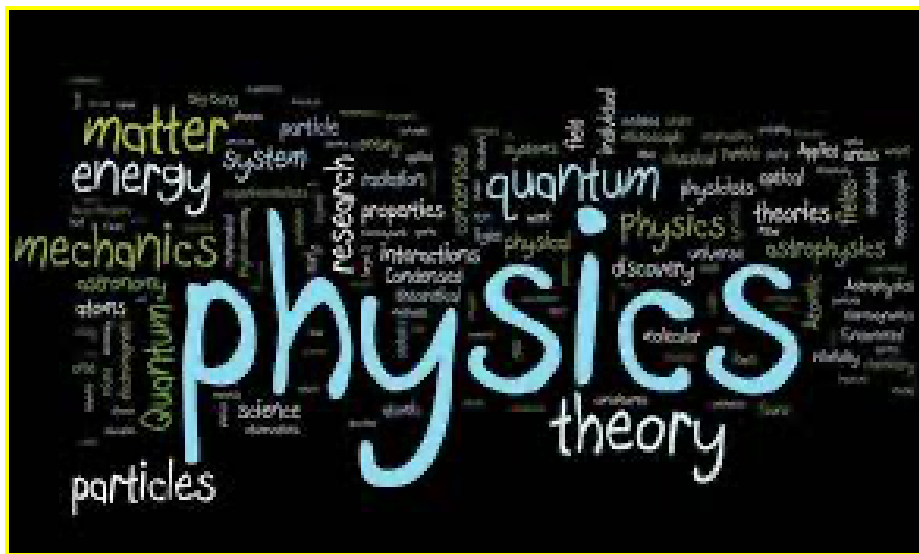


PHYSICS CURRICULUM



Grade Level(s): 11-12

Curriculum Author(s): Bill Pease

Course Description: Physics is a full year course for the student who is confident in math and science and intends to pursue a postsecondary education in the fields of Science, Pre-Medical, Engineering or Mathematics. It is also highly recommended that all students planning to attend college take this course regardless of career path. Topics covered include Newtonian mechanics, work, energy, power, mechanical waves, sound and light. It will also introduce circuits, optics, electricity and magnetism. Evaluation is based upon tests, quizzes, laboratory work, and a final exam. Physics is offered as an honors or college prep course. The honors level course is designed and implemented so that the depth of the topics discussed in the course surpass that of the College Prep course and include the following: extensions of learning, accelerated pacing, greater complexity in topics, and greater responsibility, creativity, and reflection on the part of the students as their thinking is challenged.

Year At A Glance

Unit Title	Overarching Essential Question	Overarching Enduring Understanding	Vision of A Learner “I Can” Statements
Kinematics	How does our choice of reference frame affect how we perceive and measure motion in real-world contexts?	Understanding motion in different frames of reference is crucial for fields such as aviation, space travel, and autonomous vehicle navigation.	TCC1(9-12), TCC3(9-12)
Newton's Laws	Why does anything move or stay still?	Forces cause motion and hold structures together.	TCC1(9-12), TCC3(9-12)
Work and Energy	In what ways can work and energy principles help us reduce environmental impact?	Real-world challenges like climate change and resource management depend on understanding how energy is stored, transferred, and conserved.	TCC1(9-12), TCC3(9-12)
Impulse and Momentum	How do airbags, helmets, and crumple zones use momentum concepts to reduce injury?	The conservation of momentum explains real-world phenomena like car crashes and athletic collisions and informs how we protect people from injury.	TCC1(9-12), TCC3(9-12)
2 Dimensional Physics	How can we apply Physics to 2 Dimensional Motions and Rotations?	Most Mechanical situations can be modeled in 2 Dimensions.	TCC1(9-12)
Electricity	How do circuit designs impact power distribution in homes and electronic devices?	Electric forces govern interactions in all electronic devices, and understanding these forces allows for efficient circuit design.	TCC1(9-12)
Electromagnetism	What technologies rely on electromagnetic principles to function?	Magnetic fields created by currents allow the conversion of energy between mechanical and electrical forms, enabling efficient energy systems.	TCC1(9-12)
Sound and Waves	How can wave behavior be manipulated to solve practical problems?	Engineers use wave interference and superposition to solve problems in signal processing and sound design.	TCC3(9-12)



Light and Optics	How do different wavelengths of light affect technology, health, and the environment?	Light exhibits wave and particle properties that are central to technologies like lasers, microscopes, and solar panels.	TCC1(9-12)
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Unit 1 - Kinematics

Desired Results - Goals, Transfer, Meaning, Acquisition

Established Goals:

- **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.
- **Science and Engineering Practice:** Analyzing and interpreting data.
- **Crosscutting Concepts:** Patterns; Cause and effect.

Vision of A Learner Attributes: Students will be able to independently use their learning to... (“I can” statements to be demonstrated)

TCC1(9-12): I can ask purposeful, insightful questions to find a variety of innovative solutions.

TCC3(9-12): I can integrate relevant information to produce multiple valid solutions.

Understandings: Students will understand that...

- Motion can be accurately modeled using mathematical tools, helping engineers design safer cars, better sports equipment, and efficient transit systems.
- Graphical and mathematical descriptions of motion allow us to evaluate system performance and identify trends across a range of real-world applications.
- Understanding motion in different frames of reference is crucial for fields such as aviation, space travel, and autonomous vehicle navigation.

Essential Questions:

- How can the motion of vehicles, athletes, or projectiles be predicted and optimized using mathematical models?
- In what ways does accurate motion analysis improve safety and efficiency in transportation systems?
- How does our choice of reference frame affect how we perceive and measure motion in real-world contexts?

Students will know...

- that motion can be described using such quantities as position, displacement, distance, velocity, speed, and acceleration
- that displacement, velocity and acceleration are vectors
- that displacement is a change in position. Velocity is the rate of change of position. Acceleration is the rate of change of velocity. Changes in each property are

Students will be able to...

- express the motion of an object using narrative, mathematical, and graphical representations.
- design and experimental investigation of the motion of an object.
- analyze experimental data describing the motion of an object and is able to express the results of the analysis using narrative, mathematical, and graphical representations.
- model the motion of anything with a constant acceleration or an

<p>expressed by subtracting initial values from final values</p> <ul style="list-style-type: none"> • that a choice of reference frame determines the direction and the magnitude of each of these quantities. • that motion can be described using graphs and diagrams. 	<p>acceleration that can be approximated to be constant.</p>
<p>Key Vocabulary: Displacement, distance, velocity, speed, acceleration, vector, scalar</p>	
<p>Assessment Evidence</p>	
<p>Performance Tasks:</p> <p>Labs: Motion Matching with motion sensors Measuring acceleration, velocity and position of dropped picket and rolling cart on ramp. Problem solving: Determining Position, Velocity and Acceleration from graphs Determine Position, Velocity and Acceleration using equations of motion</p>	<p>Other Evidence:</p> <p>Khan Academy practice Unit Test</p>
<p>Learning Plan</p>	
<p>TCC1 I can ask purposeful, insightful questions to find a variety of innovative solutions.</p> <ul style="list-style-type: none"> • Motion Matching Lab <p>TCC3 I can integrate relevant information to produce multiple valid solutions.</p> <ul style="list-style-type: none"> • Problem solving: Determining Position, Velocity and Acceleration from graphs • Determine Position, Velocity and Acceleration using equations of motion 	
<p>Teacher Resources:</p> <p>Physicsclassroom.com <i>Physics</i> Walker 3rd edition; <i>Conceptual Physics</i>, Hewitt, High School Ed. 2009 Lab equipment, Computer based motion measuring sensors Department Lab Report rubric Practice Problems and Khan Academy</p>	

Unit 2 - Newton's Laws

Desired Results - Goals, Transfer, Meaning, Acquisition

Established Goals:

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 claims about momentum conservation.

Science and Engineering Practice: Developing and using models; Using mathematics and computational thinking.

Crosscutting Concepts: Systems and system models; Stability and change.

Vision of A Learner Attributes: Students will be able to independently use their learning to... ("I can" statements to be demonstrated)

TCC1(9-12): I can ask purposeful, insightful questions to find a variety of innovative solutions.

TCC3(9-12): I can integrate relevant information to produce multiple valid solutions.

Understandings: Students will understand that...

- Forces cause motion and hold structures together.
- Newton's laws provide the foundation for predicting and analyzing the forces acting within engineered systems.
- Free-body diagrams help identify key factors in the stability and safety of structures and mechanical systems.
- Real-world applications—from biomechanics to aerospace—rely on understanding forces to design systems that function safely and efficiently.

Essential Questions:

- Why does anything move or stay still?
- How do engineers use Newton's laws to ensure the structural integrity of buildings, bridges, and spacecraft?
- What role do force diagrams play in predicting system behavior under stress?
- How can we model and analyze the forces involved in real-world activities like jumping, lifting, or driving?

Students will know...

- that the acceleration of an object is directly proportional to the net force exerted on it and inversely proportional to the mass of the object
- that force and acceleration are both vectors, with acceleration in the same direction as the net force.
- that forces have magnitude and direction.

Students will be able to...

- make predictions about the motion of a system based on the fact that acceleration is equal to the change in velocity, and velocity is equal to the change in position per unit time.
- make free body diagrams that describe all the forces acting on an object.

<ul style="list-style-type: none"> • if one object exerts a force on a second object, the second object always exerts a force of equal magnitude on the first object in the opposite direction. • that even though an object is at rest, there may be forces exerted on that object by other objects. • the difference between conservative and nonconservative forces. • the difference between static friction and kinetic friction. 	<ul style="list-style-type: none"> • design an experiment for collecting data to determine the relationship between the net force exerted on an object and its acceleration. • represent frictional forces, normal forces and weight where appropriate in all his or her models. • apply Newton's laws to determine the cause of accelerations. • use force diagrams to show how different forces are related • apply action-reaction to determine the external forces that make things move.
Key Vocabulary: Mass, force, contact force, non-contact force, friction, tension, weight, equilibrium and free body diagram	
Assessment Evidence	
Performance Tasks: Labs: Effects on Friction Hooke's Law Modified Atwood Machine	Other Evidence: Khan Academy practice Unit Test
Learning Plan	
TCC1 I can ask purposeful, insightful questions to find a variety of innovative solutions. <ul style="list-style-type: none"> • Effects of Friction labs TCC3 I can integrate relevant information to produce multiple valid solutions. <ul style="list-style-type: none"> • Hooke's Law lab and Modified Atwood lab 	
Teacher Resources: Physicsclassroom.com <i>Physics</i> Walker 3rd edition; <i>Conceptual Physics</i> , Hewitt, High School Ed. 2009 Lab equipment, Computer based motion measuring sensors Department Lab Report rubric Practice Problems and Khan Academy	

Unit 3 - Work and Energy

Desired Results - Goals, Transfer, Meaning, Acquisition

Established Goals:

NGSS 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.

NGSS 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.

Science and Engineering Practice: Constructing explanations; Designing solutions.

Crosscutting Concepts: Energy and matter; Structure and function.

Vision of A Learner Attributes: Students will be able to independently use their learning to... ("I can" statements to be demonstrated)

TCC1(9-12): I can ask purposeful, insightful questions to find a variety of innovative solutions.

TCC3(9-12): I can integrate relevant information to produce multiple valid solutions.

Understandings: Students will understand that...

- Energy conservation and transformation principles are essential for designing efficient systems in transportation, construction, and human performance.
- Analyzing energy flows allows us to compare the sustainability and impact of various technologies, from hybrid cars to wind turbines.
- Real-world challenges like climate change and resource management depend on understanding how energy is stored, transferred, and conserved.

Essential Questions:

- How does understanding energy transformations improve the efficiency of machines, appliances, and human movement?
- How do we evaluate the energy costs of different technologies and daily activities?
- In what ways can work and energy principles help us reduce environmental impact?

<p>Students will know...</p> <ul style="list-style-type: none"> that the change in kinetic energy of an object depends on the force exerted on the object and on the displacement of the object during the interval that the force is exerted. that the energy of a system includes its kinetic energy, potential energy, and microscopic internal energy. Examples include gravitational potential energy, elastic potential energy, and kinetic energy. that mechanical energy (the sum of kinetic and potential energies) is transferred into or out of a system such that a component of the force is parallel to its displacement. The process through which the energy is transferred is called work. If the force is constant during a given displacement, then the work done is the product of the displacement and the component of the force parallel or antiparallel to the displacement. Hooke's Law 	<p>Students will be able to...</p> <ul style="list-style-type: none"> calculate the net work applied to a system apply the law of conservation of energy to a closed system calculate kinetic energy, gravitational potential energy, elastic potential energy and power make predictions about the changes in kinetic energy of an object based on considerations of the direction of the net force on the object as the object moves. apply mathematical routines to determine the changes in kinetic energy given the forces on the object and the displacement of the object. predict changes in the total energy of a system due to changes in position and speed of objects or frictional interactions within the system. Use bar charts to illustrate energy exchanges determine when external energy is added or removed from a mechanical system. account for Work done and Energy exchanged in a variety of situations including those where mechanical energy is conserved and those where external work changes the amount of mechanical energy available.
<p>Key Vocabulary: Work, conservative forces, elastic forces, kinetic energy, potential energy, mechanical energy, power.</p>	
<p>Assessment Evidence</p>	
<p>Performance Tasks: Labs: Energy Skate Park simulation, Stair Climbing Power Lab, Bungee Jump Lab, Energy of a Tossed Ball Lab</p>	<p>Other Evidence: Khan Academy practice Unit Test</p>
<p>Learning Plan</p>	
<p>TCC1 I can ask purposeful, insightful questions to find a variety of innovative solutions.</p> <ul style="list-style-type: none"> Energy Skate Park simulation, and Energy of a Tossed ball lab. <p>TCC3 I can integrate relevant information to produce multiple valid solutions.</p>	

- Bungee Jump Lab

Teacher Resources:

Physicsclassroom.com, *Physics* Walker 3rd edition; *Conceptual Physics*, Hewitt, High School Ed. 2009

Lab equipment, Computer based motion measuring sensors

Department Lab Report rubric

Practice Problems and Khan Academy, Phet Online simulation



Unit 4 - Impulse and Momentum

Desired Results - Goals, Transfer, Meaning, Acquisition

Established Goals:

NGSS 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.

NGSS 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.

Crosscutting Concepts: Stability and change; Cause and effect.

Vision of A Learner Attributes: Students will be able to independently use their learning to... ("I can" statements to be demonstrated)

TCC1(9-12): I can ask purposeful, insightful questions to find a variety of innovative solutions.

TCC3(9-12): I can integrate relevant information to produce multiple valid solutions.

Understandings: Students will understand that...

- The conservation of momentum explains real-world phenomena like car crashes and athletic collisions and informs how we protect people from injury.
- Impulse, as the product of force and time, is a key concept in safety engineering and forensic analysis.
- Understanding collisions enables engineers to design safer vehicles and athletes to improve performance.

Essential Questions:

- How do airbags, helmets, and crumple zones use momentum concepts to reduce injury?
- How can momentum be used to analyze and reconstruct real-life collisions or sports plays?
- What trade-offs are involved in designing systems that absorb impact?

Students will know...

- that the change in momentum of an object is a vector in the direction of the net force exerted on the object.
- that the change in momentum of an object occurs over a time interval.
- that the change in momentum of an object depends on the impulse, which is the product of the average force and the time interval during which the interaction occurred.
- that in a collision between objects, linear momentum is

Students will be able to...

- calculate the momentum of an object and of a system of objects.
- calculate the impulse applied to an object.
- justify the selection of routines for the calculation of the relationships between changes in momentum of an object, average force, impulse, and time of interaction.
- make qualitative predictions about natural phenomena based on conservation of linear momentum and restoration of kinetic energy in elastic collisions.

conserved. In an elastic collision, kinetic energy is the same before and after.	<ul style="list-style-type: none"> model punches with the Impulse Momentum Theorem (Newton's Second Law). model collisions applying the Conservation of Momentum. demonstrate the difference between Elastic and Inelastic Collisions.
Key Vocabulary: Momentum, Impulse, Elastic Collision, Inelastic Collision	
Assessment Evidence	
Performance Tasks: Labs: Impulse Momentum, Conservation of Energy and Momentum in collisions	Other Evidence: Unit Test and Khan practices
Learning Plan	
TCC1 I can ask purposeful, insightful questions to find a variety of innovative solutions. <ul style="list-style-type: none"> Impulse and Momentum lab TCC3 I can integrate relevant information to produce multiple valid solutions. <ul style="list-style-type: none"> Conservation of Energy and Momentum in Collisions lab 	
Teacher Resources: Physicsclassroom.com <i>Physics</i> Walker 3rd edition; <i>Conceptual Physics</i> , Hewitt, High School Ed. 2009 Lab equipment, Computer based motion measuring sensors Department Lab Report rubric Practice Problems and Khan Academy	

Unit 5 - 2 Dimensional Physics

Desired Results - Goals, Transfer, Meaning, Acquisition

Established Goals:

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

Science and Engineering Practice: Using mathematics and computational thinking.

Crosscutting Concepts: Scale, proportion, and quantity.

Vision of A Learner Attributes: Students will be able to independently use their learning to... ("I can" statements to be demonstrated)

TCC1(9-12): I can integrate relevant information to produce multiple valid solutions.

Understandings: Students will understand that...

- Real-world motion often involves two dimensions and requires the use of vectors and reference frames to analyze effectively.
- Understanding gravitational and projectile motion is essential in aerospace, sports science, and civil engineering.
- Accurate predictions of complex motion are crucial for safe navigation and targeting technologies.

Essential Questions:

- How do pilots, athletes, and engineers apply 2D motion to navigate and optimize performance?
- What role does gravity play in shaping planetary motion and satellite paths?
- How can vector analysis help us break down and solve real-world motion problems?

Students will know...

- that perpendicular motions can be looked at independently
- that velocities depend on the frame of reference and perpendicular velocities can be added using the Pythagorean Theorem
- that horizontal projectiles experience no accelerations
- that vertical projectiles only experience gravity
- that the centripetal force acting on an object acts perpendicular to the direction of travel.
- that the centripetal force is the force that maintains circular motion.

Students will be able to...

- calculate the motions of boats in perpendicular currents
- calculate the motions of plane experiencing perpendicular crosswinds
- apply kinematics to projectiles in flight
- use Newton's law of gravitation to calculate the gravitational force the two objects exert on each other and use that force in contexts other than orbital motion.
- use Newton's law of gravitation to calculate the gravitational force between two objects and use that force in contexts involving orbital motion

<ul style="list-style-type: none"> that circular acceleration is equal to the square of the linear speed of an object divided by the radius of the circle (or portion of the circle) the object is traveling along. that on Earth, the gravitational force is called weight that the gravitational field at a point in space is measured by dividing the gravitational force exerted by the field on a test object at the point by the mass of the test object and has the same direction as the force. that the gravitational field is radial and varies as the inverse square of the radial distance from the center of that object. 	<ul style="list-style-type: none"> calculate the centripetal acceleration calculate the centripetal force calculate the gravitational force between two masses create and use free-body diagrams to analyze physical situations, solve problems with motion qualitatively and quantitatively. choose appropriate frames of reference to model circular, projectile and gravitational motions.
Key Vocabulary: Vector, Scalar, Component of Motion, Frame of Reference, Centripetal, Gravitational Field	
Assessment Evidence	
Performance Tasks: Labs: 2 Dimensional Forces in Equilibrium, Horizontal projectile lab, Projectile at an angle lab, Flying Pig lab	Other Evidence: Unit test and Khan practices
Learning Plan	
TCC1 I can integrate relevant information to produce multiple valid solutions. <ul style="list-style-type: none"> Projectile at an angle lab (target challenge) 	
Teacher Resources: Physicsclassroom.com, <i>Physics</i> Walker 3rd edition; <i>Conceptual Physics</i> , Hewitt, High School Ed. 2009 Lab equipment, Computer based motion measuring sensors Department Lab Report rubric Practice Problems and Khan Academy	

Unit 6 - Electricity

Desired Results - Goals, Transfer, Meaning, Acquisition

Established Goals:

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-PS3-5: Model interactions through electric fields and energy changes.

Crosscutting Concepts: Systems and system models; Cause and effect.

Vision of A Learner Attributes: Students will be able to independently use their learning to... ("I can" statements to be demonstrated)
TCC1(9-12): I can ask purposeful, insightful questions to find a variety of innovative solutions.

Understandings: Students will understand that...

- Electric forces govern interactions in all electronic devices, and understanding these forces allows for efficient circuit design.
- Circuit modeling and analysis enable the development of everything from smartphones to renewable energy grids.
- Mastering electric current behavior is essential in fields like electrical engineering, robotics, and biomedical device design.

Essential Questions:

- How do circuit designs impact power distribution in homes and electronic devices?
- Why is understanding electric fields and charge important for developing modern technologies?
- How can we model and troubleshoot electrical systems in daily life?

Students will know...

- Electric charge is conserved.
- There are only two kinds of electric charge. Neutral objects or systems contain equal quantities of positive and negative charge, with the exception of some fundamental particles that have no electric charge.
- The smallest observed unit of charge that can be isolated is the electron charge, also known as the elementary charge.

Students will be able to...

- make predictions, using the conservation of electric charge, about the sign and relative quantity of net charge of objects or systems after various charging processes.
- calculate any one of the variables — electric force, electric charge, and electric field — at a point given the values and sign or direction of the other two quantities.
- make and justify a quantitative prediction of the effect of a change in values or arrangements of one or two circuit elements



<ul style="list-style-type: none"> • The magnitude of the electric force F exerted on an object with electric charge q by an electric field E is $F=qE$. The direction of the force is determined by the direction of the field and the sign of the charge. • The values of currents and electric potential differences in an electric circuit are determined by the properties and arrangement of the individual circuit elements such as sources of emf, resistors, and capacitors. 	<p>on the currents and potential differences in a circuit containing a small number of sources of emf, resistors, capacitors, and switches in series and/or parallel.</p> <ul style="list-style-type: none"> • model the forces that affect electric charges. • evaluate the effects of different circuit wiring patterns (series or parallel).
Key Vocabulary: Charge, Current, Electric Field, Electric Potential	
Assessment Evidence	
Performance Tasks: Labs: Simple Circuits, Series and Parallel Circuits, Compound Circuits	Other Evidence: Unit test and Khan practices
Learning Plan	
TCC1 I can ask purposeful, insightful questions to find a variety of innovative solutions. <ul style="list-style-type: none"> • Simple Circuits lab 	
Teacher Resources: Physicsclassroom.com, <i>Physics</i> Walker 3rd edition; <i>Conceptual Physics</i> , Hewitt, High School Ed. 2009 Lab equipment, Computer based voltage and current measuring sensors Department Lab Report rubric Practice Problems and Khan Academy	

Unit 7 - Electromagnetism

Desired Results - Goals, Transfer, Meaning, Acquisition

Established Goals:

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

Crosscutting Concepts: Energy and matter; Structure and function.

Vision of A Learner Attributes: Students will be able to independently use their learning to... ("I can" statements to be demonstrated)
TCC1(9-12): I can integrate relevant information to produce multiple valid solutions.

Understandings: Students will understand that...

- The interplay between electricity and magnetism powers essential technologies, from power grids to electric vehicles.
- Magnetic fields created by currents allow the conversion of energy between mechanical and electrical forms, enabling efficient energy systems.
- Understanding electromagnetic induction is foundational to innovations in clean energy and automation.

Essential Questions:

- How do motors and generators harness the relationship between electricity and magnetism?
- What technologies rely on electromagnetic principles to function?
- How can we create more sustainable energy solutions using electromagnetism?

Students will know...

- The magnetic field exerts a force on a moving electrically charged object.
- Ferromagnetic materials contain magnetic domains that are themselves magnets.
- A magnetic force results from the interaction of a moving

Students will be able to...

- describe the orientation of a magnetic dipole placed in a magnetic field applying the right hand rule.
- create a verbal or visual representation of a magnetic field around a long straight wire or a pair of parallel wires

<p>charged object or a magnet with other moving charged objects or another magnet.</p> <ul style="list-style-type: none"> • The magnetic properties of some materials can be affected by magnetic fields in the system. • Changing magnetic flux induces an electric field that can establish an induced emf in a system. 	<ul style="list-style-type: none"> • use the representation of magnetic domains to qualitatively analyze the magnetic behavior of a bar magnet composed of ferromagnetic material. • use representations and models to qualitatively describe the magnetic properties of some materials that can be affected by magnetic properties of other objects (electromagnets) in the system. • construct an explanation of the function of a simple electromagnetic device (electric motor) in which an induced emf is produced by a changing magnetic flux through an area defined by a current loop • describe how to create a magnetic field with electricity • explain why the same mechanism can be used as a motor and a generator.
Key Vocabulary: Magnetic domain, permanent magnetism, soft magnetism, solenoid, induction, emf, Lenz's Law, Faraday's Law	
Assessment Evidence	
Performance Tasks: Labs: Magnetic field lab about various magnets, Magnetic field lab about a conductor, Mini electric motor project	Other Evidence: Unit Test
Learning Plan	
TCC1 I can integrate relevant information to produce multiple valid solutions. <ul style="list-style-type: none"> • Magnetic field about various magnets lab • Magnetic field about a conductor lab 	
Teacher Resources: Physicsclassroom.com, <i>Physics</i> Walker 3rd edition; <i>Conceptual Physics</i> , Hewitt, High School Ed. 2009 Lab equipment, PHET simulations Department Lab Report rubric	

Unit 8 - Sound and Waves

Desired Results - Goals, Transfer, Meaning, Acquisition

Established Goals:

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.

Crosscutting Concepts: Patterns; Energy and matter.

Vision of A Learner Attributes: Students will be able to independently use their learning to... ("I can" statements to be demonstrated)
TCC3(9-12): I can integrate my learning to adapt to experiences in the classroom, career and life.

Understandings: Students will understand that...

- Waves are fundamental to technologies that transmit, store, and analyze data—from cell phones to medical imaging.
- Understanding wave properties enables the design of efficient communication systems and acoustic environments.
- Engineers use wave interference and superposition to solve problems in signal processing and sound design.

Essential Questions:

- How do sound and wave technologies enhance communication, medicine, and entertainment?
- Why are digital signals more reliable than analog in transmitting information?
- How can wave behavior be manipulated to solve practical problems?

Students will know...

- The rate of oscillations depends on the physical force pulling the oscillator back to the center
- Waves can propagate via different oscillation modes such as transverse and longitudinal.
- A simple wave can be described by an equation involving one sine or cosine function involving the wavelength, amplitude, and frequency of the wave.
- When two waves cross, they travel through each other; they do not bounce off each other. Where the waves

Students will be able to...

- describe oscillations and waves using appropriate vocabulary, generating examples using waves on a spring
- calculate wave properties using appropriate mathematical models
- measure the wavelengths of standing waves in strings and sound in a tube to find the speed of the waves
- use computer tools to unpack waves and investigate the properties of different sounds



<p>overlap, the resulting displacement can be determined by adding the displacements of the two waves. This is called superposition.</p>	<ul style="list-style-type: none"> • construct representations to graphically analyze situations in which two waves overlap over time using the principle of superposition. • model waves mathematically and graphically. • graphically show the results of wave interference and use computer tools to unpack interference to see how digital (square waves) signals are easier to combine and unpack than analog (sine waves) signals.
<p>Key Vocabulary: refraction, reflection, propagation, diffraction, interference, superposition, wavelength, period, frequency, volume, longitudinal, transverse</p>	
<p style="text-align: center;">Assessment Evidence</p>	
<p>Performance Tasks: Simple Harmonic Motion of Pendulums lab Simple Harmonic Motion of Springs lab Waves in a spring lab Standing waves activity Drawing interference of waves Measuring sound waves and Beat interference Exploring sound waves using FFT Speed of sound lab</p>	<p>Other Evidence: Wave vocabulary quiz Khan reviews Unit test</p>
<p style="text-align: center;">Learning Plan</p>	
<p>TCC3 I can integrate my learning to adapt to experiences in the classroom, career and life.</p> <ul style="list-style-type: none"> • Exploring sound waves using FFT 	
<p>Teacher Resources: Physicsclassroom.com, <i>Physics</i> Walker 3rd edition; <i>Conceptual Physics</i>, Hewitt, High School Ed. 2009 Lab equipment, Computer based microphones and motion sensors Department Lab Report rubric Practice Problems and Khan Academy</p>	

Unit 9 - Light and Optics

Desired Results - Goals, Transfer, Meaning, Acquisition

Established Goals:

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

HS-PS4-3. Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.

HS-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.

Crosscutting Concepts: Wave behavior; Systems and models.

Vision of A Learner Attributes: Students will be able to independently use their learning to... (“I can” statements to be demonstrated)
TCC1(9-12): I can ask purposeful, insightful questions to find a variety of innovative solutions.

Understandings: Students will understand that...

- Light exhibits wave and particle properties that are central to technologies like lasers, microscopes, and solar panels.
- Engineers and scientists manipulate light to enhance vision, diagnose illness, and transmit data.
- Different types of electromagnetic radiation have varying impacts, applications, and risks, from UV exposure to wireless communication.

Essential Questions:

- How do different wavelengths of light affect technology, health, and the environment?
- How are lenses and mirrors used to improve vision, imaging, and scientific discovery?
- Why does understanding light matter in fields ranging from photography to quantum physics?

Students will know...

- When waves pass through an opening whose dimensions are comparable to the wavelength, a diffraction pattern can be observed.

Students will be able to...

- analyze data (or a visual representation) to identify patterns that indicate that a particular mechanical wave is polarized and

<ul style="list-style-type: none"> • When waves pass through a set of openings whose spacing is comparable to the wavelength, an interference pattern can be observed. • When light travels from one medium to another, some of the light is transmitted, some is refracted, and some is absorbed. • When light hits a smooth reflecting surface at an angle, it reflects at the same angle on the other side of the line perpendicular to the surface; this law of reflection accounts for the size and location of images seen in mirrors. • When light passes through polarizing filters or reflects off a flat surface it is polarized, demonstrating that the waves are transverse • The refraction of light as it travels from one transparent medium to another can be used to form images. • Types of electromagnetic radiation are characterized by their wavelengths, and certain ranges of wavelength have been given specific names. These include (in order of increasing wavelength spanning a range from picometers to kilometers) gamma rays, x-rays, ultraviolet, visible light, infrared, microwaves, and radio waves. 	<p>construct an explanation of the fact that the wave must have a vibration perpendicular to the direction of energy propagation</p> <ul style="list-style-type: none"> • make claims about the diffraction pattern produced when a wave passes through a small opening, and to qualitatively apply the wave model to quantities that describe the generation of a diffraction pattern when a wave passes through an opening whose dimensions are comparable to the wavelength of the wave. • qualitatively apply the wave model to quantities that describe the generation of interference patterns to make predictions about interference patterns that form when waves pass through a set of openings whose spacing and widths are small compared to the wavelength of the waves. • make claims using connections across concepts about the behavior of light as the wave travels from one medium into another, as some is transmitted, some is refracted, and some is absorbed. • make predictions about the locations of objects and images relative to the location of a reflecting surface. • plan data collection strategies as well as perform data analysis and evaluation of the evidence for noting the relationship between the angle of incidence and the angle of refraction for light crossing boundaries from one transparent material to another (Snell's law) • use quantitative and qualitative representations and models to analyze situations and solve problems about image formation occurring due to the refraction of light through thin lenses. • make qualitative comparisons of the wavelengths of types of electromagnetic radiation. • use light rays to model how light can be used to create images
Key Vocabulary: refraction, reflection, propagation, diffraction, interference, polarization, radiation, focus,	
Assessment Evidence	
Performance Tasks: Polarization, nature of light lab	Other Evidence: Unit Test

Plane Mirror Lab Ray tracing for Mirrors Snell's Law Lab Measuring object and image properties lab Diffraction Interference lab	
Learning Plan	
TCC1 I can ask purposeful, insightful questions to find a variety of innovative solutions. <ul style="list-style-type: none"> • Polarization, nature of light lab • Snell's Law lab 	
Teacher Resources: Physicsclassroom.com, <i>Physics</i> Walker 3rd edition; <i>Conceptual Physics</i> , Hewitt, High School Ed. 2009 Lab equipment, including lasers and diffraction gratings Department Lab Report rubric Practice Problems	