La Cañada High School

Proposed Course Outline – Advanced Placement Physics 1: Algebra-Based

I. **Course Title – AP Physics 1: Algebra-based**

II. **Grade Level(s) – Grades 11-12**

III. **Length/Credit – 1 Year - 10.0 units Satisfies One Year of Science for graduation credit**

IV. **Preparations –** Grade of "B" or higher in prior Honors level high school science courses or Grade of "A" in prior college preparatory level high school science courses. Completion or concurrent enrollment in LC Math 3 or the equivalent or higher math class.

V. **Course Description**

AP Physics 1 P is an algebra-based, introductory college-level physics course equivalent to the first semester introductory course in algebra-based physics. Students develop their understanding of physics through inquiry-based investigations as they explore these topics: kinematics, dynamics, circular motion and gravitation, energy, momentum, simple harmonic motion, torque and rotational motion, electric charge and electric force, DC circuits, and mechanical waves and sound.

This course requires that 25 percent of the instructional time be spent in hands-on laboratory work, with an emphasis on inquiry-based investigations that provide students with opportunities to demonstrate the foundational physics principles and apply all seven science practices defined in the course framework. This course is proposed as a UC Certified Lab Science.

VI. **Standards/ESLRs Addressed**

Introduction:
Based upon the Understanding by Design model, the AP Physics 1 course framework is organized based upon six "big ideas" of physics. These big ideas encompass core scientific principles, theories, and processes of the discipline. In addition to the big ideas, this course is organized based upon seven science practices which articulate the behaviors in which students need to engage in

order to achieve conceptual understanding in the course. The science practices enable students to establish lines of evidence and use them to develop and refine testable explanations and predictions of natural phenomena. Because content, inquiry, and reasoning are equally important in AP Physics, the learning objectives of the course described in the content outline combines content with inquiry and reasoning skills described in the science practices stated below.

Science Practice 1: The student can use representations and models to communicate scientific phenomena and solve scientific problems.

1.1 The student can create representations and models of natural or man-made phenomena and systems in the domain.
1.2 The student can describe representations and models of natural or man-made phenomena and systems in the domain.
1.3 The student can refine representations and models of natural or man-made phenomena and systems in the domain.
1.4 The student can use representations and models to analyze situations or solve problems qualitatively and quantitatively.
1.5 The student can reexpress key elements of natural phenomena across multiple representations in the domain.

Science Practice 2: The student can use mathematics appropriately.

2.1 The student can justify the selection of a mathematical routine to solve problems.
2.2 The student can apply mathematical routines to quantities that describe natural phenomena.
2.3 The student can estimate numerically quantities that describe natural phenomena.

Science Practice 3: The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course.

3.1 The student can pose scientific questions.
3.2 The student can refine scientific questions.
3.3 The student can evaluate scientific questions.

Science Practice 4: The student can plan and implement data collection strategies in relation to a particular scientific question.

4.1 The student can justify the selection of the kind of data needed to answer a particular scientific question.
4.2 The student can design a plan for collecting data to answer a particular scientific question.
4.3 The student can collect data to answer a particular scientific question.
4.4 The student can evaluate sources of data to answer a particular scientific question.

Science Practice 5: The student can perform data analysis and evaluation of evidence.

5.1 The student can analyze data to identify patterns or relationships.
5.2 The student can refine observations and measurements based on data analysis.
5.3 The student can evaluate the evidence provided by data sets in relation to a particular scientific question.

Science Practice 6: The student can work with scientific explanations and theories.

6.1 The student can justify claims with evidence.
6.2 The student can construct explanations of phenomena based on evidence produced through scientific practices.
6.3 The student can articulate the reasons that scientific explanations and theories are refined or replaced.
6.4 The student can make claims and predictions about natural phenomena based on scientific theories and models.
6.5 The student can evaluate alternative scientific explanations.

Science Practice 7: The student is able to connect and relate knowledge across various scales, concepts, and representations in and across domains.

7.1 The student can connect phenomena and models across spatial and temporal scales.
7. 2 The student can connect concepts in and across domain(s) to generalize or extrapolate in and/or across enduring understandings and/or big ideas.

VII. Brief Course Outline

Content Area 1: Kinematics
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.

Sample of Enduring Understanding (Core concepts that student should retain):
3.A: All forces share certain common characteristics when considered by observers in inertial reference frames.

Sample Learning Objective: 3.A.1.1: The student is able to express the motion of an object using narrative, mathematical, and graphical representations.

Example of Essential Knowledge Statement: 3.A.1: An observer in a particular reference frame can describe the motion of an object using such quantities as position, displacement, distance, velocity, speed, and acceleration.

Content Area 2: Dynamics

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.

Sample of Enduring Understanding (Core concepts that student should retain): 1.A: The internal structure of a system determines many properties of the system.

Sample Learning Objective: 1.A.5.1:The student is able to model verbally or visually the properties of a system based on its substructure and to relate this to changes in the system properties over time as external variables are changed.

Example of Essential Knowledge Statement: 1.A.5: Systems have properties determined by the properties and interactions of their constituent atomic and molecular substructures. In AP Physics, when the properties of the constituent parts are not important in modeling the behavior of the macroscopic system, the system itself may be referred to as an object.

Content Area 3: Circular Motion and Gravitation

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.

Sample of Enduring Understanding (Core concepts that student should retain): 1.C: Objects and systems have properties of inertial mass and gravitational mass that are experimentally verified to be the same and that satisfy conservation principles.

Sample Learning Objective: 1.C.3.1: The student is able to design a plan for collecting data to measure gravitational mass and to measure inertial mass and to distinguish between the two experiments.

Example of Essential Knowledge Statement: 1.C.2: Gravitational mass is the property of an object or a system that determines the strength of the gravitational interaction with other objects, systems, or gravitational fields.

Content Area 4: Energy

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.

Sample of Enduring Understanding (Core concepts that student should retain):
3.E:
A force exerted on an object can change the kinetic energy of the object.

Sample Learning Objective: 3.E.1.1: The student is able to make predictions about the changes in kinetic energy of an object based on considerations of the direction of the net force on the object as the object moves.

Example of Essential Knowledge Statement: 4.C.1: The energy of a system includes its kinetic energy, potential energy, and microscopic internal energy. Examples include gravitational potential energy, elastic potential energy, and kinetic energy.

Content Area 5: Momentum

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.

Sample of Enduring Understanding (Core concepts that student should retain):
3.D: A force exerted on an object can change the momentum of the object.

Sample Learning Objective: 3.D.1.1: The student is able to justify the selection of data needed to determine the relationship between the direction of the force acting on an object and the change in momentum caused by that force.

Example of Essential Knowledge Statement: 3.D.1: The change in momentum of an object is a vector in the direction of the net force exerted on the object.

Content Area 6: Simple Harmonic Motion

Big Idea 3: The interactions of an object with other objects can be described by forces.
Big Idea 5: Changes that occur as a result of interactions are constrained by conservation laws.

Sample of Enduring Understanding (Core concepts that student should retain):
5.B:
The energy of a system is conserved.

Sample Learning Objective: 5.B.2.1: The student is able to calculate the expected behavior of a system using the object model (i.e., by ignoring changes in internal structure) to analyze a situation. Then, when the model fails, the student can justify the use of conservation of energy principles to calculate the change in

internal energy due to changes in internal structure because the object is actually a system.

Example of Essential Knowledge Statement: 5.B.2: A system with internal structure can have internal energy, and changes in a system's internal structure can result in changes in internal energy.

Content Area 7: Torque and Rotational Motion
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.

Sample of Enduring Understanding (Core concepts that student should retain)**:**
3.A:
All forces share certain common characteristics when considered by observers in inertial reference frames.

Sample Learning Objective: 3.A.1.1: The student is able to express the motion of an object using narrative, mathematical, and graphical representations.

Example of Essential Knowledge Statement: 3.A.1: An observer in a particular reference frame can describe the motion of an object using such quantities as position, displacement, distance, velocity, speed, and acceleration.

Content Area 8: Electric Charge and Electric Force

Big Idea 1: Objects and systems have properties such as mass and charge. Systems may have internal structure.
Big Idea 3: The interactions of an object with other objects can be described by forces.
Big Idea 5: Changes that occur as a result of interactions are constrained by conservation laws.

Sample of Enduring Understanding (Core concepts that student should retain): 1.B:
Electric charge is a property of an objector system that affects its interactions with other objects or systems containing charge.

Sample Learning Objective: 1.B.1.1: The student is able to make claims about natural phenomena based on conservation of electric charge.

Example of Essential Knowledge Statement: 1.B.1: Electric charge is conserved. The net charge of a system is equal to the sum of the charges of all the objects in the system.

Content Area 9: DC Circuits

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

Big Idea 5: Changes that occur as a result of interactions are constrained by conservation laws.

Sample of Enduring Understanding (Core concepts that student should retain): 1.B: Electric charge is a property of an object or system that affects its interactions with other objects or systems containing charge.

Sample Learning Objective: 1.B.1.1: The student is able to make claims about natural phenomena based on conservation of electric charge.

Example of Essential Knowledge Statement: 1.B.1: Electric charge is conserved. The net charge of a system is equal to the sum of the charges of all the objects in the system.

Content Area 10: Mechanical Waves and Sound

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.

Sample of Enduring Understanding (Core concepts that student should retain): 6.A: A wave is a traveling disturbance that transfers energy and momentum.

Sample Learning Objective: 6.A.1.1: The student is able to use a visual representation to construct an explanation of the distinction between transverse and longitudinal waves by focusing on the vibration that generates the wave.

Example of Essential Knowledge Statement: 6.A.1:
Waves can propagate via different oscillation modes such as transverse and longitudinal.

VIII. Methods of Assessment

Grades and Class Participation:
All work will be assessed and the students will receive points. Overall grades in the class will be by total percentage: **A=90+ B=80-89 C=70-79 D=60-69**

Grades will be based on daily class assignments, homework, notebook checks, projects, quizzes and tests. Class participation is essential to the learning process; therefore, daily student attendance is essential for course success.

Grades for this class will derive from the following sources:

Exams	**75%**
Labs/Homework/Projects	**25%**

Attendance Policy: Attendance in this course will be treated the same way as it would be treated at a place of employment. If a student is absent, it is the student's responsibility to see the instructor to get "make-up" or "missed" information. Also, if a student is behind, he/she can set up appointment to use the computer lab before or after school, or during STEP, as is mutually agreeable to teacher and student.

Academic Honesty:
Students are expected to demonstrate honesty and integrity at all times. Each student is responsible for his or her own work, which includes test taking, homework, class assignments, individual contributions to group products, and the original creation of digital art, web pages, essays, compositions, and research papers. All work submitted by a student should be a true reflection of that student's knowledge, experience, effort and ability. It is unacceptable academic behavior to submit work that is not one's own. Refer to "Academic Honesty & Integrity" section in your student handbook. The consequences laid out in this section will be strictly adhered to in all incidents of cheating or plagiarism.

IX. Materials/Textbook(s)Physics 5th Edition, Giancoli, 1998; Conceptual Physics, Hewitt, 8th Edition, 1998.

X. **Seeking "a-f" Approval** – Yes – Yes, this course will be submitted to the University of California for approval for the 2018-19 academic year in the subject domain "D" for Laboratory Science.

XI. **Seeking AP Class Approval** – Yes – This course does seek AP approval.