EGG HARBOR TOWNSHIP PUBLIC SCHOOLS CURRICULUM

HONORS (HN) PHYSICS I
High School

Length of Course:	Full Year
Elective / Required:	Refer to Program of Studies
Schools:	High School
Student Eligibility:	Grades 11 -12
Credit Value:	5 credits
Date Submitted:	September 2016
Date Approved:	

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This curriculum guide was prepared by:

Ashle Cocca – High School
Michael Dannenhauer – High School
Christa Delaney – High School
Michelle Fitzgerald – High School
Kimberly Herman – High School
Kyle Herman – High School
Jonelle Scardino – High School

Coordinated by: **Rodney Velardi – Supervisor of Science, K-12**

DISTRICT MISSION STATEMENT

Our mission in the Egg Harbor Township School District is to partner with the student, family, school, and community to provide a safe learning environment that addresses rigorous and relevant 21st Century standards and best practices which will develop academic scholarship, integrity, leadership, citizenship, and the unique learning style of students, while encouraging them to develop a strong work ethic and to act responsibly in their school community and every day society.

SCIENCE – PHILOSOPHY

We believe that ALL students regardless of race, ethnicity, socio-economic status, religious background, and/or any other classification are deserving of a holistic science education. This holistic approach would include an education that will allow them to fully discover themselves, their strengths and weaknesses, and benefit from science instruction.

> Scientific literacy assumes an increasingly important role in the context of globalization. The rapid pace of technological advances, access to an unprecedented wealth of information, and the pervasive impact of science and technology on day-to-day living require a depth of understanding that can be enhanced through quality science education. In the 21st century, science education focuses on the practices of science that lead to a greater understanding of the growing body of scientific knowledge that is required of citizens in an ever-changing world (NJCCCS-Science).

Science curricula are designed to reinforce 21st Century Learning, to maximize rigor, relevance, and relationships, and to engage students individually through differentiated instruction.

SCIENCE - STATEMENT OF PURPOSE

Education exists for the purpose of enabling each individual to realize and maintain her/his full potential. Scientifically literate students possess the knowledge and understanding of scientific concepts and processes required for personal decision-making, participation in civic and cultural affairs, and economic productivity.

> Science, engineering, and technology influence and permeate every aspect of modern life. Some knowledge of science and engineering is required to engage with the major public policy issues of today as well as to make informed everyday decisions, such as selecting among alternative medical treatments or determining how to invest public funds for water supply options. In addition,

understanding science and the extraordinary insights it has produced can be meaningful and relevant on a personal level, opening new worlds to explore and offering lifelong opportunities for enriching people's lives. In these contexts, learning science is important for everyone, even those who eventually choose careers in fields other than science or engineering (NJSLS-Science)

All students engage in science experiences that promote the ability to ask, find, or determine answers to questions derived from natural curiosity about everyday things and occurrences. The underpinning of the revised standards lies in the premise that science is experienced as an active process in which inquiry is central to learning and in which students engage in observation, inference, and experimentation on an ongoing basis, rather than as an isolated a process. When engaging in inquiry, students describe objects and events, ask questions, construct explanations, test those explanations against current scientific knowledge, and communicate their ideas to others in their community and around the world. They actively develop their understanding of science by identifying their assumptions, using critical and logical thinking, and considering alternative explanations (NJCCCS-Science).

Our school district provides an extensive science program, which will enable students to succeed and compete in the global marketplace using the New Jersey Student Learning Standards in Science as well as the Next Generation Science Standards.

INTRODUCTION

The most precious resource teachers have is time. Regardless of how much time a course is scheduled for, it is never enough to accomplish all that one would like. Therefore, it is imperative that teachers utilize the time they have wisely in order to maximize the potential for all students to achieve the desired learning.

High quality educational programs are characterized by clearly stated goals for student learning, teachers who are well-informed and skilled in enabling students to reach those goals, program designs that allow for continuous growth over the span of years of instruction, and ways of measuring whether students are achieving program goals.

THE EGG HARBOR TOWNSHIP SCHOOL DISTRICT CURRICULUM TEMPLATE

The Egg Harbor Township School District has embraced the backward-design model as the foundation for all curriculum development for the educational program. When reviewing curriculum documents and the Egg Harbor Township curriculum template, aspects of the backward-design model will be found in the stated enduring *understandings/essential questions, unit assessments,* and *instructional activities*. Familiarization with backward-design is critical to working effectively with Egg Harbor Township's curriculum guides.

GUIDING PRINCIPLES: WHAT IS BACKWARD DESIGN? WHAT IS UNDERSTANDING BY DESIGN?

"Backward design" is an increasingly common approach to planning curriculum and instruction. As its name implies, "backward design" is based on defining clear goals, providing acceptable evidence of having achieved those goals, and then working 'backward' to identify what actions need to be taken that will ensure that the gap between the current status and the desired status is closed.

Building on the concept of backward design, Grant Wiggins and Jay McTighe (2005) have developed a structured approach to planning programs, curriculum, and instructional units. Their model asks educators to state goals; identify deep understandings, pose essential questions, and specify clear evidence that goals, understandings, and core learning have been achieved.

Programs based on backward design use desired results to drive decisions. With this design, there are questions to consider, such as: What should students understand, know, and be able to do? What does it look like to meet those goals? What kind of program will result in the outcomes stated? How will we know students have achieved that result? What other kinds of evidence will tell us that we have a quality program? These questions apply regardless of whether they are goals in program planning or classroom instruction.

The backward design process involves three interrelated stages for developing an entire curriculum or a single unit of instruction. The relationship from planning to curriculum design, development, and implementation hinges upon the integration of the following three stages.

Stage I: Identifying Desired Results: Enduring understandings, essential questions, knowledge and skills need to be woven into curriculum publications, documents, standards, and scope and sequence materials. Enduring understandings identify the "big ideas" that students will grapple with during the course of the unit. Essential questions provide a unifying focus for the unit and students should be able to answer more deeply and fully these questions as they proceed through the unit. Knowledge and skills are the *"stuff"* upon which the understandings are built.

Stage II: Determining Acceptable Evidence: Varied types of evidence are specified to ensure that students demonstrate attainment of desired results. While discrete knowledge assessments (e.g.: multiple choice, fill-in-the-blank, short answer, etc…) will be utilized during an instructional unit, the overall unit assessment is performance-based and asks students to demonstrate that they have mastered the desired understandings. These culminating (summative) assessments are authentic tasks that students would likely encounter in the real-world after they leave school. They allow students to demonstrate all that they have learned and can do. To demonstrate their understandings students can explain, interpret, apply, provide critical and insightful points of view, show empathy and/or evidence self-knowledge. Models of student performance and clearly defined criteria (i.e.: rubrics) are provided to all students in advance of starting work on the unit task.

Stage III: Designing Learning Activities: Instructional tasks, activities, and experiences are aligned with stages one and two so that the desired results are obtained based on the identified evidence or assessment tasks. Instructional activities and strategies are considered only once stages one and two have been clearly explicated. Therefore, congruence among all three stages can be ensured and teachers can make wise instructional choices.

At the curricular level, these three stages are best realized as a fusion of research, best practices, shared and sustained inquiry, consensus building, and initiative that involves all stakeholders. In this design, administrators are instructional leaders who enable the alignment between the curriculum and other key initiatives in their district or schools. These leaders demonstrate a clear purpose and direction for the curriculum within their school or district by providing support for implementation, opportunities for revision through sustained and consistent professional development, initiating action research activities, and collecting and evaluating materials to ensure alignment with the desired results. Intrinsic to the success of curriculum is to show how it aligns with the overarching goals of the district, how the document relates to district, state, or national standards, what a high quality educational program looks like, and what excellent teaching and learning looks like. Within education, success of the educational program is realized through this blend of commitment and organizational direction.

INTENT OF THE GUIDE

This guide is intended to provide teachers with course objectives and possible activities, as well as assist the teacher in planning and delivering instruction in accordance with the New Jersey Core Curriculum Content Standards. The guide is not intended to restrict or limit the teacher’s resources or individual instruction techniques. It is expected that the teacher will reflectively adjust and modify instruction and units during the course of normal lessons depending on the varying needs of the class, provided such modified instruction attends to the objectives and essential questions outlined below.

N.J.A.C. 6A:8-3.1 Required Curriculum Components

Code Language	Evident in Curriculum YES/NO	Comments
Interdisciplinary Connections	**Yes**	**Via lab activities. STEM units in development 1 per marking period**
A pacing guide	**Yes**	**By Unit approximately 2-4 units per marking period**
A list of core instructional materials, including various levels of text at each grade level	**Yes**	**Suggested Activities Labs**
Benchmark assessments	**Yes**	**Teacher-developed and common via pre/post and benchmark assessments**
Modifications for special education students, for ELLs in accordance with N.J.A.C. 6A:15, and for gifted students. (As appropriate) – See Appendix A	**Yes**	**As directed by student's Individual Education Plan**

Unit Name: The Science of Physics and Mathematical Concepts **Time Frame:** 1 week (3-4 lecture days)

Author: Egg Harbor Township High School Science Department

UNIT

Subject: HN Physics 1

Country: USA

Course/Grade: 11-12

State/Group: NJ

School: Egg Harbor Township High School

UNIT SUMMARY

The purpose of this unit is to introduce students to Physics and explain some of the many things done with and possible with Physics. Students will review fundamental math skills that are necessary in solving Physics problems including scientific notation, conversions, and units with prefixes.

UNIT RESOURCES

- Textbook- Physics 8th Edition (2009), *Cutnell and Johnson*
- Lab Manuals and materials

Internet Resource Links:

- Discovery: www.unitedstreaming.com
- NBC Learn Videos: www.nbclearn.com
- eLibrary science: http://science.bigchalk.com/sciweb/science/do/search
- Web Physics help: www.physicsclassroom.com
- Web simulators: www.pHET.colorado.edu

STAGE ONE

GOALS AND STANDARDS

HS ETS1-2 – [Content Statement] - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories.

- 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)

HS ETS1-4 – [Content Statement] - 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.

Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- 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)

ENDURING UNDERSTANDINGS

- Physics explains the natural world.
- Various skills can be utilized to visualize and analyze content, concepts and data.
- Laboratory safety is paramount.
- Accuracy and precision are important when analyzing laboratory data and expressing computations.
- Graphical analysis indicates important relationships in scientific data.
- Mathematical skills including conversions, units, graphing and spatial analysis, and vector properties are important in problem solving in physics.

- Solving problems requires an appreciation of the big picture.

ESSENTIAL QUESTIONS

- Why is it important to study Physics?
- Why is it useful to learn problem solving skills?
- How can the fundamental math skills be applied in Physics?
- How do Physicists solve problems theoretically and with experimentation?
- What is a vector and how can we use the mathematics of vectors to help solve physics problems?

KNOWLEDGE AND SKILLS

- Explain why the scope of Physics is so vast.
- Identify seven traditional areas of study in Physics.
- Identify the central themes of Physics.
- Describe the steps in the scientific method.
- Use the metric System and dimensional analysis to make conversions of units.
- Identify graph types and model data using proper graphing procedures.
- Manipulate algebraic expressions and formulas.
- Explain what a vector is and how they are used.
- Analyze real world occurrences using vectors and vector addition.

STAGE TWO

PERFORMANCE TASKS

- Laboratory investigations within small groups
- Constructed response
- Graphic organizers or models
- Do nows and/or exit slips
- Individual, small, and large group work
- Homework
- Guided practice

OTHER EVIDENCE

- Common assessment quiz
- Common assessment chapter test
- Review Activity

STAGE THREE

LEARNING PLAN

- Flashcards and/or drill and practice
- Power point presentations
- Lecture with note taking or guided notes
- Whole and small group discussions
- Laboratory groups
- Inquiry based activities with reflective discussion

- Online models and simulators

Student progress will be measured by formative and summative assessments. To maximize student understanding current and cumulative topics will be assessed weekly.

This unit is sequenced to begin with an informal assessment of prior knowledge of topics within the unit and determine any misconceptions. Students will then build small concrete blocks of information pertinent to mastery of this unit. Finally, students will be asked to use this information to evaluate higher level problems. This unit will end with a formal assessment common to all college prep students.

Unit Name: Motion in One Dimension **Time Frame:** 2 weeks (8-9 lecture days)

Author: Egg Harbor Township High School Science Department

UNIT

Subject: HN Physics 1

Country: USA

Course/Grade: 11-12

State/Group: NJ

School: Egg Harbor Township High School

UNIT SUMMARY

Students will understand math techniques needed to comprehend and solve physical motion problems and questions through the use of graphs and equations.

UNIT RESOURCES

- Textbook- Physics 8th Edition (2009), *Cutnell and Johnson*
- Lab Manuals and materials

Internet Resource Links:

- Discovery: www.unitedstreaming.com
- NBC Learn Videos: www.nbclearn.com
- eLibrary science: http://science.bigchalk.com/sciweb/science/do/search
- Web Physics help: www.physicsclassroom.com
- Web simulators: www.pHET.colorado.edu

STAGE ONE

GOALS AND STANDARDS

HS ETS1-1 – [Content Statement] - Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.

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

HS ETS1-2 – [Content Statement] - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

- Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (HS-ETS1-2)

HS ETS1-3 – [Content Statement] - 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.

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories.

- 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)

HS ETS1-4 – [Content Statement] - 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.

Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- 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)

ENDURING UNDERSTANDINGS

- Various skills can be utilized to visualize and analyze content, concepts and data.
- Laboratory safety is paramount.
- Displacement, speed, velocity, acceleration, and time are variables that can describe motion.

- Objects in motion must change position.
- Graphical interpretation is necessary to understand one dimensional motion.

ESSENTIAL QUESTIONS

- How will you be able to describe a change in position?
- How are speed, velocity and acceleration related?
- What are the kinematic equations and how are they defined?
- How is the motion of an object related to different graphs of the motion of an object?
- How can you distinguish between uniform motion and uniform acceleration?
- How is the graphical representation of motion analyzed using equations?
- How does gravity affect the motion of an object?

KNOWLEDGE AND SKILLS

- Solve motion problems.
- Apply kinematic equations to apply to different situations involving moving bodies.
- Use graphs to derive motion equation.
- Interpret graphs for a moving object and describe in words the information presented in graphs.
- Calculate the velocity and the displacement of an object undergoing constant acceleration.
- Recognize the meaning of the acceleration due to gravity.
- Define the acceleration due to gravity and determine its sign relative to the chosen coordinate system.
- Use kinematic equations to solve problems involving freely falling objects.

STAGE TWO

PERFORMANCE TASKS

- Laboratory investigations within small groups
- Constructed response
- Graphic organizers or models
- Do nows and/or exit slips
- Individual, small, and large group work
- Homework
- Guided practice

OTHER EVIDENCE

- Common assessment quiz
- Common assessment chapter test
- Review Activity

STAGE THREE

LEARNING PLAN

- Flashcards and/or drill and practice
- Power point presentations
- Lecture with note taking or guided notes
- Whole and small group discussions
- Laboratory groups
- Inquiry based activities with reflective discussion

- Online models and simulators

Student progress will be measured by formative and summative assessments. To maximize student understanding current and cumulative topics will be assessed weekly.

This unit is sequenced to begin with an informal assessment of prior knowledge of topics within the unit and determine any misconceptions. Students will then build small concrete blocks of information pertinent to mastery of this unit. Finally, students will be asked to use this information to evaluate higher level problems. This unit will end with a formal assessment common to all college prep students. In additional to the formal assessment all units will end with a project that requires students to apply scientific and mathematical knowledge to solve a real world problem via an engineering model based on design, test and redesign.

Unit Name: Motion in Two Dimension **Time Frame:** 4 weeks (16-18 lecture days)

Author: Egg Harbor Township High School Science Department

UNIT

Subject: HN Physics 1 **Country:** USA

Course/Grade: 11-12 **State/Group:** NJ

School: Egg Harbor Township High School

UNIT SUMMARY

Students will analyze projectile motion using vector analysis and problem solving formulas of uniform acceleration.

UNIT RESOURCES

- Textbook- Physics 8th Edition (2009), *Cutnell and Johnson*
- Lab Manuals and materials

Internet Resource Links:

- Discovery: www.unitedstreaming.com
- NBC Learn Videos: www.nbclearn.com
- eLibrary science: http://science.bigchalk.com/sciweb/science/do/search
- Web Physics help: www.physicsclassroom.com
- Web simulators: www.pHET.colorado.edu

STAGE ONE

GOALS AND STANDARDS

HS ETS1-1 – [Content Statement] - Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.

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

HS ETS1-2 – [Content Statement] - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

- Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (HS-ETS1-2)

HS ETS1-3 – [Content Statement] - 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.

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories.

- 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)

HS ETS1-4 – [Content Statement] - 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.

Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- 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)

ENDURING UNDERSTANDINGS

- Vectors are the key to navigation.
- Projectile motion is both horizontal and vertical motion. These two motions are independent of one another and are analyzed separately.
- Trajectories are parabolic.

ESSENTIAL QUESTIONS

- How are vectors used?
- Why are there differences between vector and scalar quantities?
- How does an object move in two dimensions?
- What variables affect a trajectory?
- How can we solve problems using the symmetry of parabolic motion?
- How does gravity impact our lives?

KNOWLEDGE AND SKILLS

- Create a vector given parameters.
- Determine resultant vectors using two methods.
- Use vectors to determine relative velocities in navigation problems.
- Separate horizontal and vertical components of motion.
- Understand and apply principles of gravitational effects on an object in projectile motion.
- Apply trigonometric functions to separate horizontal and vertical components of velocity.
- Parabolic motion demonstrates the symmetry of motion affected uniformly by gravity; this can be utilized to solve for time, displacement, and velocity at any given time.
- Relate the height, time in the air, and initial vertical velocity of a projectile using its vertical motion, then determine the range.
- Explain how the shape of the trajectory of a moving object depends upon the frame of reference from which it is observed.

STAGE TWO

PERFORMANCE TASKS

- Laboratory investigations within small groups
- Constructed response
- Graphic organizers or models
- Do nows and/or exit slips
- Individual, small, and large group work
- Homework
- Guided practice

OTHER EVIDENCE

- Common assessment quiz
- Common assessment chapter test
- Review Activity

STAGE THREE

LEARNING PLAN

- Flashcards and/or drill and practice
- Power point presentations
- Lecture with note taking or guided notes
- Whole and small group discussions
- Laboratory groups
- Inquiry based activities with reflective discussion

- Online models and simulators

Student progress will be measured by formative and summative assessments. To maximize student understanding current and cumulative topics will be assessed weekly.

This unit is sequenced to begin with an informal assessment of prior knowledge of topics within the unit and determine any misconceptions. Students will then build small concrete blocks of information pertinent to mastery of this unit. Finally, students will be asked to use this information to evaluate higher level problems. This unit will end with a formal assessment common to all college prep students. In additional to the formal assessment all units will end with a project that requires students to apply scientific and mathematical knowledge to solve a real world problem via an engineering model based on design, test and redesign.

Unit Name: Forces **Time Frame:** 6 weeks (24-27 lecture days)

Author: Egg Harbor Township High School Science Department

UNIT

Subject: HN Physics 1

Country: USA

Course/Grade: 11-12

State/Group: NJ

School: Egg Harbor Township High School

UNIT SUMMARY

Students will use Newton's laws of motion to determine the magnitude and direction of the net force on an object. Students will use Newton's laws to determine the forces necessary to keep objects in static equilibrium.

UNIT RESOURCES

- Textbook- Physics 8th Edition (2009), *Cutnell and Johnson*
- Lab Manuals and materials

Internet Resource Links:

- Discovery: www.unitedstreaming.com
- NBC Learn Videos: www.nbclearn.com
- eLibrary science: http://science.bigchalk.com/sciweb/science/do/search
- Web Physics help: www.physicsclassroom.com
- Web simulators: www.pHET.colorado.edu

STAGE ONE

GOALS AND STANDARDS

HS PS2-1 – [Content Statement] - 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.

Analyzing data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze 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)
- Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1)

HS PS2-2 – [Content Statement] – 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.

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

HS PS2-3 – [Content Statement] – Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects. (HS-PS2-3)

- Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. *(secondary to HS-PS2-3)*
- Systems can be designed to cause a desired effect. (HS-PS2-3)

HS PS2-4 – [Content Statement] – Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Use mathematical representations of phenomena to describe explanations. (HS-PS2-2),(HS-PS2-4)
- 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)

- Theories and laws provide explanations in science. (HS-PS2-1),(HS-PS2-4)
- Laws are statements or descriptions of the relationships among observable phenomena. (HS-PS2-1),(HS-PS2-4)

ENDURING UNDERSTANDINGS

- Net forces change motion.
- Newton's Laws explain motion.
- Objects in motion must change position.
- An object may be moving or not moving in equilibrium.
- Friction is part of everyday life.

ESSENTIAL QUESTIONS

- How do objects move?
- How will I be able to describe the forces of nature and how they relate to everyday occurrences?
- What are the laws that govern motion and how do we apply them?
- What is the normal force and how is it measured?
- What is equilibrium?
- What are the fundamental forces and when is each observed?

KNOWLEDGE AND SKILLS

- Identify the four fundamental forces and which apply in various scenarios.
- Identify contact vs. non-contact forces and their application in problems.
- Apply newton's 2^{nd} law to one-dimensional motion problems.
- Calculate accelerations, masses, or forces.

- Apply newton's 2^{nd} law to basic two dimension machines; calculate forces, accelerations, masses, and tensions.
- Calculate forces and tensions in systems in equilibrium.
- Construct and label free body diagrams in simple systems.
- Calculate applied, retarding, and net forces in a system including static and kinetic friction.
- Describe how the weight and the mass of an object are related.

STAGE TWO

PERFORMANCE TASKS

- Laboratory investigations within small groups
- Constructed response
- Graphic organizers or models
- Do nows and/or exit slips
- Individual, small, and large group work
- Homework
- Guided practice

OTHER EVIDENCE

- Common assessment quiz
- Common assessment chapter test
- Review Activity

STAGE THREE

LEARNING PLAN

- Flashcards and/or drill and practice
- Power point presentations
- Lecture with note taking or guided notes
- Whole and small group discussions
- Laboratory groups
- Inquiry based activities with reflective discussion
- Online models and simulators

Student progress will be measured by formative and summative assessments. To maximize student understanding current and cumulative topics will be assessed weekly.

This unit is sequenced to begin with an informal assessment of prior knowledge of topics within the unit and determine any misconceptions. Students will then build small concrete blocks of information pertinent to mastery of this unit. Finally, students will be asked to use this information to evaluate higher level problems. This unit will end with a formal assessment common to all college prep students. In additional to the formal assessment all units will end with a project that requires students to apply scientific and mathematical knowledge to solve a real world problem via an engineering model based on design, test and redesign.

Unit Name: Work, Energy and Momentum **Time Frame:** 7 weeks (28-31 lecture days)

Author: Egg Harbor Township High School Science Department

UNIT

Subject: HN Physics 1

Country: USA

Course/Grade: 11-12

State/Group: NJ

School: Egg Harbor Township High School

UNIT SUMMARY

Students will describe momentum and impulse and apply them to the interaction of objects. Students will analyze the change in momentum during a collision. Students will recognize that work and power describe how energy moves through the environment. Students will confirm that energy is the total amount of energy in a closed system remains constant.

UNIT RESOURCES

- Textbook- Physics 8th Edition (2009), *Cutnell and Johnson*
- Lab Manuals and materials

Internet Resource Links:

- Discovery: www.unitedstreaming.com
- NBC Learn Videos: www.nbclearn.com
- eLibrary science: http://science.bigchalk.com/sciweb/science/do/search
- Web Physics help: www.physicsclassroom.com
- Web simulators: www.pHET.colorado.edu

STAGE ONE

GOALS AND STANDARDS

HS PS3-1 - [Content Statement] – 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.

Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Create a computational model or simulation of a phenomenon, designed device, process, or system. (HS-PS3-1)
- Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. (HS-PS3-1)
- Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1),(HS-PS3-4)
- Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. (HS-PS3-1)
- The availability of energy limits what can occur in any system. (HS-PS3-1)
- 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)

- Science assumes the universe is a vast single system in which basic laws are consistent. (HS-PS3-1)

HS PS3-2 - [Content Statement] – 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 positions of particles (objects).

Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- 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)
- Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system’s total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HS-PS3-1),(HS-PS3-2)
- These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes

radiation, a phenomenon in which energy stored in fields moves across space. (HS-PS3-2)

- 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)

HS PS3-3 - [Content Statement] – Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- 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)
- At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HS-PS3-2) (HS-PS3-3)
- Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. (HS-PS3-3),(HS-PS3-4)

ENDURING UNDERSTANDINGS

- All energy transfers are governed by the law of conservation of energy.
- Energy is converted in a system.
- Momentum is a characteristic of mass and velocity and is conserved in collisions.
- The kinetic energy of an object is moving energy and is proportional to its mass and the square of its velocity.
- The gravitational potential energy of an object is stored energy and depends on the object's weight and distance from the Earth's surface.
- The sum of kinetic and potential energy is called mechanical energy.
- The total energy of a closed isolated system is constant.
- Work is a change in energy.
- Power is the rate at which work is done.

ESSENTIAL QUESTIONS

- How is work related to energy?
- Why does momentum have a role in the physical world?
- What is momentum and impulse and how are they related?
- What is the difference between momentum and inertia?
- How are work and power related to energy and each other?
- Why does energy have a role in the physical world?
- What is the difference between momentum and energy?
- How do changes in the amount of energy occur?
- Is this change positive or negative?
- When is equilibrium achieved?
- How do objects interact during different types of collisions?
- How is the momentum of objects affected during collisions?
- How is momentum conserved for elastic and inelastic collisions?

KNOWLEDGE AND SKILLS

- Identify different applications of work.
- Calculate work, power, kinetic and potential energies.
- Apply the work energy theorem to various motion problems.
- Use conservation of energy to calculate kinetic, potential, work, and velocity at given times during an object's motion.

- Recognize the independence of path when determining energy changes in the vertical plane.
- Calculate the change in momentum of an object in motion.
- Calculate the impulse applied to an object in motion and resulting momentum change.
- Calculate masses, velocities, and directions of objects undergoing collision reactions using law of conservation of momentum.
- Compare the system before and after an event in momentum problems.
- Define the momentum of an object.
- Recognize that impulse equals the change in momentum of an object.
- Compare the system before and after an event in energy problems.
- Describe relationship between work and energy.
- Differentiate between work and power and correctly calculate power used.
- Analyze a car crash investigation.
- Build a car that will apply the concept of impulse to protect a passenger.

STAGE TWO

PERFORMANCE TASKS

- Laboratory investigations within small groups
- Constructed response
- Graphic organizers or models
- Do nows and/or exit slips
- Individual, small, and large group work

- Homework
- Guided practice

OTHER EVIDENCE

- Common assessment quiz
- Common assessment chapter test
- Review Activity

STAGE THREE

LEARNING PLAN

- Flashcards and/or drill and practice
- Power point presentations
- Lecture with note taking or guided notes
- Whole and small group discussions
- Laboratory groups
- Inquiry based activities with reflective discussion
- Online models and simulators

Student progress will be measured by formative and summative assessments. To maximize student understanding current and cumulative topics will be assessed weekly.

This unit is sequenced to begin with an informal assessment of prior knowledge of topics within the unit and determine any misconceptions. Students will then build small concrete blocks of information pertinent to mastery of this unit. Finally, students will be asked to use this information to evaluate higher level problems. This unit will end with a formal assessment common to all college prep students. In additional to the formal assessment all units will end with a project that requires students to apply scientific and mathematical knowledge to solve a real world problem via an engineering model based on design, test and redesign.

Unit Name: Circular and Rotational Motion **Time Frame: 5** weeks (20-22 lecture days)

Author: Egg Harbor Township High School Science Department

UNIT

Subject: HN Physics 1

Country: USA

Course/Grade: 11-12

State/Group: NJ

School: Egg Harbor Township High School

UNIT SUMMARY

Students will analyze circular motion using vector analysis and problem solving formulas of uniform acceleration.

UNIT RESOURCES

- Textbook- Physics 8th Edition (2009), *Cutnell and Johnson*
- Lab Manuals and materials

Internet Resource Links:

- Discovery: www.unitedstreaming.com
- NBC Learn Videos: www.nbclearn.com
- eLibrary science: http://science.bigchalk.com/sciweb/science/do/search
- Web Physics help: www.physicsclassroom.com
- Web simulators: www.pHET.colorado.edu

STAGE ONE

GOALS AND STANDARDS

HS PS2-1 – [Content Statement] - 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.

Analyzing data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze 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)
- Newton's second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1)

HS PS2-2 – [Content Statement] – 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.

Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Use mathematical representations of phenomena to describe explanations. (HS-PS2-2),(HS-PS2-4)
- Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. (HS-PS2-2)
- If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. (HS-PS2-2),(HS-PS2-3)
- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined. (HS-PS2-2)

HS PS2-4 – [Content Statement] – Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Theories and laws provide explanations in science. (HS-PS2-1),(HS-PS2-4)
- Laws are statements or descriptions of the relationships among observable phenomena. (HS-PS2-1),(HS-PS2-4)
- Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. (HS-PS2-4)
- Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2-4),(HS-PS2-5)

- 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)

HS ESS1-4 - [Content Statement] – Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.

- Kepler’s laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. (HS-ESS1-4)
- 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)
- Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise. (HS-ESS1-2),(HS-ESS1-4)

ENDURING UNDERSTANDINGS

- The forces of nature apply to objects in circular & rotational motion.
- Gravitational forces act on objects in space.
- Gravity is the predominant cause of changes in our universe.
- An object moving in a circle at a constant speed is accelerating toward the center of the circle.
- Angular displacement, velocity, and acceleration are terms to describe motion in circles.
- Kinematic equations can be modified to include circular motion variables.
- Angular momentum is conserved.
- Torque is a force that causes rotational or circular motion.
- Torque can create equilibrium on an object.
- Moment of inertia is a measurement of the location of mass in respect to an object moving in rotational motion and can be related to mass.
- Rotational work, energy and momentum can be solved using circular motion variables.

ESSENTIAL QUESTIONS

- Why do objects move in circles?
- How do the planets or satellites move and why?
- How do objects rotate?
- How is planetary motion similar to projectile motion?
- How can we modify the kinematic equations to apply them to rotational motion?
- How can we solve for angular displacement, velocity and acceleration?
- What is the relationship between tangential and rotation motion variables?
- What are applications of angular momentum?
- How can torque change rotational motion?
- How do we apply torque to an object to make the object at equilibrium?
- What is moment of inertia and why is it different for different objects?
- How do we solve for rotational motion variables?

KNOWLEDGE AND SKILLS

- Recognize and explain the nature of the force that causes circular motion.
- Calculate centripetal acceleration and force, tension and friction as sources of centripetal force, apparent weight at tops and bottom of vertical loops.
- Apply Kepler's Law of periods to relate bodies in orbit in the same system and calculate Kepler's constant for any orbited body.
- Calculate gravitational force between any two masses, gravitational acceleration between any two masses, and gravitational field strength on any planet.

- Calculate torque and angular acceleration for a rigid body, rigid body rotation about a moving axis, work and power in a rotational motion, angular momentum and conservation of angular momentum.
- Be able to apply and calculate torques to put an object at equilibrium.
- Explain the acceleration of an object moving in a circle at constant speed.
- Know how to solve for circular motion and rotational motion variables.
- Be able to visualize objects with different moment of inertia.
- Build a toy or mechanism to apply the concept of circular or rotational motion.

STAGE TWO

PERFORMANCE TASKS

- Laboratory investigations within small groups
- Constructed response
- Graphic organizers or models
- Do nows and/or exit slips
- Individual, small, and large group work
- Homework
- Guided practice

OTHER EVIDENCE

- Common assessment quiz
- Common assessment chapter test
- Review Activity

STAGE THREE

LEARNING PLAN

- Flashcards and/or drill and practice
- Power point presentations
- Lecture with note taking or guided notes
- Whole and small group discussions
- Laboratory groups
- Inquiry based activities with reflective discussion
- Online models and simulators

Student progress will be measured by formative and summative assessments. To maximize student understanding current and cumulative topics will be assessed weekly.

This unit is sequenced to begin with an informal assessment of prior knowledge of topics within the unit and determine any misconceptions. Students will then build small concrete blocks of information pertinent to mastery of this unit. Finally, students will be asked to use this information to evaluate higher level problems. This unit will end with a formal assessment common to all college prep students. In additional to the formal assessment all units will end with a project that requires students to apply scientific and mathematical knowledge to solve a real world problem via an engineering model based on design, test and redesign.

Unit Name: Simple Harmonic Motion **Time Frame:** 2 weeks (8-10 lecture days)

Author: Egg Harbor Township High School Science Department

UNIT

Subject: HN Physics 1 **Country:** USA

Course/Grade: 11-12 **State/Group:** NJ

School: Egg Harbor Township High School

UNIT SUMMARY

UNIT RESOURCES

- Textbook- Physics 8th Edition (2009), *Cutnell and Johnson*
- Lab Manuals and materials

Internet Resource Links:

- Discovery: www.unitedstreaming.com
- NBC Learn Videos: www.nbclearn.com
- eLibrary science: http://science.bigchalk.com/sciweb/science/do/search
- Web Physics help: www.physicsclassroom.com
- Web simulators: www.pHET.colorado.edu

STAGE ONE

GOALS AND STANDARDS

HS PS3-1 - [Content Statement] – 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.

Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Create a computational model or simulation of a phenomenon, designed device, process, or system. (HS-PS3-1)

- Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. (HS-PS3-1)
- Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. (HS-PS3-1)
- The availability of energy limits what can occur in any system. (HS-PS3-1)
- 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)

HS PS3-2 - [Content Statement] – 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 positions of particles (objects).

- Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HS-PS3-1),(HS-PS3-2)
- These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HS-PS3-2)

HS PS3-3 - [Content Statement] – Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- 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)
- At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HS-PS3-2) (HS-PS3-3)

ENDURING UNDERSTANDINGS

- An object that stretches or compresses has a tendency to return to its ideal position and creates a restoring force that will maintain that position.
- Simple harmonic motion is the oscillatory motion that occurs when the restoring force acts on an object.
- The restoring force is related to the distance an object is displaced by a proportionality factor known as the spring constant.
- The relationship between the mathematical unit circle and simple harmonic motion can be helpful due to their similarities.
- The motion of a simple pendulum is an example of simple harmonic motion.
- The energy of an object in simple harmonic motion is the combination of moving energy, energy of position and energy of rotational motion.
- An object can be put into damped or driven harmonic motion.
- Understanding how an object behaves in simple harmonic motion can aid in the creation of machine parts and structures that require or forbid oscillatory movement.

ESSENTIAL QUESTIONS

- What is a restoring force and how does it cause simple harmonic motion?
- What is the spring constant and what are qualities that define the value of a spring constant?
- How is simple harmonic motion related to the mathematical unit circle?
- How is energy defined in simple harmonic motion?
- Why is the simple pendulum an example of simple harmonic motion?
- What are the benefits and disadvantages of simple harmonic motion?

- How is simple harmonic motion applied to car shock absorbers, surgical implants, and playground equipment?

KNOWLEDGE AND SKILLS

- For an ideal spring, the restorative force that causes simple harmonic motion and the distance an object moves are proportional by the object spring constant.
- The variables in a reference circle and simple harmonic motion can be compared.
- The energy in simple harmonic motion can be solved by understanding the motion and relative positions of an object and its stored energy.
- The movement of a simple pendulum is oscillatory and can be related to characteristics in simple harmonic motion.
- Damped motion is motion when simple harmonic motion is purposely reduced.
- Driven harmonic motion or resonance is created to achieve simple harmonic motion to benefit the intended movement of an object.

STAGE TWO

PERFORMANCE TASKS

- Laboratory investigations within small groups
- Constructed response
- Graphic organizers or models
- Do nows and/or exit slips
- Individual, small, and large group work
- Homework
- Guided practice

OTHER EVIDENCE

- Common assessment quiz
- Common assessment chapter test
- Review Activity

STAGE THREE

LEARNING PLAN

- Flashcards and/or drill and practice
- Power point presentations
- Lecture with note taking or guided notes
- Whole and small group discussions
- Laboratory groups
- Inquiry based activities with reflective discussion
- Online models and simulators

Student progress will be measured by formative and summative assessments. To maximize student understanding current and cumulative topics will be assessed weekly.

This unit is sequenced to begin with an informal assessment of prior knowledge of topics within the unit and determine any misconceptions. Students will then build small concrete blocks of information pertinent to mastery of this unit. Finally, students will be asked to use this information to evaluate higher level problems. This unit will end with a formal assessment common to all college prep students. In additional to the formal assessment all units will end with a project that requires students to apply scientific and mathematical knowledge to solve a real world problem via an engineering model based on design, test and redesign.

Unit Name: Waves and Sound **Time Frame:** 3 weeks (11-12 lecture days)

Author: Egg Harbor Township High School Science Department

UNIT

Subject: HN Physics

Country: USA

Course/Grade: 11-12

State/Group: NJ

School: Egg Harbor Township High School

UNIT SUMMARY

Students will determine how mechanical waves (including sound) transfer energy and describe and solve problems involving wave interactions.

UNIT RESOURCES

- Textbook- Physics 8th Edition (2009), *Cutnell and Johnson*
- Lab Manuals and materials

Internet Resource Links:

- Discovery: www.unitedstreaming.com
- NBC Learn Videos: www.nbclearn.com
- eLibrary science: http://science.bigchalk.com/sciweb/science/do/search
- Web Physics help: www.physicsclassroom.com
- Web simulators: www.pHET.colorado.edu

STAGE ONE

GOALS AND STANDARDS

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

Mathematical and computational thinking at the 9-12 level builds on K-8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-PS4-1)
- The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. (HS-PS4-1)

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

HS PS4-2 – [Content Statement] - Evaluate questions about the advantages of using a digital transmission and storage of information.

Asking questions and defining problems in grades 9–12 builds from grades K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.

- Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. (HS-PS4-2)

- Systems can be designed for greater or lesser stability. (HS-PS4-2)

HS PS3-1 - [Content Statement] – 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.

Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Create a computational model or simulation of a phenomenon, designed device, process, or system. (HS-PS3-1)

HS PS3-2 - [Content Statement] – 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 positions of particles (objects).

Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- 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)
- These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HS-PS3-2)

HS PS3-3 - [Content Statement] – Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- 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)
- At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HS-PS3-2) (HS-PS3-3)

ENDURING UNDERSTANDINGS

- When energy transfer strikes a boundary between two different media, different behaviors may be seen.
- Sound is an example of energy transfer in the form of waves
- Waves transfer energy and information without transferring matter.
- Mechanical waves require a medium.
- Interference occurs when two or more waves move through a medium at the same time.
- Waves can have constructive or destructive interference.
- Resonance and beats can occur in sound waves.

- Mechanical waves require a medium.
- Sound is a pressure variation transmitted through matter as a longitudinal wave.
- Sound is produced by vibrating objects in matter.
- Instruments or objects that create sound can demonstrate vibration and it can be described using terms like frequency, velocity, nodes and harmonics.

ESSENTIAL QUESTIONS

- How does energy travel as a wave?
- How do waves behave?
- How is sound described in terms of wave-energy transfer?
- How do waves transfer energy?
- How do waves interact?
- Can cell phones ring in space?
- Why does a glass break due to sound vibrations?
- Identify a node on a guitar string.

KNOWLEDGE AND SKILLS

- Identify, sketch, and label waveforms.
- Calculate wave characteristics given various conditions.
- Sketch results of waves changing mediums (frequency, wavelength, inversion, amplitude, velocity).
- Identify how waves transfer energy without transferring matter.
- Contrast transverse and longitudinal waves.

- Relate wave speed, wavelength, and frequency.
- Relate a wave's speed to the medium in which the wave travels.
- Describe how waves are reflected and refracted at boundaries between media, and explain how waves diffract.
- Apply the principle of superposition to the phenomenon of interference.
- Identify how waves transfer energy without transferring matter.
- Contrast transverse and longitudinal waves.
- Demonstrate knowledge of the nature of sound waves and the properties sound shares with other waves.
- Solve problems relating the frequency, wavelength, and velocity of sound.
- Define the Doppler shift and identify some of its applications.
- Build a wave machine to show characteristics of a wave.

STAGE TWO

PERFORMANCE TASKS

- Laboratory investigations within small groups
- Constructed response
- Graphic organizers or models
- Do nows and/or exit slips
- Individual, small, and large group work
- Homework
- Guided practice

OTHER EVIDENCE

- Common assessment quiz
- Common assessment chapter test
- Review Activity

STAGE THREE

LEARNING PLAN

- Flashcards and/or drill and practice
- Power point presentations
- Lecture with note taking or guided notes
- Whole and small group discussions
- Laboratory groups
- Inquiry based activities with reflective discussion
- Online models and simulators

Student progress will be measured by formative and summative assessments. To maximize student understanding current and cumulative topics will be assessed weekly.

This unit is sequenced to begin with an informal assessment of prior knowledge of topics within the unit and determine any misconceptions. Students will then build small concrete blocks of information pertinent to mastery of this unit. Finally, students will be asked to use this information to evaluate higher level problems. This unit will end with a formal assessment common to all college prep students. In additional to the formal assessment all units will end with a project that requires students to apply scientific and mathematical knowledge to solve a real world problem via an engineering model based on design, test and redesign.

Unit Name: Light and Optics **Time Frame:** 3 weeks (12-15 lecture days)

Author: Egg Harbor Township High School Science Department

UNIT

Subject: HN Physics 1 **Country:** USA

Course/Grade: 11-12 **State/Group:** NJ

School: Egg Harbor Township High School

UNIT SUMMARY

Students will understand the nature of light including the electromagnetic spectrum and its properties. Students will be able to determine that light is both a particle and a wave. Students will use the knowledge of light to demonstrate how it can be transferred by the use of optics and mirrors.

UNIT RESOURCES

- Textbook- Physics 8th Edition (2009), *Cutnell and Johnson*
- Lab Manuals and materials

Internet Resource Links:

- Discovery: www.unitedstreaming.com
- NBC Learn Videos: www.nbclearn.com
- eLibrary science: http://science.bigchalk.com/sciweb/science/do/search
- Web Physics help: www.physicsclassroom.com
- Web simulators: www.pHET.colorado.edu

STAGE ONE

GOALS AND STANDARDS

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

Mathematical and computational thinking at the 9-12 level builds on K-8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-PS4-1)
- The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. (HS-PS4-1)

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

HS PS4-2 – [Content Statement] - Evaluate questions about the advantages of using a digital transmission and storage of information.

Asking questions and defining problems in grades 9–12 builds from grades K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.

- Evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. (HS-PS4-2)

- Systems can be designed for greater or lesser stability. (HS-PS4-2)

HS PS4-3 – [Content Statement] - Evaluate the claims, evidence, and reasoning behind 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.

Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed worlds. Arguments may also come from current scientific or historical episodes in science.

- Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-PS4-3)
- A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. (HS-PS4-3)

- [From the 3–5 grade band endpoints] Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other. (Boundary: The discussion at this grade level is qualitative only; it can be based on the fact that two different sounds can pass a location in different directions without getting mixed up.) (HS-PS4-3)

- Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features. (HS-PS4-3)

- 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)

HS PS4-4 – [Content Statement] - Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.

- When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells. (HS-PS4-4)

- 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-PS4-4)

HS PS4-5 – [Content Statement] - 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.

Obtaining, evaluating, and communicating information in 9–12 builds on K–8 and progresses to evaluating the validity and reliability of the claims, methods, and designs.

- Evaluate the validity and reliability of multiple claims that appear in scientific and technical texts or media reports, verifying the data when possible. (HS-PS4-4))
- Communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-PS4-5)

- Solar cells are human-made devices that likewise capture the sun’s energy and produce electrical energy. *(secondary to HS-PS4-5)*

- Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses. (HS-PS4-2),(HS-PS4-5)

- Photoelectric materials emit electrons when they absorb light of a high-enough frequency. (HS-PS4-5)

- Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. (HS-PS4-5)

- Systems can be designed to cause a desired effect. (HS-PS4-5)
- Science and engineering complement each other in the cycle known as research and development (R&D). (HS-PS4-5)

- Modern civilization depends on major technological systems. (HS-PS4-2),(HS-PS4-5)
- Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. (HS-PS4-2)

ENDURING UNDERSTANDINGS

- Light is an electromagnetic wave that stimulates the retina of the eye.

- The electromagnetic spectrum is a group of waves that travel at the same speed but different frequencies and wavelengths.

- Light travels in a straight line through any uniform medium.

- Materials can be characterized as being transparent, translucent, or opaque.

- White light is a combination of the spectrum of colors, each having different wavelengths.

- The law of reflection states that the angle of reflection is equal to the angle of incidence.

- Refraction is the bending of light rays at the boundary between two media.

- An object is a source of diverging light rays.
- Wave behaviors such as reflection and refraction are responsible for the functioning of many optical devices.

ESSENTIAL QUESTIONS

- What constitutes the electromagnetic spectrum?
- How is light polarized?
- How does light interact with matter?
- How do waves behave?
- How do images form?
- How is light described in terms of wave-energy transfer?
- How do mirrors and lenses work?
- Why can we see?
- How do telescopes and microscopes work?

KNOWLEDGE AND SKILLS

- Identify, sketch, and label waveforms.
- Calculate wave characteristics given various conditions.
- Sketch results of waves changing mediums (frequency, wavelength, inversion, amplitude, velocity).
- Calculate angles of reflection.
- Apply Snell's Law to refraction scenarios.
- Determine the differences between real and virtual images using optical devices such as mirrors and lenses.
- Recognize that light is the visible portion of an entire range of EM frequencies.

- Describe the ray model of light.
- Define luminous intensity, luminous flux, and illuminance.
- Explain the cause and give examples of interference in thin films.
- Explain the law of reflection.
- Calculate the index of refraction in a medium.
- Distinguish between diffuse and regular reflection and provide examples.
- Explain dispersion of light in terms of the index of refraction.
- Explain total internal reflection.
- Define the critical angle.
- Explain effects caused by the refraction of light in a medium with varying refractive indices.
- Explain how concave, convex, and plane mirrors form images.
- Locate images using ray diagrams, and calculate image location, size, and magnification using equations.
- Describe how real and virtual images are formed by convex and concave lenses.
- Locate the image with a ray diagram and find the image location and size using a mathematical model.
- Define chromatic aberration and explain how it can be reduced.

STAGE TWO

PERFORMANCE TASKS

- Laboratory investigations within small groups
- Constructed response

- Graphic organizers or models
- Do nows and/or exit slips
- Individual, small, and large group work
- Homework
- Guided practice

OTHER EVIDENCE

- Common assessment quiz
- Common assessment chapter test
- Review Activity

STAGE THREE

LEARNING PLAN

- Flashcards and/or drill and practice
- Power point presentations
- Lecture with note taking or guided notes
- Whole and small group discussions
- Laboratory groups
- Inquiry based activities with reflective discussion
- Online models and simulators

Student progress will be measured by formative and summative assessments. To maximize student understanding current and cumulative topics will be assessed weekly.

This unit is sequenced to begin with an informal assessment of prior knowledge of topics within the unit and determine any misconceptions. Students will then build small concrete blocks of information pertinent to mastery of this unit. Finally, students will be asked to use this information to evaluate higher level problems. This unit will end with a formal assessment common to all college prep students. In additional to the formal assessment all units will end with a project that requires students to apply scientific and mathematical knowledge to solve a real world problem via an engineering model based on design, test and redesign.

Unit Name: Satellite Motion and Space Dimensions **Time Frame:** 1 weeks (4-5 lecture days)

Author: Egg Harbor Township High School Science Department

UNIT

Subject: HN Physics 1

Country: USA

Course/Grade: 11-12

State/Group: NJ

School: Egg Harbor Township High School

UNIT SUMMARY

Students will determine how planets and satellites travel in elliptical orbits. Students will determine how far apart objects are in space.

UNIT RESOURCES

- Textbook- Physics 8th Edition (2009), *Cutnell and Johnson*
- Lab Manuals and materials

Internet Resource Links:

- Discovery: www.unitedstreaming.com
- NBC Learn Videos: www.nbclearn.com
- eLibrary science: http://science.bigchalk.com/sciweb/science/do/search
- Web Physics help: www.physicsclassroom.com
- Web simulators: www.pHET.colorado.edu

STAGE ONE

GOALS AND STANDARDS

HS PS2-1 – [Content Statement] - 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 PS2-4 – [Content Statement] – Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

- Laws are statements or descriptions of the relationships among observable phenomena. (HS-PS2-1),(HS-PS2-4)
- Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. (HS-PS2-4)
- Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2-4)
- 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)

HS ESS1-2 - [Content Statement] – Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, 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-ESS1-2)

- A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. (HS-ESS1-2)
- The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe. (HS-ESS1-2)
- Energy cannot be created or destroyed–only moved between one place and another place, between objects and/or fields, or between systems. (HS-ESS1-2)
- Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. (HS-ESS1-2)
- Science assumes the universe is a vast single system in which basic laws are consistent. (HS-ESS1-2

HS ESS1-4 - [Content Statement] – Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.

Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Use mathematical or computational representations of phenomena to describe explanations. (HS-ESS1-4)
- Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system. (HS-ESS1-4)
- 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)
- Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise. (HS-ESS1-2),(HS-ESS1-4)

ENDURING UNDERSTANDINGS

- Satellite motion is possible due to the radius of curvature.
- Energy is conserved at all points along a satellite's orbit.
- Distances in space are often measure in light years due to the incredible distances.
- Object orbit due to gravitation forces existing between all objects.

ESSENTIAL QUESTIONS

- Why do planets orbit the sun?
- How far away is Pluto?
- Why are orbits elliptical and not circular?

KNOWLEDGE AND SKILLS

- Identify how the radius of curvature of a planet relates to the orbital velocity.
- Relate radius of curvature, satellite mass and escape velocity.
- Calculate the distances between object in space.
- Apply Kepler's laws of motion to explain planetary motion.
- Observe planetary bodies and explain their motions.

STAGE TWO

PERFORMANCE TASKS

- Laboratory investigations within small groups
- Constructed response
- Graphic organizers or models
- Do nows and/or exit slips
- Individual, small, and large group work
- Homework
- Guided practice

OTHER EVIDENCE

- Common assessment quiz
- Common assessment chapter test
- Review Activity

STAGE THREE

LEARNING PLAN

- Flashcards and/or drill and practice
- Power point presentations
- Lecture with note taking or guided notes
- Whole and small group discussions
- Laboratory groups
- Inquiry based activities with reflective discussion
- Online models and simulators

Student progress will be measured by formative and summative assessments. To maximize student understanding current and cumulative topics will be assessed weekly.

This unit is sequenced to begin with an informal assessment of prior knowledge of topics within the unit and determine any misconceptions. Students will then build small concrete blocks of information pertinent to mastery of this unit. Finally, students will be asked to use this information to evaluate higher level problems. This unit will end with a formal assessment common to all college prep students. In additional to the formal assessment all units will end with a project that requires students to apply scientific and mathematical knowledge to solve a real world problem via an engineering model based on design, test and redesign.

Unit Name: Fluid and Air Dynamics **Time Frame:** 2 weeks (8-10 lecture days)

Author: Egg Harbor Township High School Science Department

UNIT

Subject: HN Physics 1

Country: USA

Course/Grade: 11-12

State/Group: NJ

School: Egg Harbor Township High School

UNIT SUMMARY

Students will determine how buoyant forces act and help objects float. Students will determine how fluids apply pressure. Students will determine what forces make an airplane fly.

UNIT RESOURCES

- Textbook- Physics 8th Edition (2009), *Cutnell and Johnson*
- Lab Manuals and materials

Internet Resource Links:

- Discovery: www.unitedstreaming.com
- NBC Learn Videos: www.nbclearn.com
- eLibrary science: http://science.bigchalk.com/sciweb/science/do/search
- Web Physics help: www.physicsclassroom.com
- Web simulators: www.pHET.colorado.edu

STAGE ONE

GOALS AND STANDARDS

HS PS2-1 – [Content Statement] - 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.

Analyzing data in 9–12 builds on K–8 and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze 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)
- Newton’s second law accurately predicts changes in the motion of macroscopic objects. (HS-PS2-1)

HS PS2-2 – [Content Statement] – 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.

Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Use mathematical representations of phenomena to describe explanations. (HS-PS2-2),(HS-PS2-4)
- Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. (HS-PS2-2)
- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined. (HS-PS2-2)

HS PS2-3 – [Content Statement] – Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- Apply scientific ideas to solve a design problem, taking into account possible unanticipated effects. (HS-PS2-3)

- Theories and laws provide explanations in science. (HS-PS2-1),(HS-PS2-4)
- Laws are statements or descriptions of the relationships among observable phenomena. (HS-PS2-1),(HS-PS2-4)
- If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. (HS-PS2-2),(HS-PS2-3)
- Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. *(secondary to HS-PS2-3)*

HS ETS1-2 - [Content Statement] –Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

- Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (HS-ETS1-2)

HS ETS1-3 - [Content Statement] –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.

- When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3)

HS ETS1-4 - [Content Statement] –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.

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles and theories.

- 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)
- Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. (HS-ETS1-4)
- 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)

ENDURING UNDERSTANDINGS

- Force is a vector quantity that causes changes in motion.

- Pushing down on a fluid results in the fluid pushing back up.

- The magnitude of a buoyant force for a floating object is equal to the weight of the object.
- The magnitude of a buoyant force for a submerged object is equal to the weight of fluid displaced by the object.
- Pressure is a measure of force exerted over a given area.
- The pressure in a fluid increases with depth.
- Multiple forces are in effect to make an object be able to float or fly.
- Forces can be manipulated to change the air patterns of aircraft.

ESSENTIAL QUESTIONS

- How do steel ships float?
- Why do objects get crushed at different depths?
- What forces are needed to steer an airplane?

KNOWLEDGE AND SKILLS

- Calculate the Buoyant force exerted on a given object.
- Contrast a gas and a liquid.
- Relate pressure, force and area.
- Describe how fluid pressure increases with depth.
- Apply the principle of buoyancy to design and build a cardboard boat capable of carrying your team across the pool.
- Learn all the forces including lift, drag, tension and weight that combine to enable an object to float in air.
- Build a kite taking into account all the forces involved.

STAGE TWO

PERFORMANCE TASKS

- Laboratory investigations within small groups
- Constructed response
- Graphic organizers or models
- Do nows and/or exit slips
- Individual, small, and large group work
- Homework
- Guided practice

OTHER EVIDENCE

- Common assessment quiz
- Common assessment chapter test
- Review Activity

STAGE THREE

LEARNING PLAN

- Flashcards and/or drill and practice
- Power point presentations
- Lecture with note taking or guided notes
- Whole and small group discussions
- Laboratory groups
- Inquiry based activities with reflective discussion

- Online models and simulators

Student progress will be measured by formative and summative assessments. To maximize student understanding current and cumulative topics will be assessed weekly.

This unit is sequenced to begin with an informal assessment of prior knowledge of topics within the unit and determine any misconceptions. Students will then build small concrete blocks of information pertinent to mastery of this unit. Finally, students will be asked to use this information to evaluate higher level problems. This unit will end with a formal assessment common to all college prep students. In additional to the formal assessment all units will end with a project that requires students to apply scientific and mathematical knowledge to solve a real world problem via an engineering model based on design, test and redesign.

Unit Name: Electricity **Time Frame:** 2 weeks (8-10 lecture days)

Author: Egg Harbor Township High School Science Department

UNIT

Subject: HN Physics 1 **Country:** USA

Course/Grade: 11-12 **State/Group:** NJ

School: Egg Harbor Township High School

UNIT SUMMARY

Students will classify electrical charge and analyze how charge interacts with matter and solve problems relating to charge, electric fields, and forces. Students will understand and solve problems involving electric power, and resistance by describing both a series connection and a parallel connection and state the important characteristics of each.

UNIT RESOURCES

- Textbook- Physics 8th Edition (2009), *Cutnell and Johnson*
- Lab Manuals and materials

Internet Resource Links:

- Discovery: www.unitedstreaming.com
- NBC Learn Videos: www.nbclearn.com
- eLibrary science: http://science.bigchalk.com/sciweb/science/do/search
- Web Physics help: www.physicsclassroom.com
- Web simulators: www.pHET.colorado.edu

STAGE ONE

GOALS AND STANDARDS

HS PS2-4 – [Content Statement] – Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

- Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. (HS-PS2-4)

- 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)

HS PS2-5 – [Content Statement] - 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.

Planning and carrying out investigations to answer questions or test solutions to problems in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical and empirical models.

- 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)
- Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2-4),(HS-PS2-5)
- "Electrical energy" may mean energy stored in a battery or energy transmitted by electric currents. *(secondary to HS-PS2-5)*

HS PS3-3 - [Content Statement] – Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

- 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)
- At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HS-PS3-2) (HS-PS3-3)

- 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)
- Modern civilization depends on major technological systems. Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. (HS-PS3-3)

HS PS3-5 - [Content Statement] – 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.

- When two objects interacting through a field change relative position, the energy stored in the field is changed. (HS-PS3-5)
- 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)

ENDURING UNDERSTANDINGS

- Electrical force fields exist around all charges.
- Current electricity is the continuous motion of electrical charges and how this can be used to do work.
- Electrical force fields exist around all charges.
- There are two kinds of electrical charge, positive and negative. Like charges repel; unlike charges attract.
- Electrical charge is not created or destroyed.
- Objects can be charged by transfer of electrons.
- Electric potential difference is the change in potential energy per unit charge in any electric field.
- Batteries, generators, and solar cells convert various forms of energy to electric energy.
- In an electric circuit, electric energy is transmitted from a device that produces electric energy to a resistor or other device that converts electric energy into the form needed.
- The current is the same everywhere in a simple series circuit.
- In a parallel circuit, the total current is equal to the sum of the currents in the branches.

ESSENTIAL QUESTIONS

- How does moving an electric charge do work?
- How do different circuits perform electrical work?
- How is electrical energy stored and transferred?
- How do different circuits perform electrical work?
- How is electrical energy created and distributed?
- How do we use series circuits?
- How do we use parallel circuits?

KNOWLEDGE AND SKILLS

- Describe and sketch circuit diagrams.
- Calculate current, voltage, and or resistance for a given circuit.
- Describe fields created by electric charge and how they induce fields in other objects.
- Use Coulomb's law to solve problems relating to electrical force.
- Describe the differences between conductors and insulators.
- Recognize that objects that are charged exert forces, both attractive and repulsive.
- Demonstrate that charging is the separation, not the creation, of electrical charges.
- Define and measure an electric field.
- Solve problems relating to charge, electric fields, and forces.
- Define and calculate electric potential difference.
- Explain how Millikan used electric fields to find the charge of the electron.
- Describe capacitance and solve problems.
- Define power in electric circuits.

- Define resistance and describe Ohm’s law.
- Describe both a series connection and a parallel connection and state the important characteristics of each.
- Construct both a series connection and a parallel connection.
- Analyze the difference between a series connection and parallel connection.
- Build a walking robot using a simple circuit to make it move.

STAGE TWO

PERFORMANCE TASKS

- Laboratory investigations within small groups
- Constructed response
- Graphic organizers or models
- Do nows and/or exit slips
- Individual, small, and large group work
- Homework
- Guided practice

OTHER EVIDENCE

- Common assessment quiz
- Common assessment chapter test
- Review Activity

STAGE THREE

LEARNING PLAN

- Flashcards and/or drill and practice
- Power point presentations
- Lecture with note taking or guided notes
- Whole and small group discussions
- Laboratory groups
- Inquiry based activities with reflective discussion
- Online models and simulators

Student progress will be measured by formative and summative assessments. To maximize student understanding current and cumulative topics will be assessed weekly.

This unit is sequenced to begin with an informal assessment of prior knowledge of topics within the unit and determine any misconceptions. Students will then build small concrete blocks of information pertinent to mastery of this unit. Finally, students will be asked to use this information to evaluate higher level problems. This unit will end with a formal assessment common to all college prep students. In additional to the formal assessment all units will end with a project that requires students to apply scientific and mathematical knowledge to solve a real world problem via an engineering model based on design, test and redesign.

Unit Name: Magnetism **Time Frame:** 2 weeks (7-8 lecture days)

Author: Egg Harbor Township High School Science Department

UNIT

Subject: HN Physics 1

Country: USA

Course/Grade: 11-12

State/Group: NJ

School: Egg Harbor Township High School

UNIT SUMMARY

Students will understand how magnetic fields are formed and used. Students will understand how magnetic fields and electric fields affect each other and how they are used in our daily lives.

UNIT RESOURCES

- Textbook- Physics 8th Edition (2009), *Cutnell and Johnson*
- Lab Manuals and materials

Internet Resource Links:

- Discovery: www.unitedstreaming.com
- NBC Learn Videos: www.nbclearn.com
- eLibrary science: http://science.bigchalk.com/sciweb/science/do/search
- Web Physics help: www.physicsclassroom.com
- Web simulators: www.pHET.colorado.edu

STAGE ONE

GOALS AND STANDARDS

HS PS2-5 – [Content Statement] - 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.

Planning and carrying out investigations to answer questions or test solutions to problems in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical and empirical models.

- 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)
- Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2-4),(HS-PS2-5)
- "Electrical energy" may mean energy stored in a battery or energy transmitted by electric currents. *(secondary to HS-PS2-5)*

HS PS3-5 - [Content Statement] –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.

- When two objects interacting through a field change relative position, the energy stored in the field is changed. (HS-PS3-5)
- 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)

ENDURING UNDERSTANDINGS

- Magnetism is a result of moving electric charges.
- Electricity can be induced by magnetism.
- Every magnet has a north and south pole.
- Earth has a magnetic field that is strongest at the poles.
- Magnetic forces affect current carrying wires.
- Motors turn electrical energy into mechanical energy and generators turn mechanical energy into electrical energy.
- AC current is used buy power supply companies because the voltage can easily be modified to meet the voltage needs on the individual consumer.
- A magnetic field is created in areas where an electric field is changing.

ESSENTIAL QUESTIONS

- What is the relationship between electricity and magnetism?
- How does magnetism induce electricity?
- What causes earth's magnetic field?
- How many times can a magnet be cut in half and still be magnetic?
- How do generators keep the lights on?
- What kind of current is in homes?

KNOWLEDGE AND SKILLS

- Describe fields created by magnetism and how they induce electric fields in other objects.
- Calculate the force created by a magnetic field and its relation to the distance between the two objects.
- Explain how magnetic poles affect each other.
- Describe and sketch the magnetic field in the space around a magnet.
- Describe how magnetic fields are produced.
- Describe how to make a permanent magnet.
- Describe the magnetic field produced by a current-carrying wire.
- Describe how a magnetic field exerts a force on a charged particle in the field.
- Describe how current is affected by a magnetic field.
- Describe how a galvanometer, generator and a motor work.
- State and explain Faraday's law.

- Describe how a transformer works and how does it bring current into homes.
- Explain why almost all electrical energy is sold in the form of alternating current.
- Explain how an electric field creates a magnetic field.

STAGE TWO

PERFORMANCE TASKS

- Laboratory investigations within small groups
- Constructed response
- Graphic organizers or models
- Do nows and/or exit slips
- Individual, small, and large group work
- Homework
- Guided practice

OTHER EVIDENCE

- Common assessment quiz
- Common assessment chapter test
- Review Activity

STAGE THREE

LEARNING PLAN

- Flashcards and/or drill and practice
- Power point presentations
- Lecture with note taking or guided notes

- Whole and small group discussions
- Laboratory groups
- Inquiry based activities with reflective discussion
- Online models and simulators

Student progress will be measured by formative and summative assessments. To maximize student understanding current and cumulative topics will be assessed weekly.

This unit is sequenced to begin with an informal assessment of prior knowledge of topics within the unit and determine any misconceptions. Students will then build small concrete blocks of information pertinent to mastery of this unit. Finally, students will be asked to use this information to evaluate higher level problems. This unit will end with a formal assessment common to all college prep students. In additional to the formal assessment all units will end with a project that requires students to apply scientific and mathematical knowledge to solve a real world problem via an engineering model based on design, test and redesign.

Curriculum Resources - Differentiated Instruction

Special Education Interventions in General Education

Visual Supports
Extended time to complete tests and assignments
Graphic Organizers
Mnemonic tricks to improve memory
Study guides
Use agenda book for assignments
Provide a posted daily schedule
Use of classroom behavior management system
Use prompts and model directions
Use task analysis to break down activities and lessons into each individual step needed to complete the task
Use concrete examples to teach concepts
Have student repeat/rephrase written directions
Heterogeneous grouping

Resources:

Do to Learn:
http://www.do2learn.com/

Sen Teacher:
http://www.senteacher.org/

Intervention Central:
http://www.interventioncentral.org/

Learning Ally:
https://www.learningally.org/

English Language Learners Interventions in Regular Education
Resources:

FABRIC - Learning Paradigm for ELLs (NJDOE)
www.nj.gov/education/bilingual/pd/**fabric**/**fabric**.pdf

Guide to Teaching ELL Students
http://www.colorincolorado.org/new-teaching-ells

Edutopia - Supporting English Language Learners
https://www.edutopia.org/blog/strategies-and-resources-supporting-ell-todd-finley

Reading Rockets
http://www.readingrockets.org/reading-topics/english-language-learners

Gifted and Talented Interventions in Regular Education
Resources:

Who are Gifted and Talented Students
http://www.npr.org/sections/ed/2015/09/28/443193523/who-are-the-gifted-and-talented-and-what-do-they-need

Hoagies Gifted Education Page
http://www.hoagiesgifted.org/programs.htm

21st Century Learning
Resources:

Partnership for 21st Century Learning
http://www.p21.org/

Career Ready Practices (NJDOE)
http://www.nj.gov/education/cte/hl/CRP.pdf