SAN LEANDRO UNIFIED SCHOOL DISTRICT

SECTION A. COURSE DESCRIPTION COVER PAGE

1. Course Title: Advanced Placement Physics 1	6. Prerequisites Algebra II (concurrent enrollment is satisfactory)
2. Action: __X_ New Course ___ Course Revision ___ Title Change Only	7. Grade Level: 10^{th}- 12^{th}
3. Transcript Title/Abbreviation: AP Physics 1	8. Elective/Required: elective
4. Transcript Course Code/Course Number:	9. Subject Area: Physical Science
5. CBEDS Code:	10. Department: Science
11. Length /Credits: ___ 0.5 (half year or semester equivalent) __X_ 1.0 (one year equivalent) ___ 2.0 (two year equivalent)	
12. Was this course previously approved by UC? ___ Yes __X_ No If so, year removed from list: _____	
13. Meets the "__d__" requirements in the a-g university/college entrance requirement. Approval date: _____-	
14. School Contact Information Name: _Sarah Kayler___ Title/Position: __teacher____ Phone: ___510-618-4600 x 2341_____ Fax: ____510-347-1064_____ E-Mail: _____	
15. Signatures: Department Chair: _____ Site Leadership Chair/Site Curriculum Committee Chair: _____ Principal: _____ Other: _____	
16. Date Approved by Board of Education:	

SECTION B. COURSE CONTENT

17. Course Description:

Students explore principles of Newtonian mechanics (including rotational motion); work, energy, and power; mechanical waves and sound; and introductory, simple circuits. The course is based on six Big Ideas, which encompass principles, theories, and processes that cut across traditional boundaries and provide a broad way of thinking about the physical world. The following are the Big Ideas:

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

Twenty-five percent of instructional time is devoted to hands-on laboratory work with an emphasis on inquiry-based investigations. Investigations will require students to ask questions, make observations and predictions, design experiments, analyze data, and construct arguments in a collaborative setting, where they direct and monitor their progress.

18. Course Goals and/or Major Student Outcomes:

Students establish lines of evidence and use them to develop and refine testable explanations and predictions of natural phenomena. The use of scientific inquiry promotes an engaging and rigorous experience for AP Physics students. Such practices require that students:

- Use representations and models to communicate scientific phenomena and solve scientific problems;
- Use mathematics appropriately;
- Engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course;
- Plan and implement data collection strategies in relation to a particular scientific question;
- Perform data analysis and evaluation of evidence;
- Work with scientific explanations and theories; and
- Connect and relate knowledge across various scales, concepts, and representations in and across domains.

19. Course Objectives (standards):

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 *re-express key elements of natural phenomena across multiple representations* in the domain.
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.
3.1 The student can *pose scientific questions.*
3.2 The student can *refine scientific questions.*
3.3 The student can *evaluate scientific questions.*
4.1 The student can *justify the selection of the kind of data* needed to answer a particular scientific question.
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.
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.*
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.

SP = Science Practice LO = NGSS Learning Objective

1. Express the motion of an object using narrative, mathematical, and graphical representations. [LO 3.A.1.1, SP 1.5, SP 2.1, SP 2.2]
2. Design an experimental investigation of the motion of an object. [LO 3.A.1.2, SP 4.2]
3. Analyze experimental data describing the motion of an object and express the results of the analysis using narrative, mathematical, and graphical representations. [LO 3.A.1.3, SP 5.1]
4. Design an experiment for collecting data to determine the relationship between the net force exerted on an object, its inertial mass, and its acceleration. [LO 1.C.1.1, SP 4.2]
5. Design a plan for collecting data to measure gravitational mass and to measure inertial mass, and to distinguish between the two experiments. [LO 1.C.1.3, SP 4.2]
6. Challenge a claim that an object can exert a force on itself. [LO 3.A.3.2, SP 6.1]
7. Apply $F = mg$ to calculate the gravitational force on an object with mass m in a gravitational

field of strength g in the context of the effects of a net force on objects and systems. [LO 2.B.1.1, SP 2.2, SP 7.2]

8. Design a plan to collect and analyze data for motion (static, constant, or accelerating) from force measurements and carry out an analysis to determine the relationship between the net force and the vector sum of the individual forces. [LO 3.B.1.2, SP 4.2, SP 5.1]
9. Create and use free-body diagrams to analyze physical situations to solve problems with motion qualitatively and quantitatively. [LO 3.B.2.1, SP 1.1, SP 1.4, SP 2.2]
10. Analyze a scenario and make claims (develop arguments, justify assertions) about the forces exerted on an object by other objects for different types of forces or components of forces. [LO 3.A.3.1, SP 6.4, SP 7.2]
11. Predict the motion of an object subject to forces exerted by several objects using an application of Newton's second law in a variety of physical situations with acceleration in one dimension. [LO 3.B.1.1, SP 6.4, SP 7.2]
12. Re-express a free-body diagram representation into a mathematical representation and solve the mathematical representation for the acceleration of the object. [LO 3.B.1.3, SP 1.5, SP 2.2]
13. Represent forces in diagrams or mathematically using appropriately labeled vectors with magnitude, direction, and units during the analysis of a situation. [LO 3.A.2.1, SP 1.1]
14. Explain contact forces (tension, friction, normal, buoyant, spring) as arising from interatomic electric forces and that they therefore have certain directions. [LO 3.C.4.2, SP 6.2]
15. Evaluate using given data whether all the forces on a system or whether all the parts of a system have been identified. [LO 4.A.2.2, SP 5.3]
16. Apply Newton's second law to systems to calculate the change in the center-of-mass velocity when an external force is exerted on the system. [LO 4.A.3.1, SP 2.2]
17. Use visual or mathematical representations of the forces between objects in a system to predict whether or not there will be a change in the center-of-mass velocity of that system. [LO 4.A.3.2, SP 1.4]
18. Make predictions about the motion of a system based on the fact that acceleration is equal to the change in velocity per unit time, and velocity is equal to the change in position per unit time. [LO 4.A.2.1, SP 6.4]
19. Create mathematical models and analyze graphical relationships for acceleration, velocity, and position of the center of mass of a system and use them to calculate properties of the motion of the center of mass of a system. [LO 4.A.2.3, SP 1.4, SP 2.2]
20. Use Newton's third law to make claims and predictions about the action-reaction pairs of forces when two objects interact. [LO 3.A.4.2, SP 6.4, SP 7.2]
21. Analyze situations involving interactions among several objects by using free-body diagrams that include the application of Newton's third law to identify forces. [LO 3.A.4.3, SP 1.4]
22. Articulate situations when the gravitational force is the dominant force and when the electromagnetic, weak, and strong forces can be ignored. [LO 3.G.1.1, SP 7.1]
23. Apply $g = GM/r^2$ to calculate the gravitational field due to an object with mass M, where the

field is a vector directed toward the center of the object of mass *M*. [LO 2.B.2.1, SP 2.2]

24. Approximate a numerical value of the gravitational field (g) near the surface of an object from its radius and mass relative to those of the Earth or other reference objects. [LO 2.B.2.2, SP 2.2]
25. Use Newton's law of gravitation to calculate the gravitational force the two objects exert on each other and use that force in contexts other than orbital motion. [LO 3.C.1.1, SP 2.2]
26. Use Newton's law of gravitation to calculate the gravitational force between two objects and use that force in contexts involving circular orbital motion. [LO 3.C.1.2, SP 2.2]
27. Describe and make qualitative and/or quantitative predictions about everyday examples of systems with internal potential energy. [LO 5.B.3.1, SP 2.2, SP 6.4, SP 7.2]
28. Describe and make predictions about the internal energy of everyday systems. [LO 5.B.4.1, SP 6.4, SP 7.2]
29. Model verbally or visually the properties of a system based on its substructure and relate this to changes in the system properties over time as external variables are changed. [LO 1.A.5.1, SP 1.1, SP 7.1]
30. Make quantitative calculations of the internal potential energy of a system from a description or diagram of that system. [LO 5.B.3.2, SP 1.4, SP 2.2]
31. Apply mathematical reasoning to create a description of the internal potential energy of a system from a description or diagram of the objects and interactions in that system. [LO 5.B.3.3, SP 1.4, SP 2.2]
32. Calculate the total energy of a system and justify the mathematical routines used in the calculation of component types of energy within the system whose sum is the total energy. [LO 4.C.1.1, SP 1.4, SP 2.1, SP 2.2]
33. Predict changes in the total energy of a system due to changes in position and speed of objects or frictional interactions within the system. [LO 4.C.1.2, SP 6.4]
34. Set up a representation or model showing that a single object can only have kinetic energy and use information about that object to calculate its kinetic energy. [LO 5.B.1.1, SP 1.4, SP 2.2]
35. Translate between a representation of a single object, which can only have kinetic energy, and a system that includes the object, which may have both kinetic and potential energies. [LO 5.B.1.2, SP 1.5]
36. Calculate changes in kinetic energy and potential energy of a system, using information from representations of that system. [LO 5.B.4.2, SP 1.4, SP 2.1, SP 2.2]
37. 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. [LO 3.E.1.1, SP 6.4, SP 7.2]
38. Use net force and velocity vectors to determine qualitatively whether kinetic energy of an object would increase, decrease, or remain unchanged. [LO 3.E.1.2, SP 1.4]
39. Apply mathematical routines to determine the change in kinetic energy of an object given the forces on the object and the displacement of the object. [LO 3.E.1.4, SP 2.2]
40. Design an experiment and analyze data to examine how a force exerted on an object or

system does work on the object or system as it moves through a distance. [LO 5.B.5.1, SP 4.2, SP 5.1]

41. Design an experiment and analyze graphical data in which interpretations of the area under a force-distance curve are needed to determine the work done on or by the object or system. [LO 5.B.5.2, SP 4.2, SP 5.1]
42. Predict and calculate from graphical data the energy transfer to or work done on an object or system from information about a force exerted on the object or system through a distance. [LO 5.B.5.3, SP 1.4, SP 2.2, SP 6.4]
43. Define open and closed systems for everyday situations and apply conservation concepts for energy, charge, and linear momentum to those situations. [LO 5.A.2.1, SP 6.4, SP 7.2]
44. Make claims about the interaction between a system and its environment in which the environment exerts a force on the system, thus doing work on the system and changing the energy of the system (kinetic energy plus potential energy). [LO 5.B.5.4, SP 6.4, SP 7.2]
45. Predict and calculate the energy transfer to (i.e., the work done on) an object or system from information about a force exerted on the object or system through a distance. [LO 5.B.5.5, SP 2.2, SP 6.4]
46. Make predictions about the changes in the mechanical energy of a system when a component of an external force acts parallel or antiparallel to the direction of the displacement of the center of mass. [LO 4.C.2.1, SP 6.4]
47. Apply the concepts of conservation of energy and the work-energy theorem to determine qualitatively and/or quantitatively that work done on a two-object system in linear motion will change the kinetic energy of the center of mass of the system, the potential energy of the systems, and/or the internal energy of the system. [LO 4.C.2.2, SP 1.4, SP 2.2, SP 7.2]
48. 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, 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. [LO 5.B.2.1, SP 1.4, SP 2.1]
49. Predict the change in momentum of an object from the average force exerted on the object and the interval of time during which the force is exerted. [LO 3.D.2.2, SP 6.4]
50. Analyze data to characterize the change in momentum of an object from the average force exerted on the object and the interval of time during which the force is exerted. [LO 3.D.2.3, SP 5.1]
51. Design a plan for collecting data to investigate the relationship between changes in momentum and the average force exerted on an object over time. [LO 3.D.2.4, SP 4.2]
52. Calculate the change in linear momentum of a two-object system with constant mass in linear motion from a representation of the system (data, graphs, etc.). [LO 4.B.1.1, SP 1.4, SP 2.2]
53. Perform analysis on data presented as a force-time graph and predict the change in momentum of a system. [LO 4.B.2.2, SP 5.1]
54. 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. [LO

3.D.1.1, SP 4.1]

55. Justify the selection of routines for the calculation of the relationships between changes in momentum of an object, average force, impulse, and time of interaction. [LO 3.D.2.1, SP 2.1]
56. Apply mathematical routines to calculate the change in momentum of a system by analyzing the average force exerted over a certain time on the system. [LO 4.B.2.1, SP 2.2]
57. Analyze data to find the change in linear momentum for a constant-mass system using the product of the mass and the change in velocity of the center of mass. [LO 4.B.1.2, SP 5.1]
58. Make qualitative predictions about natural phenomena based on conservation of linear momentum and restoration of kinetic energy in elastic collisions. [LO 5.D.1.1, SP 6.4, SP 7.2]
59. Apply the principles of conservation of momentum and restoration of kinetic energy to reconcile a situation that appears to be isolated and elastic, but in which data indicate that linear momentum and kinetic energy are not the same after the interaction, by refining a scientific question to identify interactions that have not been considered. Solve qualitatively and/or quantitatively for one-dimensional situations and only qualitatively in two-dimensional situations. [LO 5.D.1.2, SP 2.2, SP 3.2, SP 5.1, SP 5.3]
60. Apply mathematical routines appropriately to problems involving elastic collisions in one dimension and justify the selection of those mathematical routines based on conservation of momentum and restoration of kinetic energy. [LO 5.D.1.3, SP 2.1, SP 2.2]
61. Predict the velocity of the center of mass of a system when there is no interaction outside of the system but there is an interaction within the system (i.e., the student simply recognizes that interactions within a system do not affect the center of mass motion of the system and is able to determine that there is no external force. [LO 5.D.3.1, SP 6.4]
62. Design an experimental test of an application of the principle of the conservation of linear momentum, predict an outcome of the experiment using the principle, analyze data generated by that experiment whose uncertainties are expressed numerically, and evaluate the match between the prediction and the outcome. [LO 5.D.1.4, SP 4.2, SP 5.1, SP 5.3, SP 6.4]
63. Classify a given collision situation as elastic or inelastic, justify the selection of conservation of linear momentum and restoration of kinetic energy as the appropriate principles for analyzing an elastic collision, solve for missing variables, and calculate their values. [LO 5.D.1.5, SP 2.1, SP 2.2]
64. Qualitatively predict, in terms of linear momentum and kinetic energy, how the outcome of a collision between two objects changes depending on whether the collision is elastic or inelastic. [LO 5.D.2.1, SP 6.4, SP 7.2]
65. Plan data collection strategies to test the law of conservation of momentum in a two-object collision that is elastic or inelastic and analyze the resulting data graphically. [LO 5.D.2.2, SP 4.1, SP 4.2, SP 5.1]
66. Apply the conservation of linear momentum to a closed system of objects involved in an inelastic collision to predict the change in kinetic energy. [LO 5.D.2.3, SP 6.4, SP 7.2]
67. Analyze data that verify conservation of momentum in collisions with and without an external friction force. [LO 5.D.2.4, SP 4.1, SP 4.2, SP 4.4, SP 5.1, SP 5.3]

68. Calculate the change in linear momentum of a two-object system with constant mass in linear motion from a representation of the system (data, graphs, etc.). [LO 4.B.1.1, SP 1.4, SP 2.2]
69. Analyze data to find the change in linear momentum for a constant-mass system using the product of the mass and the change in velocity of the center of mass. [LO 4.B.1.2, SP 5.1]
70. Predict which properties determine the motion of a simple harmonic oscillator and what the dependence of the motion is on those properties. [LO 3.B.3.1, SP 6.4, SP 7.2]
71. Design a plan and collect data in order to ascertain the characteristics of the motion of a system undergoing oscillatory motion caused by a restoring force. [LO 3.B.3.2, SP 4.2]
72. Analyze data to identify qualitative or quantitative relationships between given values and variables (i.e., force, displacement, acceleration, velocity, period of motion, frequency, spring constant, string length, mass) associated with objects in oscillatory motion to use that data to determine the value of an unknown. [LO 3.B.3.3, SP 2.2, SP 5.1]
73. Construct a qualitative and/or a quantitative explanation of oscillatory behavior given evidence of a restoring force. [LO 3.B.3.4, SP 2.2, SP 6.2]
74. Use representations of the relationship between force and torque. [LO 3.F.1.1, SP 1.4]
75. Compare the torques on an object caused by various forces. [LO 3.F.1.2, SP 1.4]
76. Estimate the torque on an object caused by various forces in comparison to other situations. [LO 3.F.1.3, SP 2.3]
77. Design an experiment and analyze data testing a question about torques in a balanced rigid system. [LO 3.F.1.4, SP 4.1, SP 4.2, SP 5.1]
78. Calculate torques on a two-dimensional system in static equilibrium, by examining a representation or model (such as a diagram or physical construction). [LO 3.F.1.5, SP 1.4, SP 2.2]
79. Model verbally or visually the properties of a system based on its substructure and relate this to changes in the system properties over time as external variables are changed. [LO 1.A.5.1, SP 1.1, SP 7.1]
80. Use representations of the center of mass of an isolated two-object system to analyze the motion of the system qualitatively and semi-quantitatively. [LO 4.A.1.1, SP 1.2, SP 1.4, SP 2.3, SP 6.4]
81. Model verbally or visually the properties of a system based on its substructure and relate this to changes in the system properties over time as external variables are changed. [LO 1.A.5.1, SP 1.1, SP 7.1]
82. Predict the behavior of rotational collision situations by the same processes that are used to analyze linear collision situations using an analogy between impulse and change of linear momentum and angular impulse and change of angular momentum. [LO 3.F.3.1, SP 6.4, SP 7.2]
83. In an unfamiliar context or using representations beyond equations, justify the selection of a mathematical routine to solve for the change in angular momentum of an object caused by torques exerted on the object. [LO 3.F.3.2, SP 2.1]
84. Plan data collection and analysis strategies designed to test the relationship between torques

exerted on an object and the change in momentum of that object. [LO 3.F.3.3, SP 4.1, SP 4.2, SP 5.1, SP 5.3]

85. Describe a representation and use it to analyze a situation in which several forces exerted on a rotating system of rigidly connected objects change the angular velocity and angular momentum of the system. [LO 4.D.1.1, SP 1.2, SP 1.4]
86. Plan data collection strategies designed to establish that torque, angular velocity, angular acceleration, and angular momentum can be predicted accurately when the variables are treated as being clockwise or counterclockwise with respect to a well-defined axis of rotation, and refine the research question based on the examination of data. [LO 4.D.1.2, SP 3.2, SP 4.1, SP 4.2, SP 5.1, SP 5.3]
87. Describe a model of a rotational system and use that model to analyze a situation in which angular momentum changes due to interaction with other objects or systems. [LO 4.D.2.1, SP 1.2, SP 1.4]
88. Plan a data collection and analysis strategy to determine the change in angular momentum of a system and relate it to interactions with other objects and systems. [LO 4.D.2.2, SP 4.2]
89. Use appropriate mathematical routines to calculate values for initial or final angular momentum, or change in angular momentum of a system, or average torque or time during which the torque is exerted in analyzing a situation involving torque and angular momentum. [LO 4.D.3.1, SP 2.2]
90. Plan a data collection strategy designed to test the relationship between the change in angular momentum of a system and the product of the average torque applied to the system and the time interval during which the torque is exerted. [LO 4.D.3.2, SP 4.1, SP 4.2]
91. Do qualitative reasoning with compound objects. Do calculations with a fixed set of extended objects and point masses. [LO 5.E.2.1, SP 2.2]
92. Make qualitative predictions about the angular momentum of a system for a situation in which there is no net external torque. [LO 5.E.1.1, SP 6.4, SP 7.2]
93. Make calculations of quantities related to the angular momentum of a system when the net external torque on the system is zero. [LO 5.E.1.2, SP 2.1, SP 2.2]
94. Describe a model of a rotational system and use that model to analyze a situation in which angular momentum changes due to interaction with other objects or systems. [LO 4.D.2.1, SP 1.2, SP 1.4]
95. Describe or calculate the angular momentum and rotational inertia of a system in terms of the locations and velocities of objects that make up the system. Do qualitative reasoning with compound objects. Do calculations with a fixed set of extended objects and point masses. [LO 5.E.2.1, SP 2.2]
96. 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. [LO 6.A.1.1, SP 6.2]
97. Describe representations of transverse and longitudinal waves. [LO 6.A.1.2, SP 1.2]
98. Use graphical representation of a periodic mechanical wave to determine the amplitude of the wave. [LO 6.A.3.1, SP 1.4]
99. Describe sound in terms of transfer of energy and momentum in a medium and relate the

concepts to everyday examples. [LO 6.A.2.1, SP 6.4, SP 7.2]

100. Explain and/or predict qualitatively how the energy carried by a sound wave relates to the amplitude of the wave, and/or apply this concept to a real-world example. [LO 6.A.4.1, SP 6.4]
101. Design an experiment to determine the relationship between periodic wave speed, wavelength, and frequency and relate these concepts to everyday examples. [LO 6.B.4.1, SP 4.2, SP 5.1, SP 7.2]
102. Use a graphical representation of a periodic mechanical wave (position versus time) to determine the period and frequency of the wave and describe how a change in the frequency would modify features of the representation. [LO 6.B.1.1, SP 1.4, SP 2.2]
103. Use a visual representation of a periodic mechanical wave to determine wavelength of the wave. [LO 6.B.2.1, SP 1.4]
104. Create or use a wave front diagram to demonstrate or interpret qualitatively the observed frequency of a wave, dependent upon relative motions of source and observer. [LO 6.B.5.1, SP 1.4]
105. Use representations of individual pulses and construct representations to model the interaction of two wave pulses to analyze the superposition of two pulses. [LO 6.D.1.1, SP 1.1, SP 1.4]
106. Design a suitable experiment and analyze data illustrating the superposition of mechanical waves (only for wave pulses or standing waves). [LO 6.D.1.2, SP 4.2, SP 5.1]
107. Design a plan for collecting data to quantify the amplitude variations when two or more traveling waves or wave pulses interact in a given medium. [LO 6.D.1.3, SP 4.2]
108. Analyze data or observations or evaluate evidence of the interaction of two or more traveling waves in one or two dimensions (i.e., circular wave fronts) to evaluate the variations in resultant amplitudes. [LO 6.D.2.1, SP 5.1]
109. Analyze data or observations or evaluate evidence of the interaction of two or more traveling waves in one or two dimensions (i.e., circular wave fronts) to evaluate the variations in resultant amplitudes. [LO 6.D.2.1, SP 5.1]
110. Refine a scientific question related to standing waves and design a detailed plan for the experiment that can be conducted to examine the phenomenon qualitatively or quantitatively. [LO 6.D.3.1, SP 2.1, SP 3.2, SP 4.2]
111. Plan data collection strategies, predict the outcome based on the relationship under test, perform data analysis, evaluate evidence compared to the prediction, explain any discrepancy, and, if necessary, revise the relationship among variables responsible for establishing standing waves on a string or in a column of air. [LO 6.D.3.3, SP 3.2, SP 4.1, SP 5.1, SP 5.2, SP 5.3]
112. Calculate wavelengths and frequencies (if given wave speed) of standing waves based on boundary conditions and length of region within which the wave is confined, and calculate numerical values of wavelengths and frequencies. Examples include musical instruments. [LO 6.D.4.2, SP 2.2]
113. Use a visual representation to explain how waves of slightly different frequency give rise to the phenomenon of beats. [LO 6.D.5.1, SP 1.2]

114. Predict properties of standing waves that result from the addition of incident and reflected waves that are confined to a region and have nodes and antinodes. [LO 6.D.3.2, SP 6.4]
115. Describe representations and models of situations in which standing waves result from the addition of incident and reflected waves confined to a region. [LO 6.D.3.4, SP 1.2]
116. Challenge with evidence the claim that the wavelengths of standing waves are determined by the frequency of the source regardless of the size of the region. [LO 6.D.4.1, SP 1.5, SP 6.1]
117. Calculate wavelengths and frequencies (if given wave speed) of standing waves based on boundary conditions and length of region within which the wave is confined, and calculate numerical values of wavelengths and frequencies. Examples include musical instruments. [LO 6.D.4.2, SP 2.2]
118. Make claims about natural phenomena based on conservation of electric charge. [LO 1.B.1.1, SP 6.4]
119. Make predictions, using the conservation of electric charge, about the sign and relative quantity of net charge of objects or systems after various charging processes, including conservation of charge in simple circuits. [LO 1.B.1.2, SP 6.4, SP 7.2]
120. Construct an explanation of the two-charge model of electric charge based on evidence produced through scientific practices. [LO 1.B.2.1, SP 6.2]
121. Challenge the claim that an electric charge smaller than the elementary charge has been isolated. [LO 1.B.3.1, SP 1.5, SP 6.1, SP 7.2]
123. Use Coulomb's law qualitatively and quantitatively to make predictions about the interaction between two electric point charges. [LO 3.C.2.1, SP 2.2, SP 6.4]
124. Connect the concepts of gravitational force and electric force to compare similarities and differences between the forces. [LO 3.C.2.2, SP 7.2]
125. Use Coulomb's law qualitatively and quantitatively to make predictions about the interaction between two electric point charges. [LO 3.C.2.1, SP 2.2, SP 6.4]
126. Make claims about natural phenomena based on conservation of electric charge. [LO 1.B.1.1, SP 6.4]
127. Apply conservation of energy concepts to the design of an experiment that will demonstrate the validity of Kirchhoff's loop rule ($__V = 0$) in a circuit with only a battery and resistors either in series or in, at most, one pair of parallel branches. [LO 5.B.9.2, SP 4.2, SP 6.4, SP 7.2]
128. Design an investigation of an electrical circuit with one or more resistors in which evidence of conservation of electric charge can be collected and analyzed. [LO 5.C.3.2, SP 4.1, SP 4.2, SP 5.1]
129. Choose and justify the selection of data needed to determine resistivity for a given material. [LO 1.E.2.1,SP 4.1]
130. Construct or interpret a graph of the energy changes within an electrical circuit with only a single battery and resistors in series and/or in, at most, one parallel branch as an application of the conservation of energy (Kirchhoff's loop rule). [LO 5.B.9.1, SP 1.1, SP 1.4]
131. Apply conservation of energy (Kirchhoff's loop rule) in calculations involving the total electric potential difference for complete circuit loops with only a single battery and

resistors in series and/or in, at most, one parallel branch. [LO 5.B.9.3, SP 2.2, SP 6.4, SP 7.2]

132. Use a description or schematic diagram of an electrical circuit to calculate unknown values of current in various segments or branches of the circuit. [LO 5.C.3.3, SP 1.4, SP 2.2]
133. Apply conservation of energy (Kirchhoff's loop rule) in calculations involving the total electric potential difference for complete circuit loops with only a single battery and resistors in series and/or in, at most, one parallel branch. [LO 5.B.9.3, SP 2.2, SP 6.4, SP 7.2]
134. Apply conservation of electric charge (Kirchhoff's junction rule) to the comparison of electric current in various segments of an electrical circuit with a single battery and resistors in series and in, at most, one parallel branch and predict how those values would change if configurations of the circuit are changed. [LO 5.C.3.1, SP 6.4, SP 7.2]

20. Course Outline:

Unit 1 Kinematics (Motion in one and two dimensions) **- 5 Weeks**:

Labs: Graph Matching – A student moves in front of a motion sensor to match pre –made graphs with various position, velocity, and acceleration.
Dynamics Cart/Track – Students use Vernier carts and tracks with photo-gates, pulleys and masses to measure and observe both accelerated and constant motion.
Acceleration due to Gravity – Students use photo-gates and picket fences to measure the acceleration due to gravity.
Projectiles — Students launch projectiles horizontally, both measuring and calculating the expected landing point.

Unit 2 Newton's Laws (Forces) **- 5 Weeks**:

Labs: Force and accelerated motion – Student measure and test Newton's Laws using dynamics carts and force probes. Students use a motion detector to determine 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.
Static equilibrium — Students hang 3 masses over pulleys connected to the same point. Calculating and measuring the correct angles that produce static equilibrium.
Atwood Machine — Students investigate the acceleration of 2 masses connected by a string that runs over a pulley.
Friction – Using various blocks on an incline with an adjustable angle, students explore the properties of friction.

Unit 3 Work, Energy, Power and Momentum - 7 Weeks:

Impulse and Momentum – Using dynamics carts on tracks students measure momentum change and impulse. They investigate elastic and inelastic collisions with various masses.
Rollercoaster – Students construct a marble track rollercoaster. They use photo gates to measure the final speed of their marble. Using initial height,

final speed, conservation of energy, and angular momentum they analyze the system.

Unit 4 Gravitation and Uniform Circular motion - 2 Weeks:

Labs: Centripetal Force – Students twirl a mass on a string. The string runs through a small tube and supports a mass at the end. Students measure and calculate the radius, angular speed and centripetal force.

Unit 5 Torque and Rotational Motion - 4 weeks:

Labs: Balancing a Seesaw — students calculate where to place masses on a meterstick to make it balance horizontally.
Leaning Ladder — Students simulate a ladder leaning against a wall with a person on it, answering the question, how high can the person climb before the ladder slips both mathematically and experimentally

Simple Harmonic Motion, Waves, Sound - 4 weeks:

Labs: Pendulums – Students measure various pendulums to determine the relationship between period, length, mass, and amplitude.
Pulses in a Ripple Tank - Students will observe the behavior of pulses in a ripple tank, determine what relationship exists between the angle of incidence and the angle of reflection (The Law of Reflection), and observe the diffraction and interference of waves.
Speed of Sound — Students measure the speed of sound using an adjustable length tube and a tuning fork.

Electrostatics and DC circuits - 4 Weeks:

Labs: Electrostatics – Students explore charges on pith balls, electroscopes, and use a Van de Graff generator.
Circuits – Students do a series of experiments making and analyzing circuits with various components using voltmeters and ammeters to measure potential and current.

AP Physics Exam - May

Physics Project – final weeks of class

Mousetrap Cars, Catapults, Rockets, Ruth-Goldberg devices, Physicist Biographies

21. Instructional Materials:

Required Text(s):
Title: College Physics
Publisher: Serway and Vuille
Edition/Copyright Date: 9th Edition 2012

Supplementary materials (include Title, Publisher, Edition/Copyright Date if appropriate): Verneir Lab Equipment, including dynamics carts, photo-gates, force sensors, motion sensors, ect.

22. Instructional Methods and/or Strategies
This course focuses on the application of mathematics in the field of physical science. Class time consists of lecture, demonstration, lab work, and problem solving 5 hours/week. Students do lab work every week, making up a minimum of 25% of class time. Students are evaluated by their performance on weekly problem sets, weekly lab reports, bi-weekly quizzes, unit exams, and a semester final exam.

23. Assessment and Evaluation
Students will be assessed on the basis of the following categories:

10%: Problem sets
25%: Laboratory Reports
55%: Tests, Quizzes, and the Final Exam
10%: Project (see examples above)

24. Grading Policy
Analysis of Laboratory Work and in Class Exams will make majority of grade. Homework and Class Participation will also be factored in. The AP Exam will also be considered.

25. Fiscal Impact
a) Replacement Textbooks - $165
b) Estimated number of Sections - 2
c) Estimated number of students per section - 30
d) Estimated textbook expenses - possibly none since we have 60 books already
e) Teacher Stipend, if appropriate - $2400
f) Lab Materials - $500
g) Total Estimated Expenditures = $2900

26. Context for offering the course:
This course will add another opportunity for high school students to get a head start on college-level work, hence broaden their intellectual horizons and stand out in the college admissions process. This course will give them an opportunity to explore the natural world. This is an ideal course for students considering careers in science or engineering.

SAN LEANDRO UNIFIED SCHOOL DISTRICT

Instructions for Completing the New Course Description Form

SECTION A.		
Item #	**Title**	**Directions**
1	Course Title	Record the title of the new course
2	Action	Check the appropriate space to indicate the type of action being requested
3	Transcript Title	TO BE COMPLETED BY EDUCATIONAL SERVICES
4	Course Code	TO BE COMPLETED BY EDUCATIONAL SERVICES
5	CBEDS Code	TO BE COMPLETED BY EDUCATIONAL SERVICES
6	Grade Level	Indicate the grade level of the students who are to be enrolled in the course
7	Elective/Required	Circle whether the course is an elective or required
8	Prerequisite(s)	Indicate prerequisite skills needed in order to be enrolled in the course
9	Subject Area	Indicate the subject area of the course
10	Department	Indicate the department from which the course is being offered
11	Length/Credits	Indicate the credits to be assigned upon successful completion of the course
12	UC approved	Indicate if the course has been UC approved at any point in time, if removed from the list, indicate date of removal
13	A-G Requirement	Indicate which A-G requirement the course fulfills, including the approval date
14	School Contact Information	Record all contact information of individual to be contacted in the event that questions arise
15	Signatures	Include ALL appropriate signatures
16	Board Approval Date	Record the date that the course was approved by the Board of Education

SECTION B. COURSE CONTENT		
Item #	***Title***	***Directions***
17	Course Description	Provide a sufficient detail to clearly define and describe the course, enumerate the broad concepts covered within the scope and sequence of the written curriculum
18	Course Goals and/or Major Student Outcomes	List the course goals and/or major student outcomes for this course (major strands addressed from grade level/content standards).
19	Course Objectives	State course objectives in terms of what the students will know and be able to do as a result of successful completion of the course (essential standards within each strand/substrand). This list should include the SLUSD essential standards and benchmarks and should not be simply a listing of all subject area content standards. It is expected that thoughtful consideration will be given to the listing of standards and that instruction will provide for both depth and complexity of learning objectives.
20	Course Outline	This section provides scope and sequence details including a timeline (or pacing schedule) of course topics by grading period. Each unit of instruction should include an ordered sequence of topics addressed, planned assessments, alignment to content standards is expected and should be obvious when looking at the list of units/topics. Do not list content standards here.
21	Instructional Materials	Provide an accurate list of both required instructional materials (Board approved core materials) and supplemental materials including the names of all textbooks, novels, or other curricular materials to be used directly with the students. Include Title, Publisher, Edition, and Copyright
22	Instructional Methods and/or Strategies	Instructional methodologies and strategies should include a wide range of appropriate teacher techniques designed to meet the needs of diverse learners. The focus here is on what the teacher will do to organize content and deliver it to students. For example, note taking is not an instructional strategy, but a learning strategy used by the students to develop a better understanding of key ideas presented in course material. A statement should be included here to address how the teacher

		will differentiate instruction for special needs populations, specifically, special education students, English learner students, and those students most at risk of not meeting course objectives.
23	Assessment	Assessment and evaluation must be focused on academic factors: the observable and measurable acquisition of academic content. Non-Academic factors (like class participation, effort, conduct) should not be part of the academic assessment of students.
24	Grading Policy	Include the basis for assigning grades (the policy must be aligned to the District's grading policy).
25	Fiscal Impact	Must include any impact to General Fund or non-site based categoricals (including instructional materials, supplementary materials, lab, stipends, etc.)
26	Context for offering the course	Include here any additional information regarding by there is a desire to offer this new course, i.e. is it meeting some identified student interest or specific need that is not being met through current course offerings.