SAMPLE SYLLABUS #1

AP® Physics C: Electricity and Magnetism

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 C: Electricity and Magnetism 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:* 4
CR4	The course provides opportunities for students to develop the skills related to Science Practice 2: Mathematical Routines.	*See page:* 4
CR5	The course provides opportunities for students to develop the skills related to Science Practice 3: Scientific Questioning & Argumentation.	*See page:* 4
CR6	Students spend a minimum of 25% of instructional time engaged in hands-on laboratory investigations.	*See page:* 5
CR7	Students engage in hands-on laboratory investigations representative of the topics outlined in the AP Physics C: Electricity and Magnetism Course and Exam Description.	*See page:* 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:* 5

Advanced Placement Physics C: Electricity and Magnetism Sample Syllabus #1

Textbook provided on the AP Course Audit form. CR1

All topics in the current AP® Physics C: Electricity and Magnetism Course and Exam Description will be covered in this course. CR2

- Ch. 22 Electric Interactions
  - Charge Characteristics
    - Charge carriers
    - Charged objects (positive, negative, neutral)
    - Charge polarization
    - Charge mobility
      - Charging by contact
      - Charging by induction
  - Coulomb's Law

- Ch. 23 The Electric Field
  - The Electric Field Model
    - Field due to a charged particle
  - Electric Field Diagrams
  - Superposition of Electric Fields (diagrammatical and mathematical)
    - Field due to a collection of charged particles
    - Field due to a continuous distribution of charges
  - Linear Charge Distribution
  - Surface Charge Distribution
  - Volume Charge Distribution
    - Field due to an electric dipole
  - Field on Dipole Axis
  - Field on Axis Perpendicular to Dipole
  - Dipole Moment Vector
  - Torque on an Electric Dipole in an Electric Field

- Ch. 24 Gauss' Law
  - Electric Field Lines
    - Two charged particles
    - Infinite plate
    - Parallel plates
  - Field Line Density
  - Closed Surfaces
  - Charged Conductors
  - Electric Flux
  - Gauss's Law
    - Derivation from electric flux
    - Gauss's Law applied to spherical, cylindrical, and planar symmetry

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 C: Electricity and Magnetism Course and Exam Description.

- Ch. 25 Work and Energy in Electrostatics
  - Electric Potential Energy
    - Calculate electric potential energy of a collection of point charges
  - Electrostatic Work
  - Equipotentials and Equipotential Lines
  - Electric Potential Difference
    - Potential difference between two points in an electric field
    - Potential of a single charge carrier (V=0 at infinity)
    - Potential due to a collection of charge carriers
  - Electrostatic Potential of Continuous Charge Distributions
  - Calculate the Electric Field from Electric Potential

- Ch. 26 Charge Separation and Storage
  - Charge Separation (changes in electric potential energy)
  - Capacitors & Capacitance
    - Parallel plate
    - Cylindrical
    - Spherical
  - Energy Stored by a Capacitor
  - Dielectrics
    - Dielectric constants and polarization
    - Dielectric breakdown strength
  - Capacitance & Dielectrics
    - Bound and free charge
    - Induced electric field in a dielectric
    - Gauss's Law in a Dielectric

- Ch. 27 Magnetic Interactions
  - Characteristics of Magnets
  - Magnetic Fields and Field Lines
  - Current & Magnetism (right-hand rule/force-current-magnetic field)
    - Magnetic forces due to current carrying wires
    - Magnetic flux
    - Magnetic forces on charges moving in electric and magnetic fields
  - Magnetism and Relativity

- Ch. 28 Magnetic Fields of Charged Particles in Motion
  - Source of the Magnetic Field
  - Current Loops and Spin Magnetism (right-hand rule/current-magnetic field)
  - Magnetic Dipole Moment and Torque
  - Ampere's Law
    - Amperian loops
    - Solenoids
    - Toroids
  - Biot-Savart Law

- Ch. 29 Changing Magnetic Fields
  - Motional EMF
    - Conducting rod in a magnetic field
    - Conducting loop in a magnetic field
  - Faraday's Law
    - EMF and changing magnetic flux
    - Electric fields and changing magnetic flux
  - Lenz's Law
  - Inductance
    - Flux linkage
    - Inductance
    - Magnetic energy
  - Maxwell's Equations

- Ch. 31 Electric Circuits
  - Circuit Basics: Drawing and Labeling Common Elements in Circuits
  - Potential, Current, and Resistance
    - Current density
    - Drift velocity
    - Ohm's law
    - Resistivity and conductivity
    - Power
  - Junctions and Loops
    - Series and parallel circuits
      - Equivalent Resistance
      - Combination Circuits
    - Kirchoff's loop rule
    - Kirchoff's junction rule
  - RC Circuits
  - RL Circuits

Science Practice 1 CR3

Students will create a map of electric potential difference utilizing semi-conductive paper.

Science Practice 2 CR4

Students will utilize Gauss's law to derive expressions for the electric field for both non-conducting and conducting spheres.

Science Practice 3 CR5

Students will design an experiment to determine the value of an unknown resistor in an RC circuit.

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.

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

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 Requirements

CR6 CR7 Students will spend a minimum of 25% of their time conducting and analyzing laboratory experiments with an emphasis on scientific inquiry. CR8 Students will record their experiments and report their findings digitally utilizing Google Classroom.

- Sticky Tape – Students will investigate the behavior of charge utilizing cellophane tape.
- Coulomb's Law Simulation – Students will investigate the relationship between electrical force, charge, and distance utilizing a PhET simulation for Coulomb's law.
- Electric Field Simulation – Students will investigate the electric field and electric field lines utilizing a PhET simulation for electric fields.
- Electric Potential Mapping – Students will map electric potential utilizing semi-conductive paper, then use the data to create both two-dimensional and three-dimensional contour maps to infer the strength and direction of the electric field in space.
- Capacitors – Students will use a basic variable capacitor from Pasco to explore the relationship between charge, distance, and capacitance.
- Capacitors in Circuits – Students will conduct qualitative experiments to understand the behavior of capacitors in basic circuits with bulbs and batteries.
- Dielectrics in Capacitors – Students will determine the dielectric constant for a given material when placed between the plates of a parallel plate capacitor (for both an isolated capacitor and one with a constant potential difference).
- Circuits Labs/CASTLE – We utilize CASTLE (Capacitor-Aided System for Student Teaching and Learning of Electricity) throughout the course to understand the behavior of electric charge in circuits involving batteries, resistors, capacitors, and inductors. The investigations encourage a deep understanding of the relationship between the movement of charge, electric potential difference, the electric field, and magnetic fields.
  - Section 1 – What is happening in the wires?
  - Section 2 – Where does the moving charge originate?
  - Section 3 – What do bulbs do to the moving charge?
  - Section 4 – What makes charge move in a circuit?
  - Section 5 – How do wires distribute electric pressure in a circuit?
  - Section 6 – How are values of circuit variables measured?
  - Section 7 – What is the relationship between motors and generators?
- Internal Resistance – Students determine the internal resistance of a battery in a circuit.
- Resistivity of conductive dough – Students design an experiment to determine the resistivity of conductive dough.
- Magnetic Field Line Mapping – Map the magnetic field around bar magnets.
- RC Circuit Lab – Determine the value of the time constant in an RC circuit as well as the value of an unknown resistance.
- RL Circuit Lab – Determine the value of the time constant in an RL circuit.

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.

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 C: Electricity and Magnetism Course and Exam Description.

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.