Curriculum Map: Physics 2019

Course: PHYSICS Sub-topic: Physics

Grade(s): 9 to 12

Course Description: The accelerated Physics course covers mechanics, electricity and magnetism, thermal physics, waves, and optics. The course is intended as a first year physics course for advanced college bound students not seeking an AP track. The primary difference between the Academic and the accelerated Physics courses is the greater depth of theory and problem-solving methods resulting in a more efficient use of advanced mathematical skills possessed by qualified students. It is highly recommended that a Physics course be taken by all students planning to attend a four-year college after graduation.

DEPARTMENT RECOMMENDATIONS: Completion of Algebra 1 and Algebra 2 with a 70%. Completion of Honors Chemistry or Accelerated Chemistry or Academic Chemistry with an 80%.

Course Textbooks, Workbooks, Materials Citations: Physics: Principles and application by Giancoil

Unit: Unit 1 One dimensional Kinematics

Month: September ~5 days

Skills: Review one dimensional kinematics equations.

Review the meaning individual terms (v, a, d, t, etc) in the kinematics equations. Solve problems using the kinematics equations.

Calculate outcome of situations based on positions, velocities, accelerations and elapsed times

Establish/review the sign (+ or -) convention for all vector related quantities.

Differentiate between a scalar and a vector quantity.
Differentiate between speed and velocity.
Differentiate between displacement and distance
Define acceleration.

Analyze graphs and equations for meaning and for predictive capabilities.

Review the concept of free fall. Explain the importance of the acceleration due to gravity (g) in free fall problems. Determine the fall time of a projectile undergoing free fall.

Solve free fall problems using the kinematics equations. Demonstrate a knowledge of the importance of the free fall concept in determining the fall time of a projectile in free fall.

Essential Questions: How do you systematically approach a real world word problem and apply a mathematical system to solve it?

How can we measure, describe and predict the way objects move?

Content:

1. Kinematics equations
2. Vector Sign Convention
3. Free Fall

Assessments: Homework assignments
In class assignments
Composition notebook
Laboratory
Conceptual quizzes
Unit exam

Vocabulary: Position
distance
displacement
speed
velocity
acceleration

STANDARDS:

STANDARDS

NGSS Arranged by Topic - Science (2013)

HS-PS3-2 (Advanced)	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).
3-PS2-2 (Advanced)	Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.
HS-PS2-1 (Advanced)	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.

STATE: Pennsylvania State Anchors (2010)

S11.C.3 (Advanced)	Principles of Motion and Force
S11.C.3.1 (Advanced)	Use the principles of motion and force to solve real-world challenges.
S11.C.3.1.3 (Advanced)	Describe the motion of an object using variables (i.e., acceleration, velocity, displacement).

This Curriculum Map Unit has no Topics to display

Unit: Unit 2 Two dimensional Kinematics

Month: September ~14 days

Skills: Calculate displacement, velocity, acceleration, and elapsed time.

Analyze motion in terms of vector component rather than as a whole.

Analyze graphs and equations for meaning and for predictive capabilities.

Understand the concept of a frame of reference.

Design controlled experiments.

Essential Questions: How do you systematically approach a real world word problem and apply a mathematical system to solve it?

How can we measure, describe and predict the way objects move?

Content:
Vectors
2-Dimensional displacement, velocity, and acceleration
Projectile motion
Frame of Reference

Assessments:
Home work
In class assignments
Labs
Composition Notebook
Conceptual quiz
Unit Exam

Vocabulary:
Vectors
Vector components
Displacement
Velocity
Acceleration
half parabola
full parabola
partial parabola

STANDARDS:

STANDARDS

NGSS Arranged by Topic - Science (2013)

HS-PS3-2 (Advanced)	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).

STATE: Pennsylvania State Anchors (2010)

S11.C.3 (Advanced)	Principles of Motion and Force
S11.C.3.1 (Advanced)	Use the principles of motion and force to solve real-world challenges.
S11.C.3.1.3 (Advanced)	Describe the motion of an object using variables (i.e., acceleration, velocity, displacement).

This Curriculum Map Unit has no Topics to display

Unit: Unit 3: Dynamics and Forces

Month: October ~9 days

Skills:
Analyze graphs and equations for meaning and for predictive capabilities
Design controlled experiments.
Calculate outcome of situations based on positions, velocities, accelerations and elapsed times
Determine causes of changes in motion and predict outcomes based on inertia and forces.

Incorporate static and sliding friction as needed in order to solve problems using force analysis.
Carry out force addition problems using the Principal of Superposition of Forces.
Use general and special forces in Free Body Diagrams (FBD) in order to solve force problems.

Students will solve problems for centripetal force and acceleration.

Essential Questions:

How can we affect the motion of objects?

How can we design models to test and analyze complex situations?

What is the relationship between mass and acceleration?

How are vectors added graphically and analytically?

Content:

Newton's Laws of Motion (forces and inertia)
Nature of Science (theories v. laws, etc)
1-D & 2-D Kinematics
Vectors
Free Body (vector) Diagrams
Applications of Newton's Laws
Forces
Friction
Concurrent
Parallel
Uniform Circular Motion

Assessments:

Homework assignments
In class assignments
Composition notebook
Laboratory
Conceptual quizzes
Unit exam

Vocabulary:

Force
Newton's 1st law
Newton's 2nd law
Newton's 3rd law
Inertia
Equilibrium
Centripetal acceleration

STANDARDS:

STANDARDS

NGSS Arranged by Topic - Science (2013)

3-PS2-1 (Advanced)	Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
3-PS2-2 (Advanced)	Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.
HS-PS2-1 (Advanced)	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 (Advanced)	Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

STATE: Pennsylvania State Anchors (2010)

S11.C.3 (Advanced)	Principles of Motion and Force
S11.C.3.1 (Advanced)	Use the principles of motion and force to solve real-world challenges.
S11.C.3.1.3 (Advanced)	Describe the motion of an object using variables (i.e., acceleration, velocity, displacement).

This Curriculum Map Unit has no Topics to display

Unit: Unit 4 Work and Energy

Month: November ~12 days

Skills:

Analyze graphs and equations for meaning and for predictive capabilities

Design controlled experiments

Determine causes of changes in motion and predict outcomes based on energies present, forces and distances.

Determine Power output from either changes in energy or from forces and distances.

Solve basic energy conservation problems using the law of conservation of energy.

Define kinetic energy, gravitational potential energy, elastic potential energy, rotational kinetic energy, and work.

Solve kinetics problems using the MVE with its built in Work-Kinetic Principle.

Define the Work-Kinetic Energy Principle.

Essential Questions:

What is energy and how does it affect motion?

How can conservation of energy be used to simplify the analysis of complex situations?

How can we design models to test and analyze complex situations?

Content:

Work-Energy Theorem

Kinetic, Elastic and Gravitational Potential Energies

Conservation of Energy

Power

Hooke's law

Vocabulary:

Work

Kinetic Energy

Potential Energy

Power

STANDARDS:

STANDARDS

NGSS Arranged by Topic - Science (2013)

HS-PS3-1 (Advanced)	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-PS3-3 (Advanced)	Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
3-PS2-2 (Advanced)	Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

STATE: Pennsylvania State Anchors (2010)

S11.C.2 (Advanced)	Forms, Sources, Conversion, and Transfer of Energy
S11.C.2.1 (Advanced)	Analyze energy sources and transfer of energy, or conversion of energy.
S11.C.3.1 (Advanced)	Use the principles of motion and force to solve real-world challenges.

This Curriculum Map Unit has no Topics to display

Unit: Unit 5 Momentum

Month: December ~12 days

Skills:

Define appropriate systems and differentiate between internal and external forces

Apply Newton's Laws (and Conservation of Momentum) to collisions and explosions.

Use the Law of Conservation of Linear Momentum to solve elastic and inelastic collisions in one and two dimensional collisions.

Essential Questions:

How can we affect the motion of objects?

How does conservation of momentum enable us to analyze interactions of objects more easily than conservation of energy?

How does momentum relate to forces?

What is the difference between elastic and inelastic collisions?

What is "Impulse" and what is its relationship to force, time, and momentum?

Content:

Define appropriate systems and differentiate between internal and external forces

Apply Newton's Laws (and Conservation of Momentum) to collisions and explosions.

Apply Newton's Laws and Impulse to designing a vehicle that reduces the maximum force of impact.

Calculate the linear momentum of a body traveling at a specific velocity.

Solve problems for the center of mass of a system of particles.

Solve problems for the center of mass of a solid body.

Solve problems using Newton's Second Law for a System of Particles.

Calculate the linear momentum of a body traveling at a specific velocity.

Vocabulary: Momentum

Impulse

Elastic

Inelastic

STANDARDS:

STANDARDS

NGSS Arranged by Topic - Science (2013)

HS-PS2-2 (Advanced)	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.

STATE: Pennsylvania State Anchors (2010)

S11.C.3 (Advanced)	Principles of Motion and Force
S11.C.3.1 (Advanced)	Use the principles of motion and force to solve real-world challenges.
S11.C.3.1.3 (Advanced)	Describe the motion of an object using variables (i.e., acceleration, velocity, displacement).

This Curriculum Map Unit has no Topics to display

Unit: Unit 6 Circular motion

Month: December ~5 days

Skills: Analyze motion in terms of component parts rather than as a whole

Examine the development of our understanding of the solar system from a historical perspective and in terms of scientific processes.

Analyze graphs to determine the factors that influence periods for a swinging object

Essential Questions: How can we affect the motion of objects?

How can we cause objects to move in circles, and what factors influence the nature of those circles?

How did the development of technology and societal influences affect the our understanding of and models describing the universe?

Content: Newton's Laws of Motion (forces and inertia)

Newton's Law of Universal Gravitation

Vocabulary: Centripetal Force

Centripetal Acceleration

Period & Frequency

STANDARDS:

STANDARDS

NGSS Arranged by Topic - Science (2013)

HS-PS2-1 (Advanced)	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 (Advanced)	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-PS2-4 (Advanced)	Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

STATE: Pennsylvania State Anchors (2010)

S11.C.3 (Advanced)	Principles of Motion and Force
S11.C.3.1 (Advanced)	Use the principles of motion and force to solve real-world challenges.
S11.C.3.1.3 (Advanced)	Describe the motion of an object using variables (i.e., acceleration, velocity, displacement).

This Curriculum Map Unit has no Topics to display

Unit: Unit 7 Rotational Motion

Month: January ~10 days

Skills: Apply Angular conversions where appropriate

Differentiate between angular momentum and linear momentum

Explain common phenomena in terms of conservation of angular momentum

Solve simple rotational and angular problems.

Solve conversion problems from degrees to radians and back again.

Essential Questions: How can we affect the motion of objects?

How does rotational motion relate to linear motion?

What factors affect the moment of inertia of objects, and how does the moment of inertia affect the motion of the object?

Content: Rotational Kinetic Energy

Rotational-Linear Analogs

Moment of Inertia

Torque

Conservation of Angular Momentum

Vocabulary: Torque

Moment of Inertia

Angular Momentum

STANDARDS:

STANDARDS

NGSS Arranged by Topic - Science (2013)

HS-PS3-1 (Advanced)	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-PS3-3 (Advanced)	Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
HS-PS2-1 (Advanced)	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 (Advanced)	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.

STATE: Pennsylvania State Anchors (2010)

S11.C.3 (Advanced)	Principles of Motion and Force
S11.C.3.1 (Advanced)	Use the principles of motion and force to solve real-world challenges.
S11.C.3.1.3 (Advanced)	Describe the motion of an object using variables (i.e., acceleration, velocity, displacement).

This Curriculum Map Unit has no Topics to display

Unit: Unit 8 Electrostatics

Month: April ~8 days

Skills: Compare Coulomb's Law for Electrostatics w/ Newton's Law of Universal Gravitation

Solve problems to determine the force of attraction/repulsion between two charged particles or a system of charged particles.

Essential Questions: How can we electrically affect the motion of objects?

How do charges influence each other?

How do we calculate the magnitude of the force between charged particles?

How do we determine the direction of the force between charged particles?

Content:

Coulomb's Law

Conservation of electric charge.

Vocabulary:

anion

cation

attraction/repulsion

superposition of forces

STANDARDS:

STANDARDS

NGSS Arranged by Topic - Science (2013)

HS-PS3-2 (Advanced)	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-PS3-5 (Advanced)	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-PS2-4 (Advanced)	Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.

STATE: Pennsylvania State Anchors (2010)

S11.C.2.1.4 (Advanced)	Use Ohm's Law to explain relative resistances, currents, and voltage.
S11.C.3 (Advanced)	Principles of Motion and Force
S11.C.3.1 (Advanced)	Use the principles of motion and force to solve real-world challenges.
S11.C.3.1.3 (Advanced)	Describe the motion of an object using variables (i.e., acceleration, velocity, displacement).
S11.C.3.1.4 (Advanced)	Explain how electricity induces magnetism and how magnetism induces electricity as two aspects of a single electromagnetic force.

This Curriculum Map Unit has no Topics to display

Unit: Unit 9 Electrical Circuits

Month: April ~12 days

Skills: Investigate Current, Resistance, Conductivity, Power, and Series and Parallel RC Circuits

Analyze data to determine the effect of series and parallel resistors on current, voltage and power output

Study the concept of power as it is related to electric components and circuits.

Study the Loop, Resistance, and EMF rules.

Study the behavior of resistors in series and in parallel.

Study the behavior of batteries in a circuit.

Study the Junction rule for multi-loop circuits.

Essential Questions:

How can we measure and calculate the power output of moving charges through various elements?

What is the contribution of electrons to electrical current?

What are the two primary configurations in electrical circuits?

How do we use Ohm's Law to relate potential, resistance, and current?

How do we determine the equivalents for resistance, capacitance, and voltage for series and parallel resistors, capacitors, and battery configurations?

Content:

Ohm's Law (current, resistance, voltage)

Series and Parallel resistors/capacitors

Power Equation

Vocabulary:

Current

Voltage

Resistance

Power

Parallel and Series circuits

STANDARDS:

STANDARDS

NGSS Arranged by Topic - Science (2013)

HS-PS3-5 (Advanced)	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.

STATE: Pennsylvania State Anchors (2010)

S11.C.1 (Advanced)	Structure, Properties, and Interaction of Matter and Energy
S11.C.1.1.1 (Advanced)	Explain that matter is made of particles called atoms and that atoms are composed of even smaller particles (e.g., protons, neutrons, electrons).
S11.C.2.1.4 (Advanced)	Use Ohm's Law to explain relative resistances, currents, and voltage.
S11.C.3 (Advanced)	Principles of Motion and Force
S11.C.3.1.4 (Advanced)	Explain how electricity induces magnetism and how magnetism induces electricity as two aspects of a single

electromagnetic force.

This Curriculum Map Unit has no Topics to display

Unit: Unit 10 Electromagnetism

Month: May ~ 12 Days

Skills:

Calculate the force of attraction/repulsion between current carrying conductors.

Explain the electron's role in power generation and in electromagnet devices.

Differentiate between inductance and induction.

Explain the interaction/behavior of electrons traveling in a magnetic field.

Calculate the force on a charged particle in a magnetic field.

Essential Questions:

What are the fundamental laws of magnetism?

What is the role of electromagnetism in the operation of the following electromagnetic devices including the DC electric motor, the electromagnet, the solenoid, and the transformer?

How do we map the magnetic field of a magnet and how does the magnetic field impact the operation of electromagnetic devices?

How do we calculate the magnitude of the force on moving charges in presence of a magnetic field?

How do we determine the force of attraction/repulsion between current carrying conductors?

Content:

Relationship between magnetism and force

Induction and Inductance

Faraday's Law of Induction

Lenz's Law.

Vocabulary:

Induction

Induction

Magnetic Field

Magnetic Poles

Magnetic Field

STANDARDS:

STANDARDS

NGSS Arranged by Topic - Science (2013)

HS-PS3-5 (Advanced)	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-PS2-5 (Advanced)	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.

STATE: Pennsylvania State Anchors (2010)

S11.C.1.1.1 (Advanced)	Explain that matter is made of particles called atoms and that atoms are composed of even smaller particles (e.g., protons, neutrons, electrons).
S11.C.2 (Advanced)	Forms, Sources, Conversion, and Transfer of Energy
S11.C.2.1 (Advanced)	Analyze energy sources and transfer of energy, or conversion of energy.
S11.C.2.2 (Advanced)	Demonstrate that different ways of obtaining, transforming, and distributing energy have different environmental consequences.
S11.C.2.2.2 (Advanced)	Explain the practical use of alternative sources of energy (i.e., wind, solar, and biomass) to address environmental problems (e.g., air quality, erosion, resource depletion).
S11.C.2.2.3 (Advanced)	Give examples of renewable energy resources (e.g., wind, solar, biomass) and nonrenewable resources (e.g., coal, oil, natural gas) and explain the environmental and economic advantages and disadvantages of their use.
S11.C.3 (Advanced)	Principles of Motion and Force
S11.C.3.1.4 (Advanced)	Explain how electricity induces magnetism and how magnetism induces electricity as two aspects of a single electromagnetic force.

This Curriculum Map Unit has no Topics to display

Unit: Unit 11 Waves and Oscillations

Month: March ~ 8 days

Skills:

Analyze instruments to determine the notes they produce

Apply wave phenomena to explain common occurrences with sound

Apply wave concepts and the speed of sound to solve problems

Solve problems involving SHM and mass-spring systems (mass on a spring and the simple pendulum).

Analyze and interpret simple harmonic graphs

Solve for the angular frequency and period of a body undergoing SHM

Solve energy problems for bodies undergoing SHM.

Essential Questions:

What is energy and how does it affect motion?

How do waves relate to SHM?

How do the properties of waves affect the nature of sounds we hear?

How does the nature of the medium through which a wave is traveling affect the wave?

Content: Wave types: Mechanical v. EM; Longitudinal v. Transverse

Speed of Sound

Wave Phenomena (Reflection, Refraction, Diffraction)

Interference and Superposition

Instruments and Music

Concepts of amplitude, angular frequency, damping, harmonic oscillator, resonance, and standing waves and resonance

Vocabulary: Doppler Effect

Period

Frequency

Interference

Diffraction

Wavelength

STANDARDS:

STANDARDS

STATE: Pennsylvania State Anchors (2010)	
S11.C.1 (Advanced)	Structure, Properties, and Interaction of Matter and Energy
S11.C.2 (Advanced)	Forms, Sources, Conversion, and Transfer of Energy
S11.C.2.1 (Advanced)	Analyze energy sources and transfer of energy, or conversion of energy.
S11.C.2.1.1 (Advanced)	Compare or analyze waves in the electromagnetic spectrum (e.g., ultraviolet, infrared, visible light, Xrays, microwaves) as well as their properties, energy levels, and motion.
S11.C.3 (Advanced)	Principles of Motion and Force
NGSS Arranged by Topic - Science (2013)	
HS-PS4-1 (Advanced)	Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
HS-PS4-5 (Advanced)	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.

This Curriculum Map Unit has no Topics to display

Unit: Unit 12 Electromagnet Radiation (Optics)

Month: March ~ 10

Skills: Use vector ray diagrams to determine reflected image type (real or virtual) formed by different mirrored surfaces and geometries (planar, convex, and concave).

Identify the anatomy of reflection.

Determine the magnification (plus or minus) of a reflected object.

Use Snell's Law to calculate the angles of incidence and the angles of refraction through a lens and other transparent objects.

Use Snell's Law to determine the critical angle of a material.

Use the concept of refraction to draw ray diagrams through flat, convex, concave, and hybridized lenses.

Use the Thin Lens equation to determine the focal lengths and object distances.

Use diffraction to explain the wave-particle duality of light.

Study Young's Double slit experiment.

Relate diffraction to the dispersion of light into its visible spectrum.

Use a diffraction grating to exam diffraction.

Explore thin film interference.

Use the polarizing angle and Brewster's angle and the index of refraction to determine the degree of polarization.

Essential Questions:

How do vector ray light diagrams form real/virtual images?

What type of images are formed by different mirrored surfaces and geometries (planar, convex, and concave)?

How is Snell's Law used to calculate the angles of incidence and the angles of refraction through a lens and other transparent objects?

How is the Thin Lens equation used to determine focal lengths and object distances?

What role does the wave-particle duality of light play in diffraction?

How does the index of refraction of a material impact light beams passing through transparent materials?

Content:

Diffraction

Interference

Light Polarization

Refraction and Lenses

Reflection and Mirrors

Vocabulary:

Diffraction

Interference

Light Polarization

Reflection

Refraction

STANDARDS:

STANDARDS

STATE: Pennsylvania State Anchors (2010)

S11.C.2.1.1 (Advanced)	Compare or analyze waves in the electromagnetic spectrum (e.g., ultraviolet, infrared, visible light, Xrays, microwaves) as well as their properties, energy levels, and motion.

NGSS Arranged by Topic - Science (2013)

HS-PS4-3 (Advanced)	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-PS4-5 (Advanced)	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.

This Curriculum Map Unit has no Topics to display