SAMPLE SYLLABUS #1

AP® Physics 2

Curricular Requirements

CR1	Students and teachers have access to college-level resources, including a college-level textbook and reference materials in print or electronic format.	*See page:* 2
CR2	The course provides opportunities to develop student understanding of the required content outlined in each of the units described in the AP Physics 2 Course and Exam Description.	*See page:* 2
CR3	The course provides opportunities for students to develop the skills related to Science Practice 1: Creating Representations.	*See page:* 3
CR4	The course provides opportunities for students to develop the skills related to Science Practice 2: Mathematical Routines.	*See page:* 3
CR5	The course provides opportunities for students to develop the skills related to Science Practice 3: Scientific Questioning & Argumentation.	*See page:* 3
CR6	Students spend a minimum of 25% of instructional time engaged in hands-on laboratory investigations.	*See page:* 4
CR7	Students engage in hands-on laboratory investigations representative of the topics outlined in the AP Physics 2 Course and Exam Description.	*See page:* 4, 5
CR8	The course provides opportunities for students to record evidence of their scientific investigations in a portfolio of lab reports or a lab notebook (print or digital format).	*See page:* 4

Advanced Placement Physics 2 Sample Syllabus #1

Instructional Strategies

The **AP® Physics 2** 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.

Textbook provided on the AP Course Audit form. **CR1**

Course Outline

All the content in the current AP Physics 2 Course and Exam Description will be covered in this course. **CR2**

Unit	Textbook Chapter(s)
9 Thermodynamics	**Gases:** Temperature, ideal gas law, speed distribution, kinetic theory
	First Law of Thermodynamics: internal energy, heating and work, PV diagrams, gas processes, specific heat, heating mechanisms
	Second Law of Thermodynamics: irreversible processes, entropy
10 Electric Force, Field, and Potential	**Electric Charge, Force, and Energy:** electrostatic interactions, conductors and insulators, Coulomb's law, electric potential energy
	The Electric Field: electric field, electric potential, capacitors
11 Electric Circuits	**DC Circuits:** electric current, DC circuits, Ohm's law, power, Kirchhoff's rules, RC circuits, resistivity
12 Magnetism and Electromagnetism	**Magnetism:** magnetic interactions, magnetic field, magnetic forces
	Electromagnetic Induction: magnetic flux, Faraday's law, Lenz's law, motional emf
13 Geometric Optics	**Reflection and Refraction:** reflection, refraction, Snell's law, total internal reflection
	Mirrors and Lenses: image formation by mirrors and lenses, mirror equation, thin lens equation
14 Waves, Sound, and Physical Optics	**Mechanical Waves:** mathematical description of a wave, wave interference, superposition, sound, Doppler effect, standing waves
	Wave Optics: Young's double-slit experiment, diffraction gratings, thin-film interference
	Electromagnetic Waves: electromagnetic spectrum, polarization, mathematical description of waves

CR2
The syllabus must include an outline of course content by unit title to demonstrate the inclusion of the required course content listed in the current AP Physics 2 Course and Exam Description.

Unit	Textbook Chapter(s)
15 Modern Physics	**Quantum Optics:** blackbody radiation, photoelectric effect, De Broglie wavelength
	Atomic Physics: early atomic models, Bohr's model, spectral analysis
	Nuclear Physics: radioactivity, half-life, nuclear force and binding energy, nuclear reactions, radioactive decay

THE SCIENCE PRACTICES

Science Practice 1 CR3

ACTIVITY: Thermodynamic Processes

In this activity, the students analyze thermodynamic processes. First they model the system as an ideal gas, determine whether any interactions of the environment with the system are relevant, and draw an energy bar chart to help visualize and apply the first law of thermodynamics. The students use the information given to draw a PV (pressure vs. volume) graph to represent the processes and use the mathematical model of the first law of thermodynamics to solve for the unknown quantities.

CR3
The syllabus must include a section labeled "Science Practice 1" describing one assignment, activity, or lab where students create representations that depict physical phenomena.

Science Practice 2 CR4

ACTIVITY: Electric Field

When solving a problem involving the electric field due to multiple electric charges, the students first sketch an electric field vector diagram to help them determine the x and y-components of the electric field. Students perform the component vector addition method and use the Pythagorean theorem to calculate the magnitude of the net electric field.

CR4
The syllabus must include a section labeled "Science Practice 2" describing one assignment, activity, or lab where students use mathematical routines.

Science Practice 3 CR5

LAB INVESTIGATION: Capacitance of a Parallel Plate Capacitor

The students design a simple capacitor with aluminum foil, a textbook, wires, and a capacitance meter to determine the factors that affect the capacitance of a parallel plate capacitor. The students plan a data collection strategy to determine the following:

a. Relationship between capacitance and area

b. Relationship between capacitance and plate separation

The students create graphs of the data obtained and analyze the graphs to determine the relationships between capacitance and area, and capacitance and plate separation. After writing their claims, each team presents their results to the class. As a result of the scientific argumentation process, students are able to make revisions as appropriate. As an extension to this lab investigation, the students use their data to determine the dielectric constant of the textbook paper.

CR5
The syllabus must include a section labeled "Science Practice 3" describing one assignment, activity, or lab where students design experimental procedures, and make and justify claims.

Laboratory Investigations

The AP Physics 2 course devotes over 25% of the time to laboratory investigations. The laboratory component of the course allows the students to demonstrate the three science practices through a variety of hands-on investigations in all of the units of study. CR6 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 report all of the lab investigations in a laboratory journal. CR8

Unit	Lab Investigation Objective(s) CR7
9 Thermodynamics	**1. Gas Laws** To verify the relationships between pressure, temperature, and volume of a gas (air).
	2. Thermal Conductivity To determine the thermal conductivity of a material by comparing the difference in temperature across one material to the difference in temperature across a second material of known thermal conductivity.
	3. Heat Engine To determine how the work done by an engine to raise an object of mass m during each of its cycles is related to the area enclosed by its PV graph.
10 Electric Force, Field, and Potential	**4. The Electroscope** To make qualitative observations of the behavior of an electroscope when it is charged by conduction and by induction.
	5. Coulomb's Law To estimate the net charge on identical spherical pith balls by measuring the deflection (angle and separation) between two equally charged pith balls.
	6. Electric Field and Equipotentials To map equipotential isolines around charged conducting electrodes painted with conductive ink and construction of isolines of electric fields.
11 Electric Circuits	**7. Resistance and Resistivity** To explore the microscopic and macroscopic factors that influence the electrical resistance of conducting materials. Students will investigate how geometry affects the resistance of an ionic conductor using conductive dough and determine the resistivity of the conductor.
	8. DC Circuits This investigation consists of two parts: **Brightness** To make predictions about the brightness of light bulbs in a variety of DC circuit configurations (series, parallel, and series-parallel) when some of the bulbs are removed. **Resistors** To investigate the behavior of resistors in series, parallel, and series-parallel DC circuits. The lab includes measurements of currents and potential differences.
	9. Capacitance To design a simple parallel plate capacitor to determine the factors that affect the capacitance of a capacitor and determine the capacitance of paper.
	10. RC Circuits: Resistors and Capacitors This investigation consists of two parts: a. An observational experiment where the students make qualitative descriptions of the charging and discharging of a capacitor. b. An investigation of the behavior of resistors in a series-parallel combination with a capacitor in series. The investigation includes measurement of currents and potential differences.

CR6
The syllabus must include an explicit statement that at least 25% of instructional time is spent engaged in hands-on laboratory investigations, with an emphasis on inquiry-based labs.

CR8
The syllabus must include an explicit statement that students are required to maintain a lab notebook or portfolio (hard copy or electronic) that includes all their lab reports.

CR7
The syllabus must include a title and brief description for each laboratory investigation. The labs listed should be representative of the topics outlined in the AP Physics 2 Course and Exam Description.

Unit	Lab Investigation Objective(s) CR7
12 Magnetism and Electromagnetism	**11. Magnetic Field of the Earth** To measure the horizontal component of the Earth's magnetic field using a solenoid and a compass.
	12. Magnetic Force on a Current-Carrying Wire To determine the magnitude and direction of the magnetic force exerted on a current-carrying wire.
	13. Electromagnetic Induction To move a bar magnet in and out of a solenoid and observe the deflection of the galvanometer. Students examine the effects of a changing magnetic field by observing currents induced in a solenoid and determine whether the observations agree with the theory of electromagnetic induction and Lenz's law.
13 Geometric Optics	**14. Reflection** To design an investigation to answer the following question: Are there any patterns in the way plane mirrors and curved mirrors reflect light?
	15. Concave Mirrors This investigation has two parts: • To determine the focal length of a concave mirror. • To determine two locations where a magnified image can be formed using a concave mirror.
	16. Index of Refraction and Total Internal Reflection To determine the index of refraction of an acrylic block and the critical angle when the block is submerged in an aquarium tank full of water.
14 Waves, Sound, and Physical Optics	**17. Speed of Sound** To design two different procedures to determine the speed of sound in air.
	18. Standing Waves To predict the length of the string necessary to generate the first two harmonics of a standing wave on the string, given a specified tension. Students then perform the experiment and compare the outcome with their prediction.
	19. Double-Slit Interference and Diffraction This investigation has three parts: • To determine the wavelength of a green laser using a double slit. • To apply the results of the previous experiment to predict the location of bright and dark fringes when a red laser of known wavelength is used. • To determine the spacing in a diffraction grating using either the green or the red laser.
15 Modern Physics	**20. Spectroscopy** To use a quantitative analysis spectroscope to analyze flame tests and spectrum tubes.
	21. Photoelectric Effect To determine Planck's constant from data collected from a circuit with an LED color strip.
	22. Radioactive Decay and Half-Life To simulate radioactive decay and determine half-life.

CR7
The syllabus must include a title and brief description for each laboratory investigation. The labs listed should be representative of the topics outlined in the AP Physics 2 Course and Exam Description.