interests)? **H**= Hook all students and Hold their interest? **E**= Equip students, help the Experience the key ideas and Explore the issue? **R**=Provide opportunities to Rethink and Revise their understandings and work? **E**=Allow students to Evaluate their work and its implications? **T**=be Tailored (personalized to the different needs, interests and abilities of learners? **O**=be Organized to maximize initial and sustained engagement as well as effective learning? The higher level classes will have problems on calorimetry and specific heat that are more involved than the lower level classes (phase changes). The special education classes will learn the concepts of calorimetry and buoyancy but not do any problems. Additional Modifications as Needed: • Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA) • Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).

	• Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable phenomena. • Structure the learning around explaining or solving a social or community-based issue. • Provide ELL students with multiple literacy strategies. • Collaborate with after-school programs or clubs to extend learning opportunities.
Resources	
Physics Book, NJCTL.org , Sciencespot.com, pHet.com, Vernier.com, physlab.com	
Suggested Time Frame:	15 days

D – Indicates differentiation at the Lesson Level (Identify Modifications for ELL, Gifted and Talented, Title 1, Special Education)

Content Area:	**Physics**	**Grade(s)** 11
Unit Plan Title:	**Unit 6- Wave Properties**	

Overview/Rationale

Students will apply their understanding of how wave properties can be used to transfer information across long distances, store information, and investigate nature on many scales.
Students will also understand the difference between types of waves.

Science Standards (Established Goals)

PS4.A: Wave Properties

Disciplinary Core Ideas

HS-PS4-1: Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

Science and Engineering Practices

SEP-5: Using mathematical and computational thinking

- Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-PS4-1)

Cross-Cutting Concepts

CCC-2: Cause and effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS4-1)

Technology Standard(s)

8.1.12.F.1: evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and/or social needs.

Interdisciplinary Standard(s)

English Language Arts
RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-PS4-1)

Mathematics
MP.2 Reason abstractly and quantitatively. (HS-PS4-1)
MP.4 Model with mathematics. (HS-PS4-1)
HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context. (HS-PS4-1)
HSA-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. (HS-PS4-1)
HSA.CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. (HS-PS4-1)

Enduring Understandings: (What are the big ideas? What specific understandings about them are desired? What misunderstandings are predictable?)

Students will understand that…
The fundamental measures of a wave are related to one another
Interactions of waves affect the properties of waves
How sound waves are different from light waves

Essential Question(s) : (What provocative questions will foster inquiry, understanding, and transfer of learning?)

What are the fundamental measures of a wave, and how are they related to one another?
What happens when waves interfere with each other?
What is the difference between sound waves and light waves?

In this unit plan, the following 21st Century themes and skills are addressed:

Check all that apply.	**21st Century Themes**	*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*	**21st Century Skills**
X	**Global Awareness**	E	**Critical Thinking & Problem Solving**
X	**Environmental Literacy**	E	**Creativity and Innovation**
	Health Literacy	E	**Collaboration, Teamwork and Leadership**
	Civic Literacy		**Cross-Cultural and Interpersonal Communication**
	Financial, Economic, Business and Entrepreneurial Literacy		**Communication and Media Fluency**
			Accountability, Productivity and Ethics

In this unit plan, the following Career Ready Practices are addressed:

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

	CRP1. Act as a responsible and contributing citizen and employee
E	**CRP2. Apply appropriate academic and technical skills**
	CRP3. Attend to personal health and financial well-being
	CRP4. Communicate clearly and effectively with reason
E	**CRP5. Consider the environmental, social and economic impacts of decisions**

E	**CRP6. Demonstrate creativity and innovation**
	CRP7. Employ valid and reliable research strategies
A	**CRP8. Utilize critical thinking to make sense of problems and persevere in solving them**
	CRP9. Model integrity, ethical leadership and effective management
	CRP10. Plan education and career paths aligned to personal goals
	CRP11. Use technology to enhance productivity
	CRP12. Work productively in teams while using cultural global competence

Student Learning Goals/Objectives: (What key knowledge and skills will students acquire as a result of this unit? What should they eventually be able to do as a result of such knowledge and skill?)

Students will know….	***Students will be able to (do)…***
The differences between types of waves How frequency, speed and velocity of a wave are related How a sound wave changes by adjusting the frequency of the wave How the Doppler Shift works How a wave refracts, reflects and diffracts How Snell's Law works	Differentiate between types of waves Calculate the speed, velocity and frequency of a waves by using the wave equation Apply the Doppler Shift to real-world scenarios Trace the course of different light rays and calculate the angle of incidence and to apply Snell's Law

Assessment Evidence:

Performance Tasks: *(Through what authentic performance tasks will students demonstrate the desired understandings? By what criteria will performances of understanding be judged?)*	**Other Assessment Measures*:*** *(Through what other evidence (E.g. quizzes, tests, academic prompts, observations, homework, journals, etc.) will students demonstrate achievement of the desired results? How will students reflect upon and self- assess their learning?)* ******Attach all Benchmarks***
Labs: Waves activity Resonance lab Snell's law lab	Quizzes: Wave equation

	Sound Light Homework Tests Lab reports
Teaching and Learning Actions: (What learning experiences and instruction will enable students to achieve the desired results?	
Instructional Strategies and Activities *D*	***Consider how will the design will:*** **W** = Help the students know Where the unit is going and What is expected? Help the teacher know Where the students are coming from (prior knowledge and interests)? **H**= Hook all students and Hold their interest? **E**= Equip students, help the Experience the key ideas and Explore the issue? **R**=Provide opportunities to Rethink and Revise their understandings and work? **E**=Allow students to Evaluate their work and its implications? **T**=be Tailored (personalized to the different needs, interests and abilities of learners? **O**=be Organized to maximize initial and sustained engagement as well as effective learning? The honors classes will learn the equations for the Doppler shift and how to use them where the lower level classes will only learn about the concept. The higher level classes will learn the equation for Snell's law. **Wave on a string**: Students will watch a wave on a string. Adjusting the amplitude, frequency, damping and tension will demonstrate wave properties. **Slinky Lab**: Students will observe patterns of waves and their interactions using a slinky. **Ripple Tank**: Students will investigate wave properties (speed in a medium, reflection, diffraction, interference) using the PhET virtual ripple tank, or use an actual ripple tank. **Resonance Tube**: Velocity of Sound. Students will observe the resonance phenomenon in an open ended cylindrical tube, and use the resonance to determine the velocity of sound in air at ordinary temperatures. **Resonance:** Students will identify, through experimentation, cause and effect relationships that affect natural resonance of these systems.

	Sound Waves: Students will adjust the frequency to both see and hear how the wave changes to explain how different sounds are modeled, described, and produced. **Doppler Effect:** Students will explore the detection of sound waves from a moving source and the change in frequency of the detected wave via the Doppler effect. **Refraction through Glass:** Students will trace the course of different rays of light through a rectangular glass slab at different angles of incidence, measure the angle of incidence, refraction, measure the lateral displacement to verify Snell`s law. Additional Modifications as Needed: • Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA) • Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). • Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable phenomena. • Structure the learning around explaining or solving a social or community-based issue. • Provide ELL students with multiple literacy strategies. • Collaborate with after-school programs or clubs to extend learning opportunities.
Resources	
Physics Book, NJCTL.org , Sciencespot.com, pHet.com, Vernier.com, physlab.com	
Suggested Time Frame:	20 days

D – Indicates differentiation at the Lesson Level (Identify Modifications for ELL, Gifted and Talented, Title 1, Special Education)

Content Area:	**Physics**	**Grade(s)** 11
Unit Plan Title:	**Unit 7 - Electromagnetic Radiation**	

Overview/Rationale

Students will apply their understanding of wave properties to make sense of how electromagnetic radiation can be used to transfer information across long distances, store information, and be used to investigate nature on many scales.

Science Standards (Established Goals)

PS4.A: wave properties
PS4.B: Electromagnetic radiation
PS3.D: Energy in chemical processes
PS4.C: information technologies and instrumentation
ETS1.A: Defining and delimiting engineering problems
ETS1.B: Developing possible solutions

Disciplinary Core Ideas

HS-PS4-2: Evaluate questions about the advantages of using a digital transmission and storage of information.
HS-PS4-3: Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.
HS-PS4-4: Evaluate the validity of reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
HS-PS4-5: Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.
HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of

constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

Science and Engineering Practices

SEP1: Asking questions and defining problems
SEP6: Constructing explanations and designing solutions
SEP7: Engaging in argument from evidence
SEP8: Obtaining, evaluating and communicating information

Cross-Cutting Concepts

CCC2: Cause and effect
CCC4: Systems and system models
CCC7: Stability and change

Technology Standard(s)

8.1.12.F.1: evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and/or social needs.

Interdisciplinary Standard(s)

M2: Reason abstractly and quantitatively
M4: Model with mathematics
E4: They comprehend as well as critique

Enduring Understandings: (What are the big ideas? What specific understandings about them are desired? What misunderstandings are predictable?)

Students will understand that…
Waves can add or cancel one another as they cross, depending on their relative phase
Electromagnetic radiation can be modeled as a wave of changing electric and magnetic fields or as particles
How polarization is used in sunglasses, cell phones, etc.
How ray diagrams are drawn

Essential Question(s) : (What provocative questions will foster inquiry, understanding, and transfer of learning?)

How can electromagnetic radiation be both a wave and a particle at the same time?
How do astronauts communicate with people on the ground?
Why has digital technology replaced analog technology?

In this unit plan, the following 21st Century themes and skills are addressed:

Check all that apply.

21st Century Themes

X	**Global Awareness**
X	**Environmental Literacy**
	Health Literacy
	Civic Literacy
	Financial, Economic, Business and Entrepreneurial Literacy

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

21st Century Skills

E	**Critical Thinking & Problem Solving**
E	**Creativity and Innovation**
E	**Collaboration, Teamwork and Leadership**
	Cross-Cultural and Interpersonal Communication
	Communication and Media Fluency
	Accountability, Productivity and Ethics

In this unit plan, the following Career Ready Practices are addressed:

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

	CRP1. Act as a responsible and contributing citizen and employee
E	**CRP2. Apply appropriate academic and technical skills**
	CRP3. Attend to personal health and financial well-being
	CRP4. Communicate clearly and effectively with reason
E	**CRP5. Consider the environmental, social and economic impacts of decisions**

E	**CRP6. Demonstrate creativity and innovation**
	CRP7. Employ valid and reliable research strategies
A	**CRP8. Utilize critical thinking to make sense of problems and persevere in solving them**
	CRP9. Model integrity, ethical leadership and effective management
	CRP10. Plan education and career paths aligned to personal goals
E	**CRP11. Use technology to enhance productivity**
	CRP12. Work productively in teams while using cultural global competence

Student Learning Goals/Objectives: (What key knowledge and skills will students acquire as a result of this unit? What should they eventually be able to do as a result of such knowledge and skill?)

Students will know….	***Students will be able to (do)…***
What happens when waves meet That light is a wave and a particle The difference between diffraction, refraction and reflection How to draw a ray diagram What happens when light colors mix and how they are made	Demonstrate the principle of superposition Draw ray diagrams: lenses and mirrors Apply the additive/subtractive color processes

Assessment Evidence:

Performance Tasks: *(Through what authentic performance tasks will students demonstrate the desired understandings? By what criteria will performances of understanding be judged?)*	**Other Assessment Measures***: (Through what other evidence (E.g. quizzes, tests, academic prompts, observations, homework, journals, etc.) will students demonstrate achievement of the desired results? How will students reflect upon and self- assess their learning?)* ******Attach all Benchmarks***
Labs/Activities: Ray diagrams Light labs Polarization activity	Quizzes: Diffraction, refraction and reflection Ray diagrams

	Combining colors Homework Tests Lab reports
Teaching and Learning Actions: (What learning experiences and instruction will enable students to achieve the desired results?	
Instructional Strategies and Activities *D*	***Consider how will the design will:*** **W** = Help the students know Where the unit is going and What is expected? Help the teacher know Where the students are coming from (prior knowledge and interests)? **H**= Hook all students and Hold their interest? **E**= Equip students, help the Experience the key ideas and Explore the issue? **R**=Provide opportunities to Rethink and Revise their understandings and work? **E**=Allow students to Evaluate their work and its implications? **T**=be Tailored (personalized to the different needs, interests and abilities of learners? **O**=be Organized to maximize initial and sustained engagement as well as effective learning? The higher level classes will learn how to draw ray diagrams or lenses and mirrors and how to apply the lens and mirror equations to objects. They will also learn about the additive/subtractive color processes. The lower level classes will learn about ray diagrams but not about the equations. Additional differentiation activities as needed include: • Restructure lessons using Universal Design for Learning (UDL) principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA) • Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).

	• Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable phenomena. • Structure the learning around explaining or solving a social or community-based issue. • Provide English Language Learners students with multiple literacy strategies. Collaborate with after-school programs or clubs to extend learning opportunities.
Resources	
Physics Book, NJCTL.org , Sciencespot.com, pHet.com, Vernier.com, physlab.com	
Suggested Time Frame:	30 days

Content Area:	**Physics**	**Grade(s)** 11
Unit Plan Title:	**Unit 8 - Electricity and Magnetism**	
Overview/Rationale		
Students will have an understanding of how forces at a distance can be explained by fields, why some materials are attracted to each other while others are not, how magnets or electric currents cause magnetic fields, and how charges or changing magnetic fields cause electric fields.		
Science Standards (Established Goals)		
PS2.B: Types of interactions **PS3.C:** Relationships between energy and forces		
Disciplinary Core Ideas		

HS-PS2-5: Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.

HS-PS3-5: Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction

Science and Engineering Practices

SEP-2: Developing and using models

- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS3-2),(HS-PS3-5)

SEP-3: Planning and carrying out investigations

- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS2-5)

Cross-Cutting Concepts

CCC-2: Cause and effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-PS2-5)
- Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. (HS-PS3-5)

Technology Standard(s)

8.1.12.F.1: evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and/or social needs.

Interdisciplinary Standard(s)

English Language Arts

WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-PS2-5),(HS-PS3-5)
WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (HS-PS2-5),(HS-PS3-5)
WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-PS2-5), (HS-PS3-5)
SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-PS3-5)

Mathematics
MP.2 Reason abstractly and quantitatively. (HS-PS3-5)
MP.4 Model with mathematics. (HS-PS3-5)
HSN.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-PS2-5)
HSN.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. (HS-PS2-5)
HSN.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-PS2-5)

Enduring Understandings: (What are the big ideas? What specific understandings about them are desired? What misunderstandings are predictable?)

Students will understand that…
Magnets or electric currents cause magnetic fields and that electric charges or changing magnetic fields cause electric fields
When two objects interacting through a field change relative position, the energy stored in the field is changed
How electric and magnetic fields are related

Essential Question(s) : (What provocative questions will foster inquiry, understanding, and transfer of learning?)

What are the relationships between electric currents and magnetic fields?
How can I exert a force on an object when I can't touch it?

In this unit plan, the following 21st Century themes and skills are addressed:

Check all that apply. 21st Century Themes			*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* 21st Century Skills	
X	Global Awareness		E	Critical Thinking & Problem Solving
X	Environmental Literacy		E	Creativity and Innovation
	Health Literacy		E	Collaboration, Teamwork and Leadership
	Civic Literacy			Cross-Cultural and Interpersonal Communication
	Financial, Economic, Business and Entrepreneurial Literacy			Communication and Media Fluency
				Accountability, Productivity and Ethics

In this unit plan, the following Career Ready Practices are addressed:

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*

	CRP1. Act as a responsible and contributing citizen and employee
E	CRP2. Apply appropriate academic and technical skills
	CRP3. Attend to personal health and financial well-being
	CRP4. Communicate clearly and effectively with reason
E	CRP5. Consider the environmental, social and economic impacts of decisions
E	CRP6. Demonstrate creativity and innovation
	CRP7. Employ valid and reliable research strategies
A	CRP8. Utilize critical thinking to make sense of problems and persevere in solving them
	CRP9. Model integrity, ethical leadership and effective management
	CRP10. Plan education and career paths aligned to personal goals

	E	**CRP11. Use technology to enhance productivity** **CRP12. Work productively in teams while using cultural global competence**

Student Learning Goals/Objectives: (What key knowledge and skills will students acquire as a result of this unit? What should they eventually be able to do as a result of such knowledge and skill?)

Students will know….	***Students will be able to (do)…***
How electric and magnetic fields are related How the distance from a magnet affects the magnetic field How to measure a current	Demonstrate how an electric current can produce a magnetic field Develop and use an evidence-based model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction

Assessment Evidence:

Performance Tasks: *(Through what authentic performance tasks will students demonstrate the desired understandings? By what criteria will performances of understanding be judged?)*	**Other Assessment Measures*:*** *(Through what other evidence (E.g. quizzes, tests, academic prompts, observations, homework, journals, etc.) will students demonstrate achievement of the desired results? How will students reflect upon and self- assess their learning?)* ******Attach all Benchmarks***
Labs/Activities: Magnets activity Charges and fields labs	Quizzes: Electric fields Magnets Currents Homework Tests Lab reports

Teaching and Learning Actions: (What learning experiences and instruction will enable students to achieve the desired results?	
Instructional Strategies and Activities *D*	***Consider how will the design will:*** **W** = Help the students know Where the unit is going and What is expected? Help the teacher know Where the students are coming from (prior knowledge and interests)? **H**= Hook all students and Hold their interest? **E**= Equip students, help the Experience the key ideas and Explore the issue? **R**=Provide opportunities to Rethink and Revise their understandings and work? **E**=Allow students to Evaluate their work and its implications? **T**=be Tailored (personalized to the different needs, interests and abilities of learners? **O**=be Organized to maximize initial and sustained engagement as well as effective learning? The higher level classes will learn the equations while the lower level classes will be more conceptual. Magnets and Electromagnets: Explore the interactions between a compass and bar magnet. Discover how you can use a battery and wire to make a magnet! Can you make it a stronger magnet? Can you make the magnetic field reverse? Charges and Fields: Move point charges around on the playing field and then view the electric field, voltages, equipotential lines, and more. Faraday's Law: Investigate Faraday's law and how a changing magnetic flux can produce a flow of electricity! Additional Modifications as Needed: • Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA) • Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies). • Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).

	• Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings. • Use project-based science learning to connect science with observable phenomena. • Structure the learning around explaining or solving a social or community-based issue. • Provide ELL students with multiple literacy strategies. • Collaborate with after-school programs or clubs to extend learning opportunities.
Resources	
Physics Book, NJCTL.org , Sciencespot.com, pHet.com, Vernier.com, physlab.com	
Suggested Time Frame:	15 days

D – Indicates differentiation at the Lesson Level (Identify Modifications for ELL, Gifted and Talented, Title 1, Special Education)