Course Title: AP Physics
Board Approval Date: 07/21/14
Credit / Hours: 1 credit

Course Description:

AP Physics focuses on mastery of the PA Academic Standards for Science and Technology and is the equivalent of a second-semester college course in algebra-based physics. As students progress through physics, they will participate in a systematic study of fluid mechanics; thermodynamics; electricity and magnetism; optics; and atomic and nuclear physics.

Physics is the branch of science that studies the physical world. In particular, physics explores the interactions of matter and energy. Physics is a math-intensive subject in which physical phenomena are explained by mathematical relationships. Wherever possible, demonstrations and lab exercises reinforce understanding and show the application of physics principles in everyday life. A broad objective for this course is to heighten awareness of the scientific happenings of the world and to promote critical thinking and problem solving skills.

Learning Activities / Modes of Assessment:

Large group instruction	Tests and Quizzes
Laboratory experiments	Checklists / Teacher Observation
Small group work	Projects with Rubrics
Computer simulations / Video Analysis	Lab Reports / Write-ups
Reading assignments	Writing / essays

Instructional Resources:

Physics (3rd edition), by Giancoli
Logger Pro software
Interactive Physics software
Excel, Powerpoint, Word
Moodle
eInstruction software
Phet online physics simulations
Sustainable Energy – Without the Hot Air, ebook by David MacCay
Google Docs
Discovery Education video services
Central Columbia School District Educational Video Library
Short video clips from movies for video analysis
Various instructional videos and educational websites

Course Pacing Guide

Course: **AP Physics**

Course Unit (Topic)	**Length of Instruction (Days/Periods)**
1. Lab Practices and Data Analysis	10 days
2. Fluids	22 days
3. Thermodynamics	22 days
4. Electrostatics	22 days
5. Electric Current	22 days
6. Magnetism	22 days
7. Waves and Optics	22 days
8. Modern Physics	22 days
DAYS TOTAL	164 Days

Topic: 01 - Lab Practices and Data Analysis
Days: 10
Subject(s):
Grade(s):

Know:	Understand:	Do:
How to collect data and express uncertainty. Create graphical representations of data including best line fits. Use statistics to analyze data. Equations including the formula for standard deviation and slope. Terms such as best fit, uncertainty, significant digits, standard deviation,	Clearly expressed research and experimentation are fundamental to the scientific inquiry process.	CC.3.6.11-12.F. - Conduct short as well as more sustained research projects to answer a question (including a selfgenerated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. CC.3.6.11-12.G. - Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. CC.3.6.11-12.H. - Draw evidence from informational texts to support analysis reflection, and research.

Topic: 02 - Fluids
Days: 22
Subject(s): Science
Grade(s): 11th, 12th

Know:	Understand:	Do:
Terms including: Pressure, Pascal's Principle, buoyancy, Bernoulli's Principle, lift, Archimedes' Principle, gas laws, adhesion, cohesion, capillary action equations relating to pressure at depth P = patm + densityxgxdepth, Bernoulli Equation (continuity of flow), gas law equations PV = nRT	Fluids can exert forces and be used to do work.	**3.2.P.B2.a – Essential** ENERGY STORAGE AND TRANSFORMATIONS: CONSERVATION LAWS - Explain the translation and simple harmonic motion of objects using conservation of energy and conservation of momentum. HS-PS3-3. - Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

Topic: 03 - Thermodynamics
Subject(s): Science
Days: 22
Grade(s): 11th, 12th

Know:	Understand:	Do:
S11.A.3.1.4 – Important Apply the universal systems model of inputs, processes, outputs, and feedback to a working system (e.g., heating systems, motor, food production) and identify the resources necessary for operation of the system. **S11.D.2.1.1 – Compact** Describe how changes in concentration of minor components (e.g., O2, CO2, ozone, dust, pollution) in Earth's atmosphere are linked to climate change. **S11.D.2.1.2 – Compact** Compare the transmission, reflection, absorption, and radiation of solar energy to and by the Earth's surface under different environmental conditions (e.g., major volcanic eruptions, greenhouse effect, reduction of ozone layer; increased global cloud cover) **3.2.C.B3.a – Important** HEAT/HEAT TRANSFER - Describe the law of conservation of energy. Terms relating to heat energy including: heat, temperature, calorimetry, conduction, convection, radiation, heat capacity, entropy, heat pump, heat engine,	Heat is transferred by a variety of means and can be used to do work.	**3.2.P.B3. – Essential** HEAT/HEAT TRANSFER - Analyze the factors that influence convection, conduction, and radiation between objects or regions that are at different temperatures. **3.2.10.B3.b – Important** HEAT/HEAT TRANSFER - Analyze the processes of convection, conduction, and radiation between objects or regions that are at different temperatures. **3.4.10.C2. – Essential** ENGINEERING DESIGN - Analyze a prototype and/or create a working model to test a design concept by making actual observations and necessary adjustments. 11-12.W.H/S.7 - Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. 3.2.C.B2. - ENERGY STORAGE AND TRANSFORMATIONS: CONSERVATION LAWS - Explore the natural tendency for systems to move in a direction of disorder or randomness (entropy). 3.2.C.B3.a - HEAT/HEAT TRANSFER - Describe the law of conservation of energy. 9-10.R.S.7 - Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. HS-PS3-2. - Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects). HS-PS3-4. - Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more

Topic: 03 - Thermodynamics
Days: 22
Subject(s): Science
Grade(s): 11th, 12th

Know:	Understand:	Do:
insulator, conductor, isothermal, isobaric, adiabatic, isovolumetric Concepts including:the Laws of Thermodynamics, calorimetry, methods of heat transfer, interpreting PV diagrams, Carnot cycle Formulas including: Q=mCdeltaT, Q=mL, efficiency		uniform energy distribution among the components in the system (second law of thermodynamics).

Topic: 04 - Electrostatics
Days: 22
Subject(s): Science
Grade(s): 11th, 12th

Know:	Understand:	Do:
3.2.P.B2.c – Important ENERGY STORAGE AND TRANSFORMATIONS: CONSERVATION LAWS - Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion. **S11.C.2.1.4 – Essential** Use Ohm's Law to explain resistance, current and electro-motive forces. Terms relating to electricity and magnetism including: resistance, voltage, current, electrostatic, electomagnetic induction, potential difference, charge, conductor, insulator, semiconductor, kilowatt-hour, solenoid, paramagnetism, ferromagnetism, diamagnetism, solenoid, induction Equations including: F = kq1q2/r^2, F=Eq, V=Ed, I=V/R, P=IV, E=Pt Concepts including: electrostatics, circuits, electricity in everyday life, magnetism in general, electromagnetism, electromagnetic induction	Electrical and magnetic forces are caused by charged particles and can be used in many applications.	**3.2.P.B4.a – Important** ELECTRICAL AND MAGNETIC ENERGY - Explain how stationary and moving particles result in electricity and magnetism. **3.2.P.B4.b – Essential** ELECTRICAL AND MAGNETIC ENERGY - Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. **S11.C.2.1.4 – Essential** Use Ohm's Law to explain resistance, current and electro-motive forces. **S11.C.3.1.4 – Essential** Describe electricity and magnetism as two aspects of a single electromagnetic force. 3.2.P.B2.c - ENERGY STORAGE AND TRANSFORMATIONS: CONSERVATION LAWS - Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion. 3.2.C.B4.c - ELECTRICAL AND MAGNETIC ENERGY - Explain how electrical induction is applied in technology. 9-10.R.S.3 - Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

Topic: 05 - Electric Current
Days: 22
Subject(s): Science
Grade(s): 11th, 12th

Know:	Understand:	Do:
3.2.P.B2.c – Important ENERGY STORAGE AND TRANSFORMATIONS: CONSERVATION LAWS - Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion. **S11.C.2.1.4 – Essential** Use Ohm's Law to explain resistance, current and electro-motive forces. Terms relating to electricity and magnetism including: resistance, voltage, current, electrostatic, electomagnetic induction, potential difference, charge, conductor, insulator, semiconductor, kilowatt-hour, solenoid, paramagnetism, ferromagnetism, diamagnetism, solenoid, induction Equations including: F = kq1q2/r^2, F=Eq, V=Ed, I=V/R, P=IV, E=Pt Concepts including: electrostatics, circuits, electricity in everyday life, magnetism in general, electromagnetism, electromagnetic induction	Electrical circuits can be affected by the presence of voltage sources, resistors and capacitors.	**3.2.P.B4.a – Important** ELECTRICAL AND MAGNETIC ENERGY - Explain how stationary and moving particles result in electricity and magnetism. **3.2.P.B4.b – Essential** ELECTRICAL AND MAGNETIC ENERGY - Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. **S11.C.2.1.4 – Essential** Use Ohm's Law to explain resistance, current and electro-motive forces. **S11.C.3.1.4 – Essential** Describe electricity and magnetism as two aspects of a single electromagnetic force. 3.2.P.B2.c - ENERGY STORAGE AND TRANSFORMATIONS: CONSERVATION LAWS - Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion. 3.2.C.B4.c - ELECTRICAL AND MAGNETIC ENERGY - Explain how electrical induction is applied in technology. 9-10.R.S.3 - Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

Topic: 06 - Magnetism
Days: 22
Subject(s): Science
Grade(s): 11th, 12th

Know:	Understand:	Do:
3.2.P.B2.c – Important ENERGY STORAGE AND TRANSFORMATIONS: CONSERVATION LAWS - Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion. **S11.C.2.1.4 – Essential** Use Ohm's Law to explain resistance, current and electro-motive forces. Terms relating to electricity and magnetism including: resistance, voltage, current, electrostatic, electomagnetic induction, potential difference, charge, conductor, insulator, semiconductor, kilowatt-hour, solenoid, paramagnetism, ferromagnetism, diamagnetism, solenoid, induction Equations including: F = kq1q2/r^2, F=Eq, V=Ed, I=V/R, P=IV, E=Pt Concepts including: electrostatics, circuits, electricity in everyday life, magnetism in general, electromagnetism, electromagnetic induction	Electrical and magnetic forces are caused by charged particles and can be used in many applications.	**3.2.P.B4.a – Important** ELECTRICAL AND MAGNETIC ENERGY - Explain how stationary and moving particles result in electricity and magnetism. **3.2.P.B4.b – Essential** ELECTRICAL AND MAGNETIC ENERGY - Develop qualitative and quantitative understanding of current, voltage, resistance, and the connections among them. **S11.C.2.1.4 – Essential** Use Ohm's Law to explain resistance, current and electro-motive forces. **S11.C.3.1.4 – Essential** Describe electricity and magnetism as two aspects of a single electromagnetic force. 3.2.P.B2.c - ENERGY STORAGE AND TRANSFORMATIONS: CONSERVATION LAWS - Explain how gravitational, electrical, and magnetic forces and torques give rise to rotational motion. 3.2.C.B4.c - ELECTRICAL AND MAGNETIC ENERGY - Explain how electrical induction is applied in technology. 9-10.R.S.3 - Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

Topic: 07 - Waves and Optics
Days: 22
Subject(s): Science
Grade(s): 11th, 12th

Know:	Understand:	Do:
S11.C.2.1.1 – Essential Compare or analyze different types of waves in the electromagnetic spectrum (e.g., ultraviolet, infrared, visible light, x-rays, microwaves) as it relates to their properties, energy levels, and motion. Terms relating to waves including: amplitude, period, frequency, wavelength, diffraction, interference, refraction, reflection, polarization, Doppler effect, resonance, focal length, convex, concave, converging, diverging, index of refraction Equations including: v=f x wavelength, Snell's law, thin lens equation, diffraction equation, inverse square law, Doppler equation Concepts include: Waves, forms of electromagnetic radiation, properties of light, human vision, diffraction and interference, reflection, refraction, lenses and mirrors	The properties of waves makes them useful for a variety of purposes.	**S11.C.2.1.1 – Essential** Compare or analyze different types of waves in the electromagnetic spectrum (e.g., ultraviolet, infrared, visible light, x-rays, microwaves) as it relates to their properties, energy levels, and motion. **3.2.P.B5.c – Essential** NATURE OF WAVES (SOUND AND LIGHT ENERGY) - Describe the causes of wave frequency, speed, and wave length. 3.2.C.B5.a - NATURE OF WAVES (SOUND AND LIGHT ENERGY) - Explain how waves transfer energy without transferring matter. 3.2.P.B5.b - NATURE OF WAVES (SOUND AND LIGHT ENERGY) - Explain how waves carry information from remote sources that can be detected and interpreted.

Topic: 08 - Modern Physics
Days: 22
Subject(s): Science
Grade(s): 11th, 12th

Know:	Understand:	Do:
Concepts and terms including: Standard Model of Particles and interactions including families of matter, quarks, and forces; mass/energy equivalence; wave/ particle duality; quantum model of electromagnetic spectra; Planck's Law; de Broglie wavelength; double-slit experiment equations including: E=hf; E=mc2, v=fL, L = h/p	Einstein's relativity and quantum models are used to understand the behavior of interactions on an atomic scale.	HS-PS1-8. - Develop models to illustrate the changes in the compositio n of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay. HS-PS3-1. - Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. HS-PS4-1. - Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. HS-PS4-3. - Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other. HS-PS4-4. - Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. HS-PS4-5. - Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.