Fair Lawn

Public Schools

Fair Lawn, NJ

Advanced Placement Physics 1

August

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AP Physics is a high school science class developed by the Fair Lawn Schools high school science faculty and aligned to the 2009 NJCCCS and correlated to the Common Core State Standards for Literacy & Math.

Science Department

Fair Lawn School District

Committee Credits

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Advanced Placement Physics 1

I. Course Synopsis

The Advanced Placement (A.P.) Physics 1 course offered at Fair Lawn High School is a one-year algebra/trigonometry-based course that is similar to a first-semester non-calculus university course in physics. However, there are times during this course when some Calculus is used to enhance various topics, since all the students in the course are either taking A.P. Calculus AB or BC concurrently. The full course is geared towards students who may major in any of the physical sciences or engineering in college. AP Physics 1 will involve investigations into many topics including Newtonian mechanics, conservation of energy, mechanical waves and sound, and an introduction to electrostatics and simple circuits, with a connection to 5 Big Ideas. Students will master the concepts of one- and two-dimensional kinematics and dynamics. Other topics include Universal Gravitation and Circular Motion, Simple Harmonic Systems, and Linear Momentum. Throughout the course, students develop critical skills in scientific thinking and reasoning through a multitude of inquiry-based learning and laboratory experiences.
This course meets for seven 45-minute periods per week.

II. Philosophy & Rationale

In a technologically-driven society, it is desirable for all students to develop skills like critical thinking, reasoning, and problem-solving skills that can be found prevalent in a science course. Physics, in particular, has a foundation in many other sciences and therefore can be considered "the most basic of sciences."

In addition to learning the aforementioned skills that can be used in every day real-life applications, students will also begin to understand natural laws that govern our universe (and in many cases, those that they experience daily). Throughout inquiry labs, students can safely test their own ideas, solve problems, and developing the concepts related to physics on their own, using scientific method or learning cycle. Twenty-five percent of the course must be devoted to hands-on laboratory work, including the inquiry-based labs, according to the College Board.

III. Scope & Sequence

Unit 1: Kinematics Sept. Chap. 2 (“Big Ideas” [B.I.] 3)

- Motion in One Dimension (Constant Velocity, Constant Horizontal
  - Acceleration, Acceleration Due to Gravity)
- Vector Mathematics (Resultant and Components)
- Motion in Two Dimensions (Projectile Motion)

Unit 2: Dynamics Oct. Chaps. 3 & 4 (B.I. 1,2,3,4)

- Forces (types and symbolism)
- Newton’s Three Laws of Motion
- Applications of Newton’s Laws (friction, pulleys)

Unit 3: Work and Energy Nov. Chap. 5 (B.I. 1,2,3,4)

- Work & Work-Energy Theorem
- Potential Energy (gravitational and elastic) & Kinetic Energy
- Conservation of Energy
- Power

Unit 4: Linear Momentum Nov. Chap. 6 (B.I. 3,4,5)

- Impulse
- Momentum
- Conservation of Linear Momentum
- Inelastic and Elastic Collisions

Unit 5: Circular Motion Dec. Chap. 7 (B.I. 1,2,3,4)

- Centripetal Acceleration
- Centripetal Force (including applications)

Unit 6: Universal Law of Gravitation Dec. Chap. 7 (B.I. 1,2,3,4)

- Newton’s Universal Law of Gravitation (including applications)

Unit 7: Rotational Motion Jan. Chaps. 7 &8 (B.I. 3,4,5)

- Torque
- Center of Mass and Center of Gravity
- Rotational Kinematics
- Center of Mass
- Rotational Inertia
- Rotational Dynamics
- Rotational Energy
- Angular Momentum and Its Conservation

Unit 8: Mechanical Waves Feb. Chap. 13 (B.I. 3, 5, 6)

- Wave Characteristics (Wavelength, Frequency, Speed of a Wave, Etc.)
- Traveling Waves
- Superposition and Interference of Waves

- Standing Waves on Strings
- Simple Harmonic Motion (Hooke's law, Pendulum, Springs)

Unit 9: Sound Waves Feb. Chap. 14 (B.I. 6)

- Sound
- Standing Sound Waves (Strings, Pipes)
- Resonance
- Beats

Unit 10: Electrostatics March Chaps. 15 & 16 (B.I. 1, 3, 5)

- Electric Charge and Its Conservation
- Coulomb's Law
- Electric Field Intensity
- Electrical Potential
- Electrical Potential Energy

Unit 11: Direct-current (D.C.) Circuits March/April Chaps. 17 & 18 (B.I. 1, 5)

- Electric Current
- Electric Resistance
- Ohm's Law
- Electric Power
- Series and Parallel Resistor Circuits
- Kirchhoff's Laws

Unit 12: Review for A.P. Exam April All Previous Chapters

Big Ideas (as described by the College Board)

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

IV. Unit Descriptions

IV. Unit Descriptions

Unit 1: Kinematics

Enduring Understanding

1. Kinematics is the study of the "how" things work, governed by natural laws.
2. Both direct and indirect relationships exist in nature.
3. There is a relationship between displacement, velocity, and acceleration.
4. The motion of objects can be described consistently using pictures, diagrams, mathematical expressions, and graphical representations.
5. In order to evaluate motion, an object or system must be chosen to evaluate/observe/describe.

Essential Question(s)

In which ways can we describe "how" objects move in nature?

Learning Objectives

1. Identify an "object of interest" or "system" to evaluate.
2. Utilize observations, data collection and analysis, and laboratory skills to derive equations and develop representations (graphical, mathematical, and diagrams) that describe motion.
3. Given a graph of one of the kinematic quantities, position, velocity, or acceleration, as a function of time, recognize in what time intervals the other two are positive, negative, or zero and identify or sketch a graph of each as a function of time.
4. Given an expression for one of the kinematic quantities, position, velocity or acceleration, as a function of time, determine the other two as a function of time.
5. Write down expressions for velocity and position as functions of time, and identify or sketch graphs of these quantities.
6. Describe qualitatively, with the aid of graphs, the acceleration, velocity, and
7. displacement of s a particle when it is released from rest or is projected vertically
8. with specified initial velocity.
6. Apply kinematics quantitatively to 2-D problems, specifically projectile motion.

Suggested Activities

1. Students will be able to use Microsoft EXCEL and other software to plot graphs for lab reports.
2. Experimental Uncertainty (Error) and Data Analysis Lab (Introductory statistical analysis and graphing lab)
3. Inquiry Lab on Using Measurement Instruments (Mass, Volume, and Density) (Use of the micrometer and caliper to make measurements)
4. Inquiry Lab on Velocity and Acceleration for One – Dimensional Motion Using PASCO Cart (Application of the kinematic equations to 1-D horizontal motion)
5. Inquiry Lab on Uniformly Accelerated Motion (Finding acceleration due to gravity with the spark timer and graphical analysis)

New Jersey Core Curriculum Content Standards

5.1.12A1, B1-2, C; 5.3.12A1; 9.2.12A1, F1, 4-5, C2, C3; 3.2; 8.2B3; 9.2A3

Unit 2: Dynamics

Enduring Understanding

1. Dynamics is the study of "why" things work, governed by natural laws.
2. Both direct and indirect relationships exist in nature.
3. There is a relationship between acceleration, force, and mass.
4. The motion of objects can be explained by evaluating the sum of interactions (forces) on the system.

Essential Question(s)

What causes objects to move the way they do in nature?

Learning Objectives

1. Analyze situations in which a particle remain s at rest, or moves with constant velocity, under the influence of several forces.
2. Calculate, for an object moving in one dimension, the velocity change that results when a constant force F acts over a specified time interval.
3. Draw a well-labeled, free-body diagram showing all real forces that act on the object.
4. Write down the vector equation that results from applying Newton's Second Law to the object, and take components of this equation along appropriate axes.
5. Analyze situations in which an object moves with specified acceleration under the influence of one or more forces so they can determine the magnitude and direction of the net force, or of one of the forces that makes up the net force, such as motion up or down with constant acceleration.
6. Write down the relationship between the normal and frictional forces on a surface.
7. Analyze situations in which an object moves along a rough inclined plane or horizontal surface.
8. Analyze under what circumstances an object will start to slip, or to calculate the magnitude of the force of static friction.
9. Understand Newton's Third Law so that, for a given system, one can identify the force pairs and the objects on which they act, and state the magnitude and direction of each force.
10. Apply Newton's Third Law in analyzing the force of contact between two objects that accelerate together along a horizontal or vertical line, or between two surfaces that slide across one another.
11. Know that the tension is constant in a light string that passes over a massless pulley and be able to use this fact in analyzing the motion of a system of two objects joined by a string.
12. Solve problems in which application of Newton's laws leads to two or three simultaneous linear equations involving unknown forces or accelerations.

Suggested Activities

1. Inquiry lab on The Addition and Resolution of Vectors: The Force Table
    (Using the force table to find various equilibrant forces)
2. Inquiry lab on Newton's Second Law (using PASCO carts, track, and pulley)
    (Using a PASCO track system to find acceleration through $F = ma$)
3. Newton's Second Law: The Atwood Machine Lab
    (Using a pulley system to find acceleration through $F = ma$)

New Jersey Core Curriculum Content Standards

5.1.12A1, B1 ‐ 2,C; 5.3.12A1; 9.2.12A1, F1,4 ‐ 5,C2,C3;3.2;8.2B3;9.2A3

Unit 3: Work and Energy

Enduring Understanding

1. Energy is conserved in nature.
2. A force exerted on an object can change the kinetic energy of the object.

Essential Question(s)

1. How are work, energy, and power related?
2. How can we use the conservation of energy to enhance society (solar cells)?
3. How is the conservation of energy utilized in roller coaster design?

Learning Objectives

1. Calculate the work done by a specified constant force on an object that undergoes a specified displacement.
2. Relate the work done by a force to the area under a graph of force as a function of position, and calculate this work in the case where the force is a linear function of position.
3. Calculate the change in kinetic energy or speed that results from performing a specified amount of work on an object.
4. Calculate the work performed by the net force, or by each of the forces that make up the net force, on an object that undergoes a specified change in speed or kinetic energy.
5. Apply the Work-Energy Theorem to determine the change in an object's kinetic energy and speed that result from the application of specified forces, or to determine the force that is required in order to bring an object to rest in a specified distance.
   State alternative definitions of "conservative force" and explain why these definitions are equivalent.
6. Describe examples of conservative forces and non-conservative forces.
7. State the general relation between force and potential energy, and explain why potential energy can be associated only with conservative forces.
8. Write an expression for the force exerted by an ideal spring and for the potential energy of a stretched or compressed spring.
9. Calculate the potential energy of one or more objects in a uniform gravitational field.
10. State and apply the relation between the work performed on an object by nonconservative forces and the change in an object's mechanical energy.
11. Describe and identify situations in which mechanical energy is converted to other forms of energy.
12. Analyze situations in which an object's mechanical energy is changed by friction or by a specified externally applied force.
13. Identify situations in which mechanical energy is or is not conserved.
14. Apply conservation of energy in analyzing the motion of systems of connected objects, such as an Atwood's machine.
15. Apply conservation of energy in analyzing the motion of objects that move under the

influence of springs.
16. Apply conservation of energy in analyzing the motion of objects that move under the influence of other non-constant one-dimensional forces.
17. Recognize and solve problems that call for application both of conservation of energy and Newton's Laws.
18. Calculate the power required to maintain the motion of an object with constant acceleration (e.g., to move an object along a level surface, to raise an object at a constant rate, or to overcome friction for an object that is moving at a constant speed).
19. Calculate the work performed by a force that supplies constant power, or the average power supplied by a force that performs a specified amount of work.

Suggested Activities

1. Inquiry lab on Work and Energy (using PASCO carts and track)
   (Using a PASCO track system to find and compare gravitational potential energy and kinetic energy)
2. Inquiry lab Power lab
   (Students measuring their own horsepower by being timed as they run up a flight of stairs)

New Jersey Core Curriculum Content Standards

5.1.12A1, B1 ‐ 2,C; 5.3.12A1; 9.2.12A1, F1,4 ‐ 5,C2,C3;3.2;8.2B3;9.2A3

Unit 4: Linear Momentum

Enduring Understanding

1. Momentum is conserved in various types of collisions in nature.
2. A force exerted on an object can change the momentum of the object.

Essential Question(s)

1. How do perfectly elastic collisions, inelastic collisions, and perfectly inelastic collisions differ as far as conservation of energy and momentum are concerned?
2. Why are bumpers that crumple safer than bumpers that do not when a car is involved in a collision?

Learning Objectives

1. Relate mass, velocity, and linear momentum for a moving object, and calculate the total linear momentum of a system of objects.
2. Relate impulse to the change in linear momentum and the average force acting on an object.
3. Calculate the area under a force versus time graph and relate it to the change in momentum of an object.
4. Explain how linear momentum conservation follows as a consequence of Newton's Third Law for an isolated system.
5. Identify situations in which linear momentum, or a component of the linear momentum vector, is conserved.
6. Apply linear momentum conservation to one-dimensional elastic and inelastic collisions and two-dimensional completely inelastic collisions.
7. Apply linear momentum conservation to two-dimensional elastic and inelastic collisions.

8. Analyze situations in which two or more objects are pushed apart by a spring or other agency, and calculate how much energy is released in such a process.
9. Analyze the uniform motion of an object relative to a moving medium such as a flowing stream.
10. Analyze the motion of particles relative to a frame of reference that is accelerating horizontally or vertically at a uniform rate.

Suggested Activities

1. Conservation of Linear Momentum Lab
   (Elastic and inelastic collisions through use of PASCO carts and track)
2. Inquiry lab on Conservation of Momentum in Two-Dimensional Collisions

New Jersey Core Curriculum Content Standards

5.1.12A1, B1 ‐ 2,C; 5.3.12A1; 9.2.12A1, F1,4 ‐ 5,C2,C3;3.2;8.2B3;9.2A3

Unit 5: Circular Motion

Enduring Understanding

1. A centripetal force will cause an object to move in uniform circular motion.
2. An object moving in a uniform circular motion will have an angular velocity of constant magnitude but changing direction as it travels on its path.

Essential Question(s)

1. Can any applied force cause an object to move in circular motion?
2. Why do objects, like satellites, travel in circular and elliptical orbits of a planet?

Learning Objectives

1. Relate the radius of the circle and the speed or rate of revolution of the particle to the magnitude of the centripetal acceleration.
2. Describe the direction of the particle's velocity and acceleration at any instant during the circular motion.
3. Determine the components of the velocity and acceleration vectors at any instant, and sketch or identify graphs of these quantities.
4. Analyze situations in which an object moves with specified acceleration under the influence of one or more forces so they can determine the magnitude and direction of the net force, or of one of the forces that make s up the net force, in situations such as the following:
   a. Motion in a horizontal circle (e.g., mass on a rotating merry-go-round, or car rounding a banked curve).
   b. Motion in a vertical circle (e.g., mass swinging on the end of a string, cart rolling down a curved track, rider on a Ferris wheel).

Suggested Activities

1. Inquiry lab on Centripetal Force
   (Using a hand-held centripetal force apparatus to find relationships between centripetal force, velocity, and radius)

New Jersey Core Curriculum Content Standards

5.1.12A1, B1 ‐ 2,C; 5.3.12A1; 9.2.12A1, F1,4 ‐ 5,C2,C3;3.2;8.2B3;9.2A3

Unit 6: Universal Law of Gravitation

Enduring Understanding

1. Based on Newton's Law of Gravitation, the force of gravity can be calculated for regularly and irregularly-shaped objects.
2. The gravitational forces between to objects are a Newton's Third Law pair and can be calculated between any two objects of known mass and at a known distance apart.

Essential Question(s)

How can the Law of Gravitation be applied to circular and elliptical orbits of planets?

Learning Objectives

1. Determine the force that one spherically symmetrical mass exerts on another.
2. Determine the strength of the gravitational field at a specified point outside a spherically symmetrical mass.
3. Determine the "weight" of an object on multiple planets and discuss the difference between weight and mass of an object.
4. Recognize that the motion of an object in orbit does not depend on the object's mass; describe qualitatively how the velocity, period of revolution, and centripetal acceleration depend upon the radius of the orbit; and derive expressions for the velocity and period of revolution in such an orbit.
5. Derive Kepler's Third Law for the case of circular orbits.
6. Derive and apply the relations among kinetic energy, potential energy, and total energy for such an orbit.
7. State Kepler's Three Laws of Planetary Motion and use them to describe in qualitative terms the motion of an object in an elliptical orbit.
8. Explain, using words diagrams and mathematical expressions to explain why objects like International Space Station travel at 17,500 mph to remain approximately 250 km from Earth's surface.

Suggested Activities

1. Inquiry lab on Finding the Mass of a Solar System Planet and/or Exoplanet
   (Using online data from various websites – will involve extensive graphing techniques.)

New Jersey Core Curriculum Content Standards

5.1.12A1, B1 ‐ 2,C; 5.3.12A1; 9.2.12A1, F1,4 ‐ 5,C2,C3;3.2;8.2B3;9.2A3

Unit 7: Rotational Motion

Enduring Understanding

1. A perpendicular or angled force applied at a certain distance from an object's pivot point can cause a system to torque.
2. Angular momentum is conserved in rotating systems in nature, in the absence of external torques.
3. Objects cannot always be represented as point-like.

Essential Question(s)

1. Can a centripetal force and torque-causing force co-exist on the same object?
2. How does the angular momentum of a rotating system change as the mass-distribution or angular velocity of a rotating system changes?

Learning Objectives

1. Calculate the magnitude and direction of the torque associated with a given force.
2. Calculate the torque on a rigid object due to gravity.
3. State the conditions for translational and rotational equilibrium of a rigid object.
4. Apply the above conditions in analyzing the equilibrium of a rigid object under the combined influence of a number of coplanar forces applied at different locations.
5. Determine by inspection which of a set of symmetrical objects of equal mass has the greatest rotational inertia.
6. Determine by what factor an object’s rotational inertia changes if all its dimensions are increased by the same factor.
7. Identify by inspection the center-of-mass of a symmetrical object.
8. Locate the center-of-mass of a system consisting of two such objects.
9. Understand and apply the relation between center-of-mass, velocity, and linear momentum, and between center-of-mass, acceleration, and net external force for a system of particles.
10. Define center-of-gravity and to use this concept to express the gravitational potential energy of a rigid object in terms of the position of its center-of-mass.
11. Apply conservation of angular momentum to determine the velocity and radial distance at any point in the orbit.
12. Apply angular momentum conservation and energy conservation to relate the speeds of an object at the two extremes of an elliptical orbit.
13. Apply energy conservation in analyzing the motion of an object that is projected straight up from a planet’s surface or that is projected directly toward the planet from far above the surface.

Suggested Activities

1. Inquiry lab on Torque, Equilibrium, and Center of Gravity
(Applying the above by using a simple meter stick, pivot, and weight setup)

New Jersey Core Curriculum Content Standards

5.1.12A1, B1 ‐ 2,C; 5.3.12A1; 9.2.12A1, F1,4 ‐ 5,C2,C3;3.2;8.2B3;9.2A3

Unit 8: Mechanical Waves

Enduring Understanding

1. Waves occur in nature in two ways: transverse and longitudinal.
2. A periodic wave is one that repeats as a function of both time and position and can be described by its amplitude, frequency, wavelength, speed, and energy
3. The sum of potential energy and kinetic energy is constant in oscillating systems.

Essential Question(s)

1. How is energy transferred in a transverse wave versus a longitudinal wave, and how do the particles move differently?
2. How can the period of an oscillating pendulum and the period of an oscillating spring-mass system be determined?

Learning Objectives

1. Develop an understanding of the concepts of wave characteristics such as amplitude, wavelength, frequency, period, speed of a wave and be able to show relationships, if any, between those characteristics.
2. Understand the concepts of traveling waves, standing waves, superposition of waves, interference of waves, and standing waves on strings.
3. Understand the concepts of simple harmonic motion (SHM) so that one may sketch or identify a graph of displacement as a function of time, and determine from such a graph the amplitude, period, and frequency of the motion.
4. Write down an appropriate expression for displacement of the form $x = A \sin \omega t$ or $x = A \cos \omega t$ to describe the motion.
5. Find an expression for velocity as a function of time for SHM.
6. State the relations between acceleration, velocity and displacement, and identify points in the motion where these quantities are zero or achieve their greatest positive and negative values.
7. State how the total energy of an oscillating system depends on the amplitude of the motion, sketch or identify a graph of kinetic or potential energy as a function of time, and identify points in the motion where this energy is all potential or all kinetic.
8. Calculate the kinetic and potential energies of an oscillating system as functions of time, sketch or identify graphs of these functions, and prove that the sum of kinetic and potential energy is constant.
9. Calculate the maximum displacement or velocity of a particle that moves in simple harmonic motion with specified initial position and velocity.
10. Apply the expression for the period of oscillation of a mass on a spring.
11. Analyze problems in which a mass hangs from a spring and oscillates vertically.
12. Analyze problems in which a mass attached to a spring oscillates horizontally.
13. Apply the expression for the period of a simple pendulum.

Suggested Activities

1. Inquiry lab on The Simple Pendulum
   (Finding acceleration due to gravity by measuring the period of a simple pendulum)
2. Inquiry lab on Hooke's Law: Simple Harmonic Motion
   (Finding the spring constant through various experiments with a Hooke's Law apparatus)

New Jersey Core Curriculum Content Standards

5.1.12A1, B1 ‐ 2,C; 5.3.12A1; 9.2.12A1, F1,4 ‐ 5,C2,C3;3.2;8.2B3;9.2A3

Unit 9: Sound Waves

Enduring Understanding

Interference and superposition lead to standing waves and beats for sound waves.

Essential Question(s)

How do standing sound waves form in open and closed pipes?

Learning Objectives

1. Apply the concepts of traveling waves, standing waves, superposition of waves, interference of waves, and standing waves to the physics of sound waves.
2. Develop a qualitative understanding of resonance so that a student can apply this concept to sound wave applications.
3. Develop a qualitative understanding of beats so that a student can apply this concept to sound wave applications.

Suggested Activities

1. Inquiry lab on Air Column Resonance: The Speed of Sound in Air
   (Students find the speed of sound in air with tuning forks and resonance tubes partially filled with water)

New Jersey Core Curriculum Content Standards

5.1.12A1, B1 ‐ 2,C; 5.3.12A1; 9.2.12A1, F1,4 ‐ 5,C2,C3;3.2;8.2B3;9.2A3

Unit 10: Electrostatics

Enduring Understanding

1. Electric charge is conserved in nature.
2. Electric forces and fields exist between charges; electric charges can interact at a distance with a calculated force.

Essential Question(s)

How can the electric field and electric potential be calculated outside and inside charged regularly-shaped geometric conducting objects?

Learning Objectives

1. Describe the types of charge and the attraction and repulsion of charges.
2. Calculate the magnitude and direction of the force on a positive or negative charge due to other specified point charges.
3. Analyze the motion of a particle of specified charge and mass under the influence of an electrostatic force.
4. Define electric field in terms of the force on a test charge.
5. Describe and calculate the electric field of a single point charge.
6. Calculate the magnitude and direction of the electric field produced by two or more point charges.
7. Calculate the magnitude and direction of the force on a positive or negative charge placed in a specified field.
8. Interpret an electric field diagram.
9. Analyze the motion of a particle of specified charge and mass in a uniform electric field.
10. Determine the electric potential in the vicinity of one or more point charges.

11. Calculate the electrical work done on a charge or use conservation of energy to determine the speed of a charge that moves through a specified potential difference.
11. Determine the direction and approximate magnitude of the electric field at various positions given a sketch of equipotentials.
12. Calculate the potential difference between two points in a uniform electric field, and state which point is at the higher potential.

Suggested Activities

1. Electric Field Mapping lab (computer simulation)

New Jersey Core Curriculum Content Standards

5.1.12A1, B1 ‐ 2,C; 5.3.12A1; 9.2.12A1, F1,4 ‐ 5,C2,C3;3.2;8.2B3;9.2A3

Unit 11: Direct Current (D.C.) Circuits

Enduring Understanding

In electric circuits, voltage and electric current are directly related for a given electric resistance.

Essential Question(s)

How can voltage and current be measured in series circuits, parallel circuits, series-parallel circuits, and complex circuits?

Learning Objectives

1. Relate the magnitude and direction of the electric current to the rate of flow of positive and negative charge.
2. Understand conductivity, resistivity, and resistance, so that one can relate current and voltage for a resistor.
3. Describe how the resistance of a resistor depends upon its length and cross-sectional area, and apply this result in comparing current flow in resistors of different material or different geometry.
4. Apply an expression for the resistance of a resistor of uniform cross-section in terms of its dimensions and the resistivity of the material from which it is constructed.
5. Identify on a circuit diagram whether resistors are in series or in parallel.
6. Calculate the equivalent resistance of a network of resistors that can be broken down into series and parallel combinations.
5. Calculate the voltage, current, and power dissipation for any resistor in such a network of resistors connected to a single power supply.
6. Design a simple series-parallel circuit that produces a given current through and potential difference across one specified component, and draw a diagram for the circuit using conventional symbols.
7. Calculate the terminal voltage of a battery of specified emf and internal resistance from which a known current is flowing.
8. Calculate the rate at which a battery is supplying energy to a circuit or is being charged up by a circuit.
9. Be able to apply Ohm's law and Kirchhoff's rules to direct-current circuits, in order to:
    (a) Determine a single unknown current, voltage, or resistance.
    (b) Set up and solve simultaneous equations to determine two unknown currents.
10. Understand the properties of voltmeters and ammeters, so one can:
    (a) State whether the resistance of each is high or low.
    (b) Identify or show correct methods of connecting meters into circuits in order to measure voltage or current.
    (c) Assess qualitatively the effect of finite meter resistance on a circuit into which these meters are connected.

<u>Suggested Activities</u>

1. Inquiry lab on Ohm's Law
   (Students find the value of a color-coded resistor by the voltmeter-ammeter method of finding resistance)
2. Inquiry lab on Resistances in Series, Parallel, and Series - Parallel Circuits
   (Students find potential differences and currents for the above resistor circuits using voltmeters and ammeters)

<u>New Jersey Core Curriculum Content Standards</u>

5.1.12A1, B1 ‑ 2,C; 5.3.12A1; 9.2.12A1, F1,4 ‑ 5,C2,C3;3.2;8.2B3;9.2A3

V. Course Materials

Textbook: “College Physics”, 9th Ed., by Serway and Faughn (Brooks/Cole – CENGAGE Learning Inc.) Adopted by the FLBOE during school year 2012-2013 for AP Physics B which was replaced by AP Physics 1.

Experiments for the course are taken from several sources including:

• “AP Physics Lab Guide” by J. Patrick Polley
(2003 College Entrance Examination Board)

• “CENCO AP Physics Lab Manual – A Guided Inquiry Approach” by Borislaw Bilash II
(2011 Borislaw Bilash II and VWR Education LLC)

• “Physics Laboratory Experiments” (7th Ed.) by Jerry D. Wilson and Cecilia A. Hernandez-Hall
(2010 Brooks/Cole, Cengage Learning)

• “PASCO Laboratory Experiments” (manuals accompanying various physics laboratory equipment purchases) (PASCO Co.)

• “Physics with Vernier” by Kenneth Appel
(Vernier Software and Technology)

Other resources may be referenced as well.

<u>Chapter Correlations & Time Frames</u>

Unit	AP Physics 1 Time Frame	"College Physics", 9th Ed
1 Kinematics	September	2 ("Big Ideas" [B.I.] 3)
2 Dynamics	October	3 & 4 (B.I. 1,2,3,4)
3 Work and Energy	November	5 (B.I. 1,2,3,4)
4 Linear Momentum	November	6 (B.I. 3,4,5)
5 Circular Motion	December	7 (B.I. 1,2,3,4)
6 Universal Law of Gravitation	December	7 (B.I. 1,2,3,4)
7 Rotational Motion	January	7 &8 (B.I. 3,4,5)
8 Mechanical Wave	February	13 (B.I. 3, 5, 6)
9 Sound Waves	February	14 (B.I. 6)
10 Electrostatics	March	15 & 16 (B.I. 1, 3, 5)
11 Direct-Currents Circuits	March/April	17 & 18 (B.I. 1, 5)
12 Review for AP Exam	April	All Previous Chapters

Suggested Activities & Suggested Modifications for Special Education Students, ELL Students, Students at Risk, and Gifted Students:

1. Students with special needs and ELL learners may be provided with key vocabulary terms prior to the unit beginning. In particular, the amount of key vocabulary terms should be reduced for ELL students.
2. ELL students may be provided with additional visual aids. For additional modifications, refer to Classroom Instruction that Works for ELL Learners *or the* SIOP protocol.
3. Gifted students may be challenged by asking them to form additional connections between biology, chemistry, and physics.

VI. Assessments

All students in A.P. Physics 1 will take a midterm exam, covering Units 1 – 6 inclusive, which contain a "common aspect" among all students. There is no final exam as per FLBOE policy towards A.P. courses; however, there will be a 5th marking period project related to Units 7 – 11 inclusive. In addition, regular tests, quizzes, lab reports, homework assignments, class participation, etc. will be required throughout marking periods 1 – 4.

VII. Cross Curricular Aspects

The study of A.P. Physics 1 requires an understanding of Algebra, Trigonometry, and a little Statistics/Probability. On occasion, students in A.P. Physics 1 may be involved with physics-related applications to biology, medicine, and chemistry.

CCCS Literacy: Click on the link to the High School Evidence Statements to see expectations related to literacy for this unit. In addition, a focus of the course will be on the development of the LAL standards for science & technical subjects.

CCCS Math: Students will be expected to perform measurement, modeling, apply algebra, and geometry and statistics.

Interdisciplinary Connections and Alignment to Technology standards

Science classes in the Fair Lawn Public schools promote career-readiness skills related to Personal Financial Literacy (9.1) and Career Awareness, Exploration, and Presentation (9.2). Some course concepts from the Career and Technical Education Standards (9.3), but these are not directly correlated since our district is not a CTE program.

The Fair Lawn Public Schools District fosters an environment that promotes career-readiness skills in all content areas. Whereas Career Ready Practices are explored consistently, specific alignment to Personal Finance Literacy (9.1) and Career Awareness, Exploration, and Presentation Standards (9.2) are included in the district level document (below). When appropriate, the Career and Technical Education Standards (9.3) have been reviewed and aligned as well.

Examples: 9.2B: Career exploration in each unit of study.

In addition, every effort is made to integrate technology and engineering into our science classes. Educational Technology (8.1) and Technology Education, Engineering, Design, and Computational Thinking – Programming (8.2) standards are cross connected throughout our science programs.

Examples:

8.1A: Use spreadsheets to analyze & interpret data from laboratories, 6-12.
Use the internet to increase productivity and efficiency, 9-12.

8.1B,C: Use data to solve real-world problems, 6-12.
Use online platforms to collaborate & address global issues, 9-12.

8.1F: Collect and analyze data using internet and data simulations, 6-12.

8.2A: Become aware of the invention process, 3-5.

8.2B: Become aware of the global impacts on technology, 6-12.

8.2C: Apply the design process to pushes & pulls, K-2.

8.2D: Use tools to reduce work, K-2.

For additional detail on how these standards are integrated throughout the Fair Lawn Schools curriculum, review the Fair Lawn Public Schools District Alignment to Technology & Career Readiness & 21st Century Skills Standards Curriculum Appendix.