MOORESTOWN TOWNSHIP PUBLIC SCHOOLS
MOORESTOWN, NEW JERSEY

Moorestown High School
Science Department

AP Physics C: Mechanics

Grades 11 & 12

Date: July 2022
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Course Description and Fundamental Concepts

AP Physics C Mechanics provides a systematic introduction to the main principles of physics at the freshman college level, and follows Physics C format. Physics C emphasizes the development of problem solving abilities. Strong emphasis is placed on solving a variety of challenging problems, with fundamental calculus use being introduced. The subject matter covers Linear and Rotational Mechanics, as well as Conservation Principles, with equal emphasis on these three areas. The laboratory components of the course offer many experiences dealing with both simple and advanced topics. Upon completion of the course students will be prepared to take the AP-C Mechanics test offered by the College Board.

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New Jersey Student Learning Standards (NJSLS)

Subject/Content Standards
Include grade appropriate subject/content standards that will be addressed

Standard #	Standard Description
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-PS3-1	Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
HS-PS3-2	Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).
HS-PS3-3	Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
HS-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.

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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.
HS-ETS1-1	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
HS-ETS1-4	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

English Companion Standards

List grade-level appropriate companion standards for History, Social Studies, Science and Technical Subjects (CTE/Arts) 6-12. English Companion Standards are required in these subject/content areas.

Unit Addressed	Standard #	Standard Description
2,3,4,5	*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.*
1,2,3,4,6	*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.*
2,3,4,5	*WHST.9-12.9*	*Draw evidence from informational texts to support analysis, reflection, and research.*

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Career Awareness, Exploration, Preparation, and Training (Standard 9.2)
List appropriate units below for which standards will be addressed

By Grade 12		
Unit Addressed	**Core Idea**	**Standard / Description**
2,6	There are strategies to improve one's professional value and marketability.	***9.2.12.CAP.1**: Analyze unemployment rates for workers with different levels of education and how the economic, social, and political conditions of a time period are affected by a recession.* ***9.2.12.CAP.2**: Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs.* ***9.2.12.CAP.3**: Investigate how continuing education contributes to one's career and personal growth.*
1,2,5,6	Career planning requires purposeful planning based on research, self-knowledge, and informed choices.	***9.2.12.CAP.4**: Evaluate different careers and develop various plans (e.g., costs of public, private, training schools) and timetables for achieving them, including educational/training requirements, costs, loans, and debt repayment.* ***9.2.12.CAP.5**: Assess and modify a personal plan to support current interests and postsecondary plans.* ***9.2.12.CAP.6**: Identify transferable skills in career choices and design alternative career plans based on those skills.* ***9.2.12.CAP.7**: Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest.* ***9.2.12.CAP.8**: Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors.* ***9.2.12.CAP.9**: Locate information on working papers, what is required to obtain them, and who must sign them.* ***9.2.12.CAP.10**: Identify strategies for reducing overall costs of postsecondary education (e.g., tuition assistance, loans, grants, scholarships, and student loans).* ***9.2.12.CAP.11**: Demonstrate an understanding of Free Application for Federal Student Aid (FAFSA) requirements to apply for postsecondary education.*

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6	An individual's income and benefit needs and financial plan can change over time.	***9.2.12.CAP.12****: Explain how compulsory government programs (e.g., Social Security, Medicare) provide insurance against some loss of income and benefits to eligible recipients.* ***9.2.12.CAP.13****: Analyze how the economic, social, and political conditions of a time period can affect the labor market.*
2,5,6	Securing an income involves an understanding of the costs and time in preparing for a career field, interview and negotiation skills, job searches, resume development, prior experience, and vesting and retirement plans.	***9.2.12.CAP.14****: Analyze and critique various sources of income and available resources (e.g., financial assets, property, and transfer payments) and how they may substitute for earned income.*
6	Understanding income involves an analysis of payroll taxes, deductions and earned benefits.	***9.2.12.CAP.15****: Demonstrate how exemptions, deductions, and deferred income (e.g., retirement or medical) can reduce taxable income.* ***9.2.12.CAP.16****: Explain why taxes are withheld from income and the relationship of federal, state, and local taxes (e.g., property, income, excise, and sales) and how the money collected is used by local, county, state, and federal governments.* ***9.2.12.CAP.17****: Analyze the impact of the collective bargaining process on benefits, income, and fair labor practice.* ***9.2.12.CAP.18****: Differentiate between taxable and nontaxable income from various forms of employment (e.g., cash business, tips, tax filing and withholding).* ***9.2.12.CAP.19****: Explain the purpose of payroll deductions and why fees for various benefits (e.g., medical benefits) are taken out of pay, including the cost of employee benefits to employers and self-employment income.* ***9.2.12.CAP.20****: Analyze a Federal and State Income Tax Return.*

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3,5,6	There are ways to assess a business's feasibility and risk and to align it with an individual's financial goals.	***9.2.12.CAP.21****: Explain low-cost and low-risk ways to start a business.* ***9.2.12.CAP.22****: Compare risk and reward potential and use the comparison to decide whether starting a business is feasible.* ***9.2.12.CAP.23****: Identify different ways to obtain capital for starting a business*

Life Literacies and Key Skills (Standard 9.4) *List appropriate units below for which standards will be addressed*

By Grade 12		
Unit Addressed	**Core Idea**	**Standard / Description**
1,2,5,	**Creativity and Innovation**: With a growth mindset, failure is an important part of success.	***9.4.12.CI.1****: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).*
3	**Creativity and Innovation**: Innovative ideas or innovation can lead to career opportunities.	***9.4.12.CI.2:*** *Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).* ***9.4.12.CI.3:*** *Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).*
2,3,5	**Critical Thinking and Problem-solving:** Collaboration with individuals with diverse experiences can aid in the problem-solving process, particularly for global issues where diverse solutions are needed.	***9.4.12.CT.1:*** *Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).* ***9.4.12.CT.2:*** *Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).* ***9.4.12.CT.3:*** *Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue (e.g., environmental justice).* ***9.4.12.CT.4:*** *Participate in online strategy and planning sessions for course-based, school-based, or other projects and determine the strategies that contribute to effective outcomes.*

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5	**Digital Citizenship:** Laws govern the use of intellectual property and there are legal consequences to utilizing or sharing another's original works without permission or appropriate credit.	***9.4.12.DC.1****: Explain the beneficial and harmful effects that intellectual property laws can have on the creation and sharing of content (e.g., 6.1.12.CivicsPR.16.a).* ***9.4.12.DC.2****: Compare and contrast international differences in copyright laws and ethics*
3	**Digital Citizenship:** Laws govern many aspects of computing, such as privacy, data, property, information, and identity. These laws can have beneficial and harmful effects, such as expediting or delaying advancements in computing and protecting or infringing upon people's rights.	***9.4.12.DC.3****: Evaluate the social and economic implications of privacy in the context of safety, law, or ethics (e.g., 6.3.12.HistoryCA.1).* ***9.4.12.DC.4****: Explain the privacy concerns related to the collection of data (e.g., cookies) and generation of data through automated processes that may not be evident to users (e.g., 8.1.12.NI.3).* ***9.4.12.DC.5****: Debate laws and regulations that impact the development and use of software.*
3,5	**Digital Citizenship:** Cultivating online reputations for employers and academia requires separating private and professional digital identities.	***9.4.12.DC.6****: Select information to post online that positively impacts personal image and future college and career opportunities.*
1,3,6	**Digital Citizenship:** Digital communities influence many aspects of society, especially the workforce. The increased connectivity between people in different cultures and different career fields have changed the nature, content, and responsibilities of many careers.	***9.4.12.DC.7****: Evaluate the influence of digital communities on the nature, content and responsibilities of careers, and other aspects of society (e.g., 6.1.12.CivicsPD.16.a).*
2,3,4	**Digital Citizenship:** Network connectivity and computing capability extended to objects, sensors and everyday items not normally considered computers allows these devices to generate, exchange, and consume data with minimal human intervention. Technologies such as Artificial Intelligence (AI) and blockchain can help minimize the effect of climate change.	***9.4.12.DC.8****: Explain how increased network connectivity and computing capabilities of everyday objects allow for innovative technological approaches to climate protection.*

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3	**Global and Cultural Awareness:** Solutions to the problems faced by a global society require the contribution of individuals with different points of view and experiences.	***9.4.12.GCA.1:*** *Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than others (e.g., SL.11-12.1., HS-ETS1-1, HS-ETS1-2, HS-ETS1-4, 6.3.12.GeoGI.1, 7.1.IH.IPERS.6, 7.1.IL.IPERS.7, 8.2.12.ETW.3).*
1,2,3,4,5,6	**Information and Media Literacy:** Advanced search techniques can be used with digital and media resources to locate information and to check the credibility and the expertise of sources to answer questions, solve problems, and inform the decision-making.	***9.4.12.IML.1:*** *Compare search browsers and recognize features that allow for filtering of information.* ***9.4.12.IML.2:*** *Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources (e.g., NJSLSA.W8, Social Studies Practice: Gathering and Evaluating Sources.*
1,3,5	**Information and Media Literacy:** Digital tools such as artificial intelligence, image enhancement and analysis, and sophisticated computer modeling and simulation create new types of information that may have profound effects on society. These new types of information must be evaluated carefully	***9.4.12.IML.3****: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S-ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8)* ***9.4.12.IML.4****: Assess and critique the appropriateness and impact of existing data visualizations for an intended audience (e.g., S-ID.B.6b, HS-LS2-4).*
5	**Information and Media Literacy:** In order for members of our society to participate productively, information needs to be shared accurately and ethically.	***9.4.12.IML.5****: Evaluate, synthesize, and apply information on climate change from various sources appropriately (e.g., 2.1.12.CHSS.6, S.IC.B.4, S.IC.B.6, 8.1.12.DA.1, 6.1.12.GeoHE.14.a, 7.1.AL.PRSNT.2).* ***9.4.12.IML.6****: Use various types of media to produce and store information on climate change for different purposes and audiences with sensitivity to cultural, gender, and age diversity (e.g., NJSLSA.SL5).*
3	**Information and Media Literacy:** Accurate information may help in making valuable and ethical choices.	***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).*

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3,5	**Information and Media Literacy:** Media have embedded values and points of view.	***9.4.12.IML.8****: Evaluate media sources for point of view, bias, and motivations (e.g., NJSLSA.R6, 7.1.AL.IPRET.6).* ***9.4.12.IML.9****: Analyze the decisions creators make to reveal explicit and implicit messages within information and media (e.g., 1.5.12acc.C2a, 7.1.IL.IPRET.4).*
3,5	**Technology Literacy:** Digital tools differ in features, capacities, and styles. Knowledge of different digital tools is helpful in selecting the best tool for a given task.	***9.4.12.TL.1****: Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specific task (e.g., W.11-12.6.).* ***9.4.12.TL.2****: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.*
1,2,3,5	**Technology Literacy:** Collaborative digital tools can be used to access, record and share different viewpoints and to collect and tabulate the views of groups of people.	***9.4.12.TL.3****: Analyze the effectiveness of the process and quality of collaborative environments.* ***9.4.12.TL.4****: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem (e.g., 7.1.AL.IPERS.6).*

Interdisciplinary Connections (2020 NJSLS)

Visual & Performing Arts Integration (Standard 1)		
Unit Addressed	**Artistic Process**	**Anchor Standard**
1,2,3,4,6	**Creating**	*Anchor Standard 1: Generating and conceptualizing ideas.* *Anchor Standard 2: Organizing and developing ideas.* *Anchor Standard 3: Refining and completing products.*
	Connecting	*Anchor Standard 10: Synthesizing and relating knowledge and personal experiences to create products.* *Anchor Standard 11: Relating artistic ideas and works within societal, cultural, and historical contexts to deepen understanding.*
	Performing/ Presenting/ Producing	*Anchor Standard 4: Selecting, analyzing, and interpreting work.* *Anchor Standard 5: Developing and refining techniques and models or steps needed to create products.* *Anchor Standard 6: Conveying meaning through art.*

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	Responding	*Anchor Standard 7: Perceiving and analyzing products.* *Anchor Standard 8: Applying criteria to evaluate products.* *Anchor Standard 9: Interpreting intent and meaning.*

Unit Addressed	Content / Standard #	Standard Description
1,2,3,4,5,6	*Math / MP.2*	*Reason abstractly and quantitatively*
1,2,3,4,5,6	*Math / MP.4*	*Model with mathematics.*
1,2,3,4,5,6	*Math / 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*
1,2,3,4,5,6	*Math / HSN-Q.A.2*	*Define appropriate quantities for the purpose of descriptive modeling.*
1,2,3,4,5	*Math / HSN-Q.A.3*	*Choose a level of accuracy appropriate to limitations on measurement when reporting quantities*
1,2,3,4,5,6	*Math / HSA-SSE.A.1*	*Interpret expressions that represent a quantity in terms of its context.*
1,2,3,4,5,6	*Math / 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*
1,2,3,4,5,6	*Math / HSA-CED.A.1*	*Create equations and inequalities in one variable and use them to solve problems.*
1,2,3,4,5,6	*Math / 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*
1,2,3,4,5,6	*Math / HSA-CED.A.4*	*Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.*
1,2,3,4,5,6	*Math / HSF-IF.C.7*	*Graph functions expressed symbolically and show key features of the graph, by in hand in simple cases and using technology for more complicated cases.*
1,2,3,4,5,6	*Math / HSS-ID.A.1*	*Represent data with plots on the real number line (dot plots, histograms, and box plots).*

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Pacing Guide (All Dates are approximate based on the school calendar)

Unit/ Topic	Month (w/Approx number of Teaching Days)
1-Kinematics	September (~19 days)
2-Dynamics	October (~19 days)
2-Dynamics 3-Energy	November (~16 days)
3-Energy	December (~15 days)
4-Momentum	January (~18 days)
Revisit 1,2,3,4 in terms of Rotation	February (~18 days)
5-Gravitation	March (~15-20 days)
6-Harmonic Motion	April (~15-20 days)
AP Review & Projects	May (~18 days)
Projects	June (~15 days)

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Units Scope and Sequence

Unit 1: Kinematics

Learning Goals: What do I want my students to learn?

Standards

NJSLS -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-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

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

HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Anchor Standard 1: Generating and conceptualizing ideas.
Anchor Standard 2: Organizing and developing ideas.
Anchor Standard 3: Refining and completing products.

NJSLS - Career Awareness, Exploration, Preparation, and Training
NJSLS - Life Literacies and Key Skills
NJSLS - Interdisciplinary Standards

Fundamental Concepts / Big Ideas

- Motion of an object can be described in terms of position, velocity and acceleration.
- When an object is in free fall the equations of kinematics can describe its motion.
- Motion in horizontal and vertical directions are independent of each other.
- Some quantities are vectors and must be added as such.
- Calculus can be used to find and instantaneous rate of change
- Calculus can be applied to find the area of nonlinear functions

Learning Objectives

Students will be able to…

- Work with scalar and vector quantities
- Define kinematics variables
- Derive equations of kinematics
- Solve problems using equations of kinematics in both one and two dimensions
- Recognize and solve free fall problems
- Construct and interpret graphs of motion

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- Apply calculus to compute and instantaneous rate or an area
- Recognize when it is appropriate to apply calculus vs. algebra
- Recognize when it is appropriate to apply a derivative vs. an integral

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Units

Unit 2: Dynamics

Learning Goals: What do I want my students to learn?

Standards

NJSLS -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-PS2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.

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

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

Anchor Standard 1: Generating and conceptualizing ideas.
Anchor Standard 2: Organizing and developing ideas.
Anchor Standard 3: Refining and completing products.

NJSLS - Career Awareness, Exploration, Preparation, and Training
NJSLS - Life Literacies and Key Skills
NJSLS - Interdisciplinary Standards

Fundamental Concepts / Big Ideas

- Objects and systems have properties such as mass
- Fields existing in space can be used to explain interactions
- Acceleration can be predicted by Newton's Second Law
- Certain types of forces are considered fundamental

Learning Objectives

Students will be able to…

- Identify forces and make free-body-diagrams
- Identify action-reaction forces in accordance with Newton's Third Law
- Assess the type of motion a body will experience based on the free-body-diagram
- The three above for systems as well as a single body
- Explain how Newton's First Law applies to various situations
- Apply Newton's Second Law to a single body or system and calculate the acceleration
- Identify the centripetal force for objects in uniform circular motion
- Apply Newton's Second Law for situations where the object is in circular motion

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Units

Unit 3: Work, Energy, Power

Learning Goals: What do I want my students to learn?

Standards

NJSLS -HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).

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

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

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

HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range on constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural and environmental impacts.

Anchor Standard 1: Generating and conceptualizing ideas.
Anchor Standard 2: Organizing and developing ideas.
Anchor Standard 3: Refining and completing products.

NJSLS - Career Awareness, Exploration, Preparation, and Training
NJSLS - Life Literacies and Key Skills
NJSLS - Interdisciplinary Standards

Fundamental Concepts / Big Ideas

- Work is a form of energy
- The total work done equals the change in kinetic energy
- Total energy is always conserved but can change forms
- When only conservative forces act, mechanical energy is conserved
- Power is the rate at which work is done
- Instantaneous rates can be found using calculus
- Calculus can be applied to find the area of nonlinear functions

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Learning Objectives
Students will be able to… ● Identify which forces are doing work ● Calculate the work done by a force ● Apply the work-energy theorem to given situations ● Identify when only conservative forces act ● Apply conservation of energy to various situations that involve both conservative and non-conservative forces. ● Calculate the instantaneous and average power of a given force ● Recognize when it is necessary to apply calculus to a situation vs. algebra ● Appropriately apply calculus to problems involving work, potential energy, and power

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Units

Unit 4: Linear Momentum

Learning Goals: What do I want my students to learn?

Standards

NJSLS - 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-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).

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

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

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

Anchor Standard 1: Generating and conceptualizing ideas.
Anchor Standard 2: Organizing and developing ideas.
Anchor Standard 3: Refining and completing products.

NJSLS - Career Awareness, Exploration, Preparation, and Training
NJSLS - Life Literacies and Key Skills
NJSLS - Interdisciplinary Standards

Fundamental Concepts / Big Ideas

- Change in momentum is due to a net force acting on the object
- Both mass and velocity affect momentum linearly but not so for kinetic energy
- Linear momentum is conserved for an object or system if the net external force is zero
- Impulse is equivalent to the change in momentum

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Learning Objectives
Students will be able to… • Determine in what situations an impulse is acting on an object • Calculate the impulse and/or the change in momentum and realize they are equivalent • Analyze one dimensional elastic and inelastic collisions and solve for an unknown • Analyze two dimensional elastic and inelastic collisions and solve for an unknown • Read and interpret force vs. time graphs and use the graph to solve for an unknown • Analyze the energy in a collision • Differentiate between situations in which it is appropriate to apply conservation of momentum and/or conservation of energy. • Apply calculus to find the impulse produced by a force

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Units

Unit 5: Universal Gravitation

Learning Goals: What do I want my students to learn?

Standards

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

NJSLS - Career Awareness, Exploration, Preparation, and Training
NJSLS - Life Literacies and Key Skills
NJSLS - Interdisciplinary Standards

Fundamental Concepts / Big Ideas

- A gravitational field at the location of an object causes a gravitational force on the object
- Gravitation is governed by and inverse square law
- Gravitational forces and fields are due to mass
- Gravitational forces and fields are vectors and must be treated as such
- Gravitational potential energy near the earth is not treated the same as when far from the earth
- Calculus can be used to find and instantaneous rate of change
- Calculus can be applied to find the area of nonlinear functions

Learning Objectives

Students will be able to…

- Describe the gravitational force or field at a location due to given masses
- Calculate the gravitational force or field due to several masses in various arrangements
- Explain how the gravitational force or field changes as the reference position changes
- Calculate speed or period of a satellite starting with gravitation as the centripetal force
- Use calculus to determine the potential energy of various arrangements of masses

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Units

Unit 6: Simple Harmonic Motion

Learning Goals: What do I want my students to learn?

Standards

NJSLS -
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.*

Anchor Standard 1: Generating and conceptualizing ideas.
Anchor Standard 2: Organizing and developing ideas.
Anchor Standard 3: Refining and completing products.

NJSLS - Career Awareness, Exploration, Preparation, and Training
NJSLS - Life Literacies and Key Skills
NJSLS - Interdisciplinary Standards

Fundamental Concepts / Big Ideas

- Restoring forces result in oscillatory motion
- Linear restoring forces result in simple harmonic motion
- Mechanical energy is conserved when only conservative forces act
- Energy transmission via waves
- Information transmission via waves

Learning Objectives

Students will be able to…

- Calculate the period of a simple pendulum, physical pendulum, and mass on a spring
- Describe energy transformations during one period of SHM
- Predict where the maximum and minimum speed, acc, KE, PE will occur for SHM

Please contact the Content Supervisor for any questions.

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