SCHOOL DISTRICT OF THE CHATHAMS
CURRICULUM PROFILE

Physics A
Grades 10 & 11
Full Year

Course Overview

This course provides students with a comprehensive understanding of key concepts that help them make sense of the physical sciences. The concepts in physics include forces and motion and types of interactions, wave properties, electromagnetic radiation, and information technologies..In addition, students explore definitions of energy, conservation of energy and energy transfer, the relationship between energy and forces, energy in chemical processes and everyday life. These performance expectations blend the core ideas with scientific and engineering practices and crosscutting concepts to support students in developing usable knowledge to explain ideas across the science disciplines. In the physical science performance expectations at the high school level, there is a focus on several scientific practices. These include developing and using models, planning and conducting investigations, analyzing and interpreting data, using mathematical and computational thinking, and constructing explanations; and to use these practices to demonstrate an understanding of the core ideas. Students are also expected to demonstrate an understanding of several engineering practices, including design and evaluation.

New Jersey Student Learning Standards
The New Jersey Student Learning Standards (NJSLS) can be located at www.nj.gov/education/cccs/2020/.

Physical Science:
HS-PS2-1 Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
HS-PS2-2 Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.
HS-PS2-3 Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
HS-PS2-4 Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.
HS-PS2-5 Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.
HS-PS3-1 Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
HS-PS3-2 Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).
HS-PS3-3 Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
HS-PS3-5 Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.
HS-PS4-1 Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

HS-PS4-2 Evaluate questions about the advantages of using a digital transmission and storage of information.
HS-PS4-3 Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.
HS-PS4-4 Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.
HS-PS4-5 Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.

Earth and Space Science:
HS- ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
HS-ESS1-4 Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.

Technology Standards
9.4.12.IML.7: Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change (e.g., NJSLSA.W1, 7.1.AL.PRSNT.4).
9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
9.4.12.TL.3: Analyze the effectiveness of the process and quality of collaborative environments.

21st Century Integration | NJSLS 9
9.3.ST-ET.1 Use STEM concepts and processes to solve problems involving design and/or production.
9.3.ST.2 Use technology to acquire, manipulate, analyze and report data.

Career Ready Practices
CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
CRP2. Apply appropriate academic and technical skills.
CRP4. Communicate clearly and effectively and with reason.

Interdisciplinary Connections
English Language Arts:
Reading
- RST.9-10.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
- RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
- RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

Writing
- WHST.11-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of

the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
- WHST.11-12.9 Draw evidence from informational texts to support analysis, reflection, and research.

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

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

Units of Study

Unit 1: Forces and Motion *(~20 days)*
- How can the motion of macroscopic objects be explained?
- How are mass, force and the acceleration of an object related?
- How can acceleration of a free falling object or projectile be described?

Unit 2: Motion and Space *(~20 days)*
- What forces affect orbiting objects in the solar system?
- How can you predict the gravitational forces?
- How can you predict electrostatic forces?

Unit 3: Energy *(~20 days)*
- How can conservation of energy be explained?
- How can energy be measured?
- How can energy be converted to different forms within a single macroscopic object?

Unit 4: Collisions and Momentum *(~20 days)*
- What interactions will cause a system and momentum to change?

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- What interactions will cause a system and momentum to be conserved?

Unit 5: Waves and their Applications *(~20 days)*
- What factors affect the speed of a wave?
- How can digital information be transported via waves?
- How does energy change in the electromagnetic spectrum?
- How do certain materials respond to specific frequencies?

Unit 6: Electrostatics, Electricity and Magnetism *(~20 days)*
- How can the effects of gravitational and electrostatic forces between distant objects be predicted and described?
- How can the relationship between electric and magnetic fields be explained?
- How can energy in a field be changed?

Learning Objectives/Discipline Standards of Practice

Learning Objectives
- Design, evaluate and test a solution to a problem
- Use mathematics to describe and explain phenomena
- Use mathematical formulas to explain attraction between two objects
- Use a theory or law to describe a scientific phenomena
- Develop and use a model to illustrate force between objects
- Plan and conduct an investigation to provide evidence of magnetic fields and electric current relationshipsCreate a computational model or simulation of a phenomenon, designed device, process, or system.
- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.
- 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.
- Analyze and interpret data to understand science phenomena
- Analyze theories to explain science
- Make observations to understand scientific law
- Evaluate questions that challenge the premise of an argument
- Use mathematical representations of phenomena
- Design solutions to describe and/or support claims and/or explanations
- Evaluate the claims, evidence, and reasoning behind currently accepted explanations
- Evaluate the validity and reliability of multiple claims that appear in scientific
- Communicate technical information or ideas about phenomena

Discipline Standards of Practice
Science and Engineering Practices
- Plan and Carryout and Investigation
- Ask questions and define problems
- Develop and use models
- Obtain, evaluate and communicate information
- Analyze and interpret data
- Construct explanations and design solutions
- Engage in argument from evidence

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- Use mathematics and computational thinking

Crosscutting Concepts

- Cause and Effect
- Scale, Proportion and Quantity
- Structure and Function
- Patterns
- Energy and Matter
- Systems and System Models
- Stability and Change

Instructional Resources and Materials
Whole class resources have been identified with an asterisk.

Resources
Physics., 2001, Holt, Serway & Faughn.

Materials

- HOLT Physics 2002
- Collision carts
- PASCO tracks
- Motion Sensors
- Force Sensors
- Collision Brackets
- Voltmeters
- Ammeters
- Wires
- Batteries
- Alligator Clips
- Compasses
- Magnets
- Play-Doh
- Pasco Carts
- PVC Pipe
- Clamps
- Weights
- RopesForce Tables
- Weights
- String
- Pasco Carts
- Motion Detectors
- Friction Boxes
- Computers
- PhET Simulations
- Whirligig Kit
- Pith Balls
- Measuring tools
- Ring Stand
- Fur and Rubber rods
- Slinkys
- PASCO wave generator
- PASCO 2.2M tracks
- Tuning forks
- string

Assessment Strategies
Assessment is designed to measure a student's mastery of a course standard and learning objective. Assessment can be used for both instructional purposes (formative assessment) and for evaluative purposes (summative assessment).

The following is a general list of the many forms assessment may take in learning.

- Tests
- Quizzes
- Projects
- Unit Assessments
- Labs

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