Curricular Requirements	
CR1	Students and teachers have access to college-level resources including college-level textbooks and reference materials in print or electronic format.
CR2a	The course design provides opportunities for students to develop understanding of the foundational principles of kinematics in the context of the big ideas that organize the curriculum framework.
CR2b	The course design provides opportunities for students to develop understanding of the foundational principles of dynamics in the context of the big ideas that organize the curriculum framework.
CR2c	The course design provides opportunities for students to develop understanding of the foundational principles of gravitation and circular motion in the context of the big ideas that organize the curriculum framework.
CR2d	The course design provides opportunities for students to develop understanding of the foundational principles of simple harmonic motion in the context of the big ideas that organize the curriculum framework.
CR2e	The course design provides opportunities for students to develop understanding of the foundational principles of linear momentum in the context of the big ideas that organize the curriculum framework.
CR2f	The course design provides opportunities for students to develop understanding of the foundational principle of energy in the context of the big ideas that organize the curriculum framework.
CR2g	The course design provides opportunities for students to develop understanding of the foundational principles of rotational motion in the context of the big ideas that organize the curriculum framework.
CR2h	The course design provides opportunities for students to develop understanding of the foundational principles of electrostatics in the context of the big ideas that organize the curriculum framework.
CR2i	The course design provides opportunities for students to develop understanding of the foundational principles of electric circuits in the context of the big ideas that organize the curriculum framework.
CR2j	The course design provides opportunities for students to develop understanding of the foundational principles of mechanical waves in the context of the big ideas that organize the curriculum framework.
CR3	Students have opportunities to apply AP Physics 1 learning objectives connecting across enduring understandings as described in the curriculum framework. These opportunities must occur in addition to those within laboratory investigations.
CR4	The course provides students with opportunities to apply their knowledge of physics principles to real world questions or scenarios (including societal issues or technological innovations) to help them become scientifically literate citizens.
CR5	Students are provided with the opportunity to spend a minimum of 25 percent of instructional time engaging in hands-on laboratory work with an emphasis on inquiry-based investigations.
CR6a	The laboratory work used throughout the course includes investigations that support the foundational AP Physics 1 principles.
CR6b	The laboratory work used throughout the course includes guided-inquiry laboratory investigations allowing students to apply all seven science practices.
CR7	The course provides opportunities for students to develop their communication skills by recording evidence of their research of literature or scientific investigations through verbal, written, and graphic presentations.
CR8	The course provides opportunities for students to develop written and oral scientific argumentation skills.

TEXTBOOK:

- Etkina, Eugenia, Michael Gentile, and Alan Van Heuvelen. College Physics. San Francisco, CA: Pearson, 2014. [CR1]

TEACHING RESOURCES:

- Gastineau, John, *et. al.* Physics with Vernier. Beaverton, OR: Vernier Software & Technology, 2013.

- Giancoli, Douglas C. Physics: Principles with Applications (6th Edition, Updated). San Francisco, CA: Pearson Prentice Hall, 2009.

- Hewitt, Paul G. Conceptual Physics. Menlo Park, CA: Addison-Wesley Publishing Company Inc. 1987.

- Hieggelke, Curtis, David Maloney, and Stephen Kanim. Newtonian Tasks Inspired by Physics Education Research: nTIPERs. Upper Saddle River, NJ: Pearson, 2012.

INSTRUCTIONAL STRATEGIES

The AP Physics 1 course is conducted using inquiry-based instructional strategies that focus on experimentation to develop students' conceptual understanding of physics principles. The students begin studying a topic by making observations and discovering patterns of natural phenomena. The next steps involve developing, testing and applying models. Throughout the course, the students construct and use multiple representations of physical processes, solve multi-step problems, design investigations, and reflect on knowledge construction through self-assessment rubrics.

In most labs, the students use probeware technology in data acquisition. In the classroom, they use graphing calculators and digital devices for interactive simulations, collaborative activities and formative assessments.

COURSE SYLLABUS

UNIT 1. KINEMATICS [22 days] [CR2a]

- Kinematics in one-dimension: constant velocity and uniform accelerated motion
- Vectors: vector components and resultant
- Kinematics in two-dimensions: projectile motion

Big Idea 3
Learning Objectives: 3.A.1.1, 3.A.1.2, 3.A.1.3

UNIT 2. DYNAMICS [18 days] [CR2b]

- Forces, types (friction, normal, gravity) and representation (FBD)
- Newton's First Law

- Newton's Third Law
- Newton's Second Law
- Applications of Newton's 2nd Law
- Friction
- Interacting objects: ropes and pulleys

Big Ideas 1, 2, 3, 4
Learning Objectives: 1.C.1.1, 1.C.1.3, 2.B.1.1, 3.A.2.1, 3.A.3.1, 3.A.3.2, 3.A.3.3, 3.A.4.1, 3.A.4.2, 3.A.4.3, 3.B.1.1, 3.B.1.2, 3.B.1.3, 3.B.2.1, 3.C.4.1, 3.C.4.2, 4.A.1.1, 4.A.2.1, 4.A.2.2, 4.A.2.3, 4.A.3.1, 4.A.3.2

UNIT 3. CIRCULAR MOTION AND GRAVITATION [11 days] [CR2c]

- Uniform circular motion
- Dynamics of uniform circular motion
- Universal Law of Gravitation

Big Ideas 1, 2, 3, 4
Learning Objectives: 1.C.3.1, 2.B.1.1, 2.B.2.1, 2.B.2.2, 3.A.3.1, 3.A.3.3, 3.B.1.2, 3.B.1.3, 3.B.2.1, 3.C.1.1, 3.C.1.2, 3.C.2.1, 3.C.2.2, 3.G.1.1, 4.A.2.2

UNIT 4. ENERGY [13 days] [CR2f]

- Work
- Power
- Kinetic energy
- Potential energy: gravitational and elastic
- Conservation of energy

Big Ideas 3, 4, 5
Learning Objectives: 3.E.1.1, 3.E.1.2, 3.E.1.3, 3.E.1.4, 4.C.1.1, 4.C.1.2, 4.C.2.1, 4.C.2.2, 5.A.2.1, 5.B.1.1, 5.B.1.2, 5.B.2.1, 5.B.3.1, 5.B.3.2, 5.B.3.3, 5.B.4.1, 5.B.4.2, 5.B.5.1, 5.B.5.2, 5.B.5.3, 5.B.5.4, 5.B.5.5, 5.D.1.1, 5.D.1.2, 5.D.1.3, 5.D.1.4, 5.D.1.5, 5.D.2.1, 5.D.2.3

UNIT 5. MOMENTUM [11 days] [CR2e]

- Impulse
- Momentum
- Conservation of momentum(when no outside forces are present)
- Elastic and inelastic collisions

Big Ideas 3, 4, 5
Learning Objectives: 3.D.1.1, 3.D.2.1, 3.D.2.2, 3.D.2.3, 3.D.2.4, 4.B.1.1, 4.B.1.2, 4.B.2.1, 4.B.2.2, 5.A.2.1, 5.D.1.1, 5.D.1.2, 5.D.1.3, 5.D.1.4, 5.D.1.5, 5.D.2.1, 5.D.2.2, 5.D.2.3, 5.D.2.4,5.D.2.5, 5.D.3.1

UNIT 6. SIMPLE HARMONIC MOTION [12 days] [CR2d]

- Linear restoring forces and simple harmonic motion
- Simple harmonic motion graphs

- Simple pendulum
- Mass-spring systems (ignoring effective mass)

Big Ideas 3, 5
Learning Objectives: 3.B.3.1, 3.B.3.2, 3.B.3.3, 3.B.3.4, 5.B.2.1, 5.B.3.1, 5.B.3.2, 5.B.3.3, 5.B.4.1, 5.B.4.2

UNIT 7. ROTATIONAL MOTION [20 days] [CR2g]

- Torque
- Center of mass
- Rotational kinematics
- Rotational dynamics and rotational inertia
- Rotational energy
- Angular momentum
- Conservation of angular momentum, when no external torques are present

Big Ideas 3, 4, 5
Learning Objectives: 3.F.1.1, 3.F.1.2, 3.F.1.3, 3.F.1.4, 3.F.1.5, 3.F.2.1, 3.F.2.2, 3.F.3.1, 3.F.3.2, 3.F.3.3, 4.A.1.1, 4.D.1.1, 4.D.1.2, 4.D.2.1, 4.D.2.2, 4.D.3.1, 4.D.3.2, 5.E.1.1, 5.E.1.2, 5.E.2.1

UNIT 8. MECHANICAL WAVES [11 days] [CR2j]

- Traveling waves
- Wave characteristics
- Sound
- Superposition
- Standing waves on a string
- Standing sound waves

Big Idea 6
Learning Objectives: 6.A.1.1, 6.A.1.2, 6.A.1.3, 6.A.2.1, 6.A.3.1, 6.A.4.1, 6.B.1.1, 6.B.2.1, 6.B.4.1, 6.B.5.1, 6.D.1.1, 6.D.1.2, 6.D.1.3, 6.D.2.1, 6.D.3.1, 6.D.3.2, 6.D.3.3, 6.D.3.4, 6.D.4.1, 6.D.4.2, 6.D.5.1

UNIT 9. ELECTROSTATICS [7 days] [CR2h]

- Electric charge and conservation of charge
- Electric force: Coulomb's Law

Big Ideas 1, 3, 5
Learning Objectives: 1.B.1.1, 1.B.1.2, 1.B.2.1, 1.B.3.1, 3.C.2.1, 3.C.2.2, 5.A.2.1

UNIT 10. DC CIRCUITS [7 days] [CR2i]

- Electric resistance
- Ohm's Law
- DC circuits
- Series and parallel connections
- Kirchhoff's Laws
- Introduction to Magnetism (ACT Quality Core targets)

Big Ideas 1, 5
Learning Objectives: 1.B.1.1, 1.B.1.2, 1.E.2.1, 5.B.9.1, 5.B.9.2, 5.B.9.3, 5.C.3.1, 5.C.3.2, 5.C.3.3

LABORATORY INVESTIGATIONS AND THE SCIENCE PRACTICES

The AP Physics 1 course devotes over 25% of the time to laboratory investigations [CR5]. The laboratory component of the course allows the students to demonstrate the seven science practices through a variety of investigations in all of the foundational principles.

The students use guided inquiry (GI) or open inquiry (OI) in the design of their laboratory investigations. Some labs focus on investigating a physical phenomenon without having expectations of its outcomes. In other experiments, the student has an expectation of its outcome based on concepts constructed from prior experiences. In application experiments, the students use acquired physics principles to address practical problems.

Students are expected to record their observations, data, and data analyses. Data analyses include identification of the sources and effects of experimental uncertainty, calculations, results and conclusions, and suggestions for further refinement of the experiment as appropriate. [CR7]

UNIT	LAB INVESTIGATION OBJECTIVE(S) CR6a (Investigation identifier: Guided Inquiry: GI Open Inquiry: OI) [CR6b]	SCIENCE PRACTICES [CR6b]
UNIT 1. KINEMATICS Chapter 1-2	1. Meeting Point (OI) To predict where two battery-powered cars will collide if they are released from opposite ends of the lab table at different times.	1.1, 1.2, 1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 6.4, 7.2
	2. Match the Graph (GI) To produce a motion that matches a set of given graphs: position, velocity and acceleration versus time.	1.2, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2
	3. Free-Fall Investigation (OI) To determine and compare the acceleration of two objects dropped simultaneously. (Vernier 5)	1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2
	4. Vector Addition (GI) To determine the value of a resultant of several vectors, and then compare that value to the values obtained through graphical and analytical methods. (CP 5)	1.1, 1.2, 1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2
	5. Shoot the Target (OI) To determine the initial velocity of a projectile, the angle at which the maximum range can be	1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2

	attained and predict where the projectile will land. (Vernier 8a)	
	6. Chase Scenario (OI) Students use a battery- cart and a fan cart to recreate a chase scenario (police-thief) to predict the position where the "'thief"' will be caught and the final speeds of both cars.	1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 6.4, 7.2
UNIT 2. DYNAMICS Chapter 3	7. Inertial and Gravitational Mass (GI) To determine the difference (if any) between inertial mass and gravitational mass.	1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2
	8. Forces Inventory (GI) Qualitative and quantitative investigation on a variety of interactions between objects.	1,1, 1.4, 1.5, 2.1, 2.2, 3.3, 4.1, 4.2, 4.3, 5.1, 6.1, 6.2, 6.4, 7.2
	9. Static Equilibrium Challenge (OI) To determine the mass of a hanging object in a setup with three strings at various angles.	1.1, 1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2
	10. Newton's Second Law (OI) To determine the variation of the acceleration of a dynamics cart in two scenarios: (1) the total mass of the system is kept constant while the net force varies, and (2) the net force is kept constant while the total mass of the system varies. (Vernier 9) (CP 18-20)	1.1, 1.4, 1.5, 2.1, 2.2, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 6.4, 7.2
	11. Coefficient of Friction (OI) To determine the maximum coefficient of static friction between a shoe and a wooden plank. (Vernier 12)	1.1, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2
	12. Atwood's Machine (GI) To determine the acceleration of a hanging mass and the tension in the string. (Vernier 10)	1.1, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2
UNIT 3. CIRCULAR MOTION AND GRAVITATION Chapter 4	13. Flying Toy (GI) To determine the tension in the string and the centripetal acceleration of the flying toy. (CP 35)	1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2
	14. Work Done in Stretching a Spring (GI) To determine the work done on the spring from force-versus-distance graph of the collected data.	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2
	15. Energy and Non-Conservative Forces (GI) To determine the energy dissipated by friction of a system consisting of a modified Atwood's machine.	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 6.5, 7.2
UNIT 5. MOMENTUM	16. The Unbreakable Egg – Impulse and Force	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2,

Chapter 5-6	To measure the change in momentum of a egg and compare it to the impulse received while caught by a sheet.	4.3, 5.1, 5.3, 6.1, 6.4, 7.2
	17. Elastic and Inelastic Collisions (OI) To investigate conservation of momentum and conservation of energy using a dynamic cart to determine the type of collision. (Vernier 18)	1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 6.4, 7.2
	18. Forensic Investigation (OI) Apply principles of conservation of energy, conservation of momentum, the work-energy theorem, and a linear model of friction to find the coefficient of kinetic friction.	1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 6.4, 7.2
UNIT 6. SIMPLE HARMONIC MOTION Chapter 19	19. Finding the Spring Constant (OI) To design two independent experiments to determine the spring constants of various springs of equal length. (CP 49)	1.1, 1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2
	20. Graphs of an Oscillating System (GI) To analyze graphs of position, velocity, and acceleration versus time for an oscillating system to determine how velocity and acceleration vary at the equilibrium position and at the endpoints. (nTippers)	1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2
	21. Simple Pendulum Investigation (OI) To investigate the factors that affect the period of a simple pendulum and test whether the period is proportional to the pendulum's length, the square of its length, or the square root of its length. (CP 69)	1.2, 1.4, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2
UNIT 7. ROTATIONAL MOTION Chapter 7-8	22. Balanced Torques (GI) To determine the relationship between mass and distance from fulcrum to balance torques. (CP 38&40)	1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 6.1, 6.2, 6.4, 7.1, 7.2
	23. Rotational Derby (GI) To observe how round objects of various shapes and masses roll down an incline and how their rotational inertias affect their rate of rotation and predict a winner based on data collected. (CP 41)	1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2
	24. Conservation of Angular Momentum (GI) To investigate how the angular momentum of a rotating system responds to changes in the rotational inertia. (Vernier)	1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2

UNIT 8. MECHANICAL WAVES Chapter 20	25. Mechanical Waves (OI) To model mechanical waves properties of frequency, wavelength and amplitude with a string and speaker set-up.	1.2, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.2, 6.4, 7.2
	26. Speed of Sound (GI) Design two different procedures to determine the speed of sound in air. (CP 72/Vernier 33)	1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2
	27. Wave Boundary Behavior (GI) To compare what happens to the phase of a transverse wave on a spring toy when a pulse is reflected from a boundary and when it is reflected and transmitted from various boundaries (spring to string).	1.4, 3.1, 4.1, 4.2, 4.3, 5.1, 6.1, 6.4, 7.2
	28. Standing Waves (GI) Given a specified tension, students predict the length of the string necessary to generate the first two harmonics of a standing wave on the string. Then they perform the experiment and compare the outcome with their prediction.	1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2
UNIT 9. ELECTROSTATICS Chapter 14	29. Static Electricity Interactions (GI) Students use electroscopes, sticky tape and a variety of objects to make qualitative observations of the interactions when objects are charged, discharged, and recharged. (CP 89-90)	1.2, 3.1, 4.1, 4.2, 5.1, 6.2, 7.2
	30. Coulomb's Law (GI) To estimate the charge on two identical, equally charged spherical pith balls of known mass.	1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2
UNIT 10. DC CIRCUITS Chapter 16	31. Brightness Investigation (GI) To make predictions about the brightness of light bulbs in a variety of series and parallel circuits when some of the bulbs are removed. (CP 91)	1.2, 3.1, 4.1, 4.2, 4.3, 5.3, 6.1, 6.4, 7.2
	32. Voltage and Current (GI) To determine the relationship between the current through a resistor and the voltage across the resistor. (CP /Vernier 22)	1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1, 5.3, 6.1, 6.4, 7.2
	33. Resistance and Resistivity (OI) To investigate the effects of cross-sectional area and length on the flow of current through a roll of Play-Doh.	1.4, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3, 5.1,5.3, 6.1, 6.4, 7.2
	34. Series and Parallel Circuits (OI)	1.1, 1.2, 1.4, 1.5, 2.1, 2.2, 3.1, 4.1, 4.2, 4.3,

	To investigate the behavior of resistors in series, parallel, and series-parallel circuits. The lab should include measurements of voltage and current. (Vernier 23)	5.1, 5.2, 5.3, 6.1, 6.4, 7.2