Curriculum Map: AP Physics I

MASH

Science

Course Description: This is an AP laboratory course that meets six periods per week. It is designed to meet the requirements for students to be able to sit for the AP Physics 1 (algebra-based) exam. The course will explore principles of Newtonian mechanics (including rotational motion); work, energy, and power; mechanical waves and sound; and introductory, simple circuits. This is a mathematically rigorous course that will explore the subjects presented in great detail and at an accelerated pace. The focus will be on inquiry-based analyses of the properties of objects and systems, and their interactions.

Summary of Topics & Pacing

		Suggested Timing		Running Total	
Unit Title:	Units, Standards, Matter & Coordinate Systems	1	week	1	week
Unit Title:	Trigonometry	1	week	2	weeks
Unit Title:	Kinematics in One Dimension	3	weeks	5	weeks
Unit Title:	Kinematics in Two Dimensions	2	weeks	7	weeks
Unit Title:	Force and Motion	3	weeks	10	weeks
Unit Title:	Work and Energy	3	weeks	13	weeks
Unit Title:	Momentum	3	weeks	16	weeks
Unit Title:	Rotational Motion	1	week	17	weeks
Unit Title:	Newtonian Gravitation	1	week	18	weeks
Unit Title:	Rotational Equilibrium & Rotational Dynamics	3	weeks	21	weeks
Unit Title:	Harmonic Motion and Waves	2	weeks	23	weeks
Unit Title:	Sound	2	weeks	25	weeks
Unit Title:	Electric Forces	1	week	26	weeks
Unit Title:	Simple DC Circuits	2	weeks	28	weeks
Unit Title:	Review for AP Physics 1 Exam	2	weeks	30	weeks
Unit Title:	Selected Topics/Project Based Analysis	3	weeks	33	weeks
Unit Title:	Review for Final Exam	2	weeks	35	weeks

Note: For the "Essential Questions" portion of the curriculum, the applicable "Big Idea" concepts, as presented in the AP Physics 1 materials from the College Board, are presented for each unit.

Unit Title: Units, Standards, Matter & Coordinate Systems

Suggested time frame: 1 week

Standards: Course - 3.2.P.B: PHYSICS

Standard - 3.2.P.B6: PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

Essential Questions:

- Big Idea 1: Objects and systems have properties such as mass and charge. Systems may have internal structure.

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. State and use the SI units and US Customary units for length, mass, and time 2. State the fundamental components of matter 3. Describe the levels of the structure of matter 4. State the definition of a dimension 5. Give examples of dimensions of basic physical quantities 6. Use dimensions to derive relationships between physical quantities 7. Define and calculate percent error 8. Convert physical quantities between magnitudes and systems of units 9. Describe and locate points in coordinate systems.	dimension; units; magnitude; standard units; scientific notation; time; distance; length; mass; weight; metric system; SI units; US Customary units; mks; cgs; mass; gram; slug; meter; second; unit prefix; matter; proton; electron; neutron; quark; nucleus; dimensional analysis; significant figures; conversion of units; coordinate system; axis; Cartesian coordinate system; rectangular coordinate system; polar coordinate system; coordinate plane	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• College Physics, Tenth Edition, Serway and Vuille, Cengage Learning (2015) • Simulation Websites • Labs • Online Demos and Videos

Unit Title: Trigonometry

Suggested time frame: 1 week

Standards: Course - 3.2.P.B: PHYSICS

Standard - 3.2.P.B6: PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

Essential Questions:

- Big Idea 1: Objects and systems have properties such as mass and charge. Systems may have internal structure.

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Convert between Cartesian and polar coordinates using basic trigonometric functions and the Pythagorean Theorem 2. Apply basic trigonometric functions and the Pythagorean Theorem in simple physical contexts	trigonometry; trigonometric functions; angle; radian; sine; cosine; tangent; cotangent; secant; cosecant; opposite side; adjacent side; hypotenuse; Pythagorean theorem; inverse trigonometric functions; arcsine; arccosine; arctangent	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• College Physics, Tenth Edition, Serway and Vuille, Cengage Learning (2015) • Simulation Websites • Labs • Online Demos and Videos

Unit Title: Kinematics in One Dimension

Suggested time frame: 3 weeks

Standards: Course - 3.2.P.B: PHYSICS

Standard - 3.2.P.B1: Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.

Standard - 3.2.P.B6: PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

Essential Questions:

- Big Idea 3: The interactions of an object with other objects can be described by forces.
- Big Idea 4: Interactions between systems can result in changes in those systems.

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Explain the difference between scalars and vectors 2. Distinguish the difference between distance and displacement 3. Calculate displacement and distance in one and two dimensions 4. Distinguish the difference between speed and velocity 5. Calculate the average speed and velocity of an object 6. Distinguish the difference between average velocity and instantaneous velocity 7. Determine instantaneous and average velocities from a position vs. time graph	kinematic; one dimension; scalar; vector; displacement; distance; speed; velocity; acceleration; kinematic equation; average velocity; instantaneous velocity; average acceleration; instantaneous acceleration; motion diagram; free-fall; gravity; acceleration due to gravity;	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• College Physics, Tenth Edition, Serway and Vuille, Cengage Learning (2015) • Simulation Websites • Labs • Online Demos and Videos

Competency	Vocabulary	Strategy	Resource
8. Calculate the average acceleration of an object 9. Distinguish the difference between average acceleration and instantaneous acceleration 10. Determine instantaneous and average accelerations from a velocity vs. time graph 11. Describe an objects motion using a motion diagram 12. Determine the quantitative characteristics of an object moving with a constant acceleration using the kinematic equations 13. Determine an object's displacement and acceleration using a velocity vs. time graph 14. Apply the kinematic equations for objects falling with a constant acceleration near the Earth's surface 15. Solve kinematic equations for two distinct phases of acceleration			

Unit Title: Kinematics in Two Dimensions

Suggested time frame: 2 weeks

Standards: Course – 3.2.P.B: PHYSICS

Standard – 3.2.P.B1: Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.

Standard – 3.2.P.B2: Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.

Essential Questions:

- Big Idea 3: The interactions of an object with other objects can be described by forces.
- Big Idea 4: Interactions between systems can result in changes in those systems.

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Categorize physical quantities as being vectors or scalars 2. Determine resultant vectors geometrically when applying arithmetic operations to vectors 3. Determine x and y components of vectors 4. Determine resultant vectors algebraically when applying arithmetic operations to vectors 5. Define displacement in two dimensions 6. Define average and instantaneous velocities in two dimensions 7. Define average and instantaneous accelerations in two dimensions	two dimensions; vector; scalar; resultant vector; vector addition; vector subtraction; component vectors; projectile motion; parabolic motion; relative velocity	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• College Physics, Tenth Edition, Serway and Vuille, Cengage Learning (2015) • Simulation Websites • Labs • Online Demos and Videos

Competency	Vocabulary	Strategy	Resource
8. Describe projectile motion in two dimensions, graphically 9. Apply kinematic equations in two dimensions for objects in motion near the surface of the Earth 10. Derive the relative velocity equation 11. Solve problems involving relative velocity			

Unit Title: Force and Motion

Suggested time frame: 3 weeks

Standards: Course – 3.2.P.B: PHYSICS

Standard – 3.2.P.B1: Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.

Standard – 3.2.P.B6: PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

Essential Questions:

- Big Idea 1: Objects and systems have properties such as mass and charge. Systems may have internal structure.
- Big Idea 2: Fields existing in space can be used to explain interactions.
- Big Idea 3: The interactions of an object with other objects can be described by forces.
- Big Idea 4: Interactions between systems can result in changes in those systems.
- Big Idea 5: Changes that occur as a result of interactions are constrained by conservation laws.

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Distinguish between contact forces and field forces 2. Identify and describe the four field forces as they relate to the interaction of matter 3. Explain the implication of Newton's first law of motion on an object's motion and the forces acting on the object 4. State Newton's second law of motion 5. Solve problems by applying Newton's second law of motion	force, contact force; field force; force of gravity; electromagnetic force; strong nuclear force; weak nuclear force; Newton's first law of motion; equilibrium Newton's second law of motion; mass; acceleration; Universal Law of Gravitation; weight; Newton's third law of motion; reaction force; free-	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• College Physics, Tenth Edition, Serway and Vuille, Cengage Learning (2015) • Simulation Websites • Labs • Online Demos and Videos

Competency	Vocabulary	Strategy	Resource
6. Apply Newton's Universal law of gravitation to systems of objects 7. Distinguish the concepts of mass and weight 8. State Newton's third law of motion 9. Determine reaction forces using Newton's third law of motion 10. Draw free-body diagrams for objects and systems of objects 11. Apply Newton's second law of motion to objects/systems in equilibrium 12. Apply Newton's second law of motion to objects/systems being accelerated 13. Explain the physical origins of friction 14. Describe the conditions involving static friction and kinetic friction 15. Solve problems involving systems of objects involving friction	body diagram; force of friction; normal force; coefficient of friction; static friction; kinetic friction		

Unit Title: Work and Energy

Suggested time frame: 3 weeks

Standards: Course - 3.2.P.B: PHYSICS

Standard – 3.2.P.B1: Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.

Standard – 3.2.P.B2: Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.

Standard – 3.2.P.B6: PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

Essential Questions:

- Big Idea 1: Objects and systems have properties such as mass and charge. Systems may have internal structure.
- Big Idea 2: Fields existing in space can be used to explain interactions.
- Big Idea 3: The interactions of an object with other objects can be described by forces.
- Big Idea 4: Interactions between systems can result in changes in those systems.
- Big Idea 5: Changes that occur as a result of interactions are constrained by conservation laws.

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Distinguish between physics concept of work and the commonly accepted concept of work; 2. Calculate the work done by a force on an object 3. Define kinetic energy 4. Explain the physical nature of the work-energy theorem 5. Apply the work-energy theorem to systems of objects 6. Describe and categorize forces as being conservative and non-conservative forces 7. Relate the concepts of gravitation potential energy and work performed by gravity 8. Define mechanical energy 9. Apply the principle of conservation of mechanical energy to systems 10. Apply the work-energy theorem to problems involving gravity 11. Relate the concepts of spring potential energy and work performed by a spring 12. Apply the work-energy theorem to problems involving springs 13. State the work-energy theorem in terms of total mechanical energy 14. Describe the different forms energy and energy transfer 15. Describe the principle of conservation of energy 16. Define average and instantaneous power and their physical meaning 17. Calculate average and instantaneous power	work; joule; Newton-meter; foot-pound; British thermal unit; dissipative force; nonconservative force; conservative force; kinetic energy; work-energy theorem; gravitational potential energy; gravitational work; reference level; mechanical energy; ideal spring; spring potential energy; spring constant; Hooke's law; elastic potential energy; conservation of energy; power; watt; average power; instantaneous power; power delivered; power dissipated	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• College Physics, Tenth Edition, Serway and Vuille, Cengage Learning (2015) • Simulation Websites • Labs • Online Demos and Videos

Unit Title: Momentum

Suggested time frame: 3 weeks

Standards: Course - 3.2.P.B: PHYSICS

Standard – 3.2.P.B1: Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.

Standard – 3.2.P.B2: Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.

Standard – 3.2.P.B6: PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

Essential Questions:

- Big Idea 1: Objects and systems have properties such as mass and charge. Systems may have internal structure.
- Big Idea 2: Fields existing in space can be used to explain interactions.
- Big Idea 3: The interactions of an object with other objects can be described by forces.
- Big Idea 4: Interactions between systems can result in changes in those systems.
- Big Idea 5: Changes that occur as a result of interactions are constrained by conservation laws.

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Define momentum 2. Define impulse 3. State the impulse-momentum theorem 4. Determine average forces using the impulse-momentum theorem 5. Derive the principle of conservation of momentum using the impulse-momentum theorem and Newton's third law of motion 6. Apply the conservation of momentum to solve recoil problems 7. Define elastic, perfectly inelastic, and inelastic collisions 8. Apply the conservation of momentum and conservation of energy to collisions of objects 9. Solve rocket propulsion problems using conservation of momentum and conservation of energy	momentum; kg·m/s; impulse; impulse-momentum theorem; conservation of momentum; recoil; elastic collision; inelastic collision; perfectly inelastic collision; collision; glancing collision; ballistic pendulum; propulsion	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• College Physics, Tenth Edition, Serway and Vuille, Cengage Learning (2015) • Simulation Websites • Labs • Online Demos and Videos

Unit Title: Rotational Motion

Suggested time frame: 1 week

Standards: Course - 3.2.P.B: PHYSICS

Standard – 3.2.P.B1: Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.

Standard – 3.2.P.B2: Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.

Standard – 3.2.P.B6: PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

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- Big Idea 3: The interactions of an object with other objects can be described by forces.
- Big Idea 4: Interactions between systems can result in changes in those systems.
- Big Idea 5: Changes that occur as a result of interactions are constrained by conservation laws.
- Big Idea 6: Waves can transfer energy and momentum from one location to another without the permanent transfer of mass and serve as a mathematical model for the description of other phenomena.

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Define radial motion, angular position; and angular displacement 2. Define instantaneous and average angular speed 3. Define instantaneous and average angular acceleration 4. Use angular variables to solve problems 5. Identify the correspondence between linear and angular kinematic equations 6. Use angular kinematic equations to solve motion problems 7. Covert angular units to linear units 8. Define centripetal acceleration 9. Calculate centripetal, tangential, and total acceleration of objects in circular motion 10. Use Newton's second law of motion to objects in uniform circular motion 11. Identify forces that cause objects to experience centripetal acceleration	radial motion; radian; degrees; radius; angular position; angular displacement; angular speed; angular acceleration; rad/s; rad/s^2; instantaneous angular speed; average angular speed; instantaneous angular acceleration; average angular acceleration; tangential velocity/speed; tangential acceleration; centripetal acceleration; centripetal force;	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• College Physics, Tenth Edition, Serway and Vuille, Cengage Learning (2015) • Simulation Websites • Labs • Online Demos and Videos

Unit Title: Newtonian Gravitation

Suggested time frame: 1 week

Standards: Course - 3.2.P.B: PHYSICS

Standard – 3.2.P.B1: Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.

Standard – 3.2.P.B2: Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.

Standard – 3.2.P.B5: Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.

Standard – 3.2.P.B6: PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

Essential Questions:

- Big Idea 1: Objects and systems have properties such as mass and charge. Systems may have internal structure.
- Big Idea 2: Fields existing in space can be used to explain interactions.
- Big Idea 3: The interactions of an object with other objects can be described by forces.
- Big Idea 4: Interactions between systems can result in changes in those systems.
- Big Idea 5: Changes that occur as a result of interactions are constrained by conservation laws.
- Big Idea 6: Waves can transfer energy and momentum from one location to another without the permanent transfer of mass and serve as a mathematical model for the description of other phenomena.

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Determine the forces acting on objects due to the law of gravitation 2. Determine the motion of objects that are interacting due to the law of gravitation and the concept of gravitational potential energy 3. Use the concepts of conservation of mechanical energy to determine escape speeds of small objects from large objects	gravity; law of gravitation; force of gravity; constant of universal gravitation (G); inverse-square law; gravitational potential energy; escape speed/velocity; geocentric/heliocentric model	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• College Physics, Tenth Edition, Serway and Vuille, Cengage Learning (2015) • Simulation Websites • Labs • Online Demos and Videos

Unit Title: Rotational Equilibrium & Rotational Dynamics

Suggested time frame: 3 weeks

Standards: Course - 3.2.P.B: PHYSICS

Standard – 3.2.P.B1: Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.

Standard – 3.2.P.B2: Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.

Standard – 3.2.P.B6: PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

Essential Questions:

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- Big Idea 5: Changes that occur as a result of interactions are constrained by conservation laws.
- Big Idea 6: Waves can transfer energy and momentum from one location to another without the permanent transfer of mass and serve as a mathematical model for the description of other phenomena.

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Define torque 2. State the rotational analog to Newton's first law of motion 3. Apply the definition of torque to a system of objects 4. State the two conditions of mechanical equilibrium 5. Apply the two conditions of mechanical equilibrium to systems of objects 6. Define center of gravity 7. Determine the center of gravity for homogenous and symmetrical bodies 8. Determine the center of gravity for systems of objects 9. Define the moment of inertia 10. State the rotational analog of Newton's second law of motion 11. Calculate the moment of inertia for objects 12. Use the rotational version of Newton's second law of motion to solve systems of rotating objects 13. Define the kinetic energy of a rotating object 14. State the work-energy theorem for objects that are rotating 15. Use the work-energy theorem to solve problems involving rotating objects 16. Define angular momentum 17. State Newton's second law of motion in terms of angular momentum 18. State the principle of conservation of angular momentum 19. Use conservation of angular momentum to systems of rotating objects	torque; equilibrium; conditions of equilibrium; center of gravity; homogenous; symmetrical; moment of inertia; angular acceleration; pulley; angular momentum; conservation of angular momentum; rotational kinetic energy	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• College Physics, Tenth Edition, Serway and Vuille, Cengage Learning (2015) • Simulation Websites • Labs • Online Demos and Videos

Unit Title: Harmonic Motion and Waves

Suggested time frame: 2 weeks

Standards: Course - 3.2.P.B: PHYSICS

Standard – 3.2.P.B1: Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.

Standard – 3.2.P.B2: Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.

Standard – 3.2.P.B5: Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.

Standard – 3.2.P.B6: PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

Essential Questions:

- Big Idea 1: Objects and systems have properties such as mass and charge. Systems may have internal structure.
- Big Idea 2: Fields existing in space can be used to explain interactions.
- Big Idea 3: The interactions of an object with other objects can be described by forces.
- Big Idea 4: Interactions between systems can result in changes in those systems.
- Big Idea 5: Changes that occur as a result of interactions are constrained by conservation laws.
- Big Idea 6: Waves can transfer energy and momentum from one location to another without the permanent transfer of mass and serve as a mathematical model for the description of other phenomena.

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. State Hooke's force law for springs 2. State how Hooke's force law leads to simple harmonic motion 3. Use Hooke's law to solve spring problems 4. Use the work-energy theorem and elastic potential energy to solve spring problems 5. Describe the relationship between simple harmonic motion and circular motion 6. Define and apply the concepts of frequency; period; and angular frequency to a spring harmonic oscillator 7. Describe and apply the position, velocity, and acceleration of simple harmonic oscillators as a function of time 8. Define a pendulum and under what conditions it approximates simple harmonic motion 9. Describe and apply the angular frequency, frequency, and period for a simple pendulum 10. Generalize the pendulum to pendulums of arbitrary shape and size 11. Describe the concept of a wave Contrast longitudinal and transverse waves 12. Describe the physical meaning of wavelength 13. Relate wave speed to a frequency and wavelength 14. Relate the dependence of the speed of a wave created on a string with the string's linear mass density and string tension 15. State the principle of superposition 16. Describe the phenomena of constructive and destructive interference of two waves using the principle of superposition	Hooke's law; spring constant; harmonic motion; simple harmonic motion; oscillation; harmonic oscillator; amplitude; period; frequency; equilibrium; elastic potential energy; circular motion; uniform circular motion; sine wave; sine function; sinusoidal; pendulum; simple pendulum; damped oscillation; wave; transverse wave; longitudinal wave; medium; wavelength; superposition; interference; constructive interference; destructive interference; reflection	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• College Physics, Tenth Edition, Serway and Vuille, Cengage Learning (2015) • Simulation Websites • Labs • Online Demos and Videos

Unit Title: Sound

Suggested time frame: 2 weeks

Standards: Course - 3.2.P.B: PHYSICS

Standard – 3.2.P.B1: Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.

Standard – 3.2.P.B2: Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.

Standard – 3.2.P.B5: Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.

Standard – 3.2.P.B6: PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

Essential Questions:

- Big Idea 1: Objects and systems have properties such as mass and charge. Systems may have internal structure.
- Big Idea 2: Fields existing in space can be used to explain interactions.
- Big Idea 3: The interactions of an object with other objects can be described by forces.
- Big Idea 4: Interactions between systems can result in changes in those systems.
- Big Idea 5: Changes that occur as a result of interactions are constrained by conservation laws.
- Big Idea 6: Waves can transfer energy and momentum from one location to another without the permanent transfer of mass and serve as a mathematical model for the description of other phenomena.

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Describe the connection between sound and vibrating objects 2. Explain sound as the compression and rarefication of molecules due to vibrating objects 3. Define audible, infrasonic, and ultrasonic sound waves 4. Relate the speed of sound to physical properties of the propagation medium and its temperature 5. Describe the average intensity of a sound wave, the threshold of hearing, and the threshold of pain 6. Define and describe the decibel scale for sound waves 7. Apply the equations for the sound intensity and decibel levels 8. Explain and apply wave fronts and waves to spherical waves and plane waves 9. Determine the intensity of a sound wave based on the distance from the source 10. Explain the concept of the Doppler effect 11. Determine the wave characteristics of sounds subjected to the Doppler effect 12. State the definition of the Mach number 13. Explain the physical conditions resulting in a shock waves 14. Describe the physical conditions needed to create constructive and destructive interference of sound waves 15. Apply the concepts of interference to problems involving two sound waves 16. Define what a standing sound wave is	sound; vibration; compression; rarefication; audible; infrasonic; ultrasonic; propagation medium; wave intensity; threshold of pain; threshold of hearing; decibel; decibel level/scale; wave front; spherical wave; plane wave; Doppler effect; Mach number; shock wave; constructive interference; destructive interference; standing wave; fundamental frequency node; antinode; harmonic; resonance; forced vibrations; air column; beat	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• College Physics, Tenth Edition, Serway and Vuille, Cengage Learning (2015) • Simulation Websites • Labs • Online Demos and Videos

Competency	Vocabulary	Strategy	Resource
17. Define the fundamental frequency of a string fixed on both ends and how the relationship between string length and wavelength 18. Define standing wave, node, and antinode 19. Explain the conditions needed to create a standing wave 20. Derive the relationship between a strings fundamental frequency and higher harmonics 21. Calculate the harmonics of a strings and wires under tension 22. Describe resonance due to forced vibrations 23. Explain physical examples of resonance 24. Contrast standing waves in air columns open at one end and at both ends 25. Apply the equations for frequencies of open and closed pipes to harmonic systems 26. Explain the interference phenomenon of beats 27. Apply the concept of beats to two-frequency situations			

Unit Title: Electric Forces

Suggested time frame: 1 week

Standards: Course - 3.2.P.B: PHYSICS

Standard – 3.2.P.B4: Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.

Essential Questions:

- Big Idea 1: Objects and systems have properties such as mass and charge. Systems may have internal structure.
- Big Idea 2: Fields existing in space can be used to explain interactions.
- Big Idea 3: The interactions of an object with other objects can be described by forces.
- Big Idea 4: Interactions between systems can result in changes in those systems.
- Big Idea 5: Changes that occur as a result of interactions are constrained by conservation laws.
- Big Idea 6: Waves can transfer energy and momentum from one location to another without the permanent transfer of mass and serve as a mathematical model for the description of other phenomena.

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Define the SI unit of charge 2. Identify the basic carries of positive and negative charges 3. Explain the concept of conservation of charge 4. Explain the concepts of insulators, conductors, and semiconductors as they relate to their ability to conduct electric charges 5. Explain the concepts of charge conduction and charge induction 6. State Coulomb's law 7. Apply Coulomb's law to systems of static charges	charge; Coulomb; electron; ion; charge carrier; insulator, conductor; semiconductor; charge conduction; charge induction; Coulomb's law; static charge; electric current; electric circuit; ammeter; voltmeter; ohmmeter; electrical resistance; resistivity; Ohm's law; voltage; electrical power	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• College Physics, Tenth Edition, Serway and Vuille, Cengage Learning (2015) • Simulation Websites • Labs • Online Demos and Videos

Competency	Vocabulary	Strategy	Resource
8. Define electrical current 9. Define an electric circuit 10. Explain the concepts of ammeters and voltmeters as they apply to measuring electrical characteristics in a circuit 11. Explain the concept of electrical resistance 12. Explain resistance and resistivity 13. Use the equation for resistivity to determine the resistance of objects 14. Apply resistance to electrical systems 15. State Ohm's law 16. Use Ohm's law to relate current, voltage, and resistance in simple electrical circuits 17. Derive the expression for electrical power and apply to simple electrical systems			

Unit Title: Simple DC Circuits

Suggested time frame: 2 weeks

Standards: Course - 3.2.P.B: PHYSICS

Standard – 3.2.P.B4: Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.

Essential Questions:

- Big Idea 1: Objects and systems have properties such as mass and charge. Systems may have internal structure.
- Big Idea 2: Fields existing in space can be used to explain interactions.
- Big Idea 3: The interactions of an object with other objects can be described by forces.
- Big Idea 4: Interactions between systems can result in changes in those systems.
- Big Idea 5: Changes that occur as a result of interactions are constrained by conservation laws.
- Big Idea 6: Waves can transfer energy and momentum from one location to another without the permanent transfer of mass and serve as a mathematical model for the description of other phenomena.

Competency	Vocabulary	Strategy	Resource
For theoretical systems and laboratory procedures: 1. Describe concepts of emf, terminal voltage, internal resistance, and load resistance 2. Determine the current output and power delivered by an emf source 3. Derive expressions for the equivalent resistance for networks of series and of parallel resistors 4. Determine the resistance of a network of resistors 5. Analyze basic circuits to determine the circuits' electrical characteristics	voltage/volt, ampere/amp; resistance; ohm; current; emf; battery; voltage source; terminal voltage, internal resistance, load resistance, current, wattage/watt; power dissipation; power delivery; voltage drop; voltage polarity	Notes, example problems, labs, readings, homework, online simulations, formative assessment, summative assessment, differentiated instructions, cooperative learning.	• College Physics, Tenth Edition, Serway and Vuille, Cengage Learning (2015) • Simulation Websites • Labs • Online Demos and Videos

Unit Title: Review for AP Physics 1 Exam

Suggested time frame: 2 weeks

Standards: Course - 3.2.P.B: PHYSICS

Standard – 3.2.P.B1: Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.

Standard – 3.2.P.B2: Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.

Standard – 3.2.P.B3: Analyze the factors that influence convection, conduction, and radiation between objects or regions that are at different temperatures.

Standard – 3.2.P.B4: Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.

Standard – 3.2.P.B5: Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.

Standard – 3.2.P.B6: PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton’s laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

Unit Title: Selected Topics/Project Based Analysis

Possible Topics: Kepler's laws; Relativity; Car accident analysis; Using Microsoft Excel to analyze complex systems

Suggested time frame: 3 weeks

Standards: Course - 3.2.P.B: PHYSICS

Standard – 3.2.P.B1: Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.

Standard – 3.2.P.B2: Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.

Standard – 3.2.P.B3: Analyze the factors that influence convection, conduction, and radiation between objects or regions that are at different temperatures.

Standard – 3.2.P.B4: Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.

Standard – 3.2.P.B5: Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.

Standard – 3.2.P.B6: PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton's laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.

Unit Title: Review for Final Exam

Suggested time frame: 2 weeks

Standards: Course - 3.2.P.B: PHYSICS

Standard – 3.2.P.B1: Differentiate among translational motion, simple harmonic motion, and rotational motion in terms of position, velocity, and acceleration. Use force and mass to explain translational motion or simple harmonic motion of objects. Relate torque and rotational inertia to explain rotational motion.

Standard – 3.2.P.B2: Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. Describe the rotational motion of objects using the conservation of energy and conservation of angular momentum. Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion.

Standard – 3.2.P.B3: Analyze the factors that influence convection, conduction, and radiation between objects or regions that are at different temperatures.

Standard – 3.2.P.B4: Explain how stationary and moving particles result in electricity and magnetism. Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. Explain how electrical induction is applied in technology.

Standard – 3.2.P.B5: Explain how waves transfer energy without transferring matter. Explain how waves carry information from remote sources that can be detected and interpreted. Describe the causes of wave frequency, speed, and wave length.

Standard – 3.2.P.B6: PATTERNS SCALE MODELS CONSTANCY/CHANGE Use Newton’s laws of motion and gravitation to describe and predict the motion of objects ranging from atoms to the galaxies.