

## Wilson Area School District Planned Course Guide

**Title of Planned Course:** AP Physics 2

**Subject Area:** Science

**Grade Level:** 12

**Course Description:** AP Physics 2 is an algebra-based, introductory college-level physics course. Students cultivate their understanding of physics by developing models of physical phenomena through inquiry-based investigations. Students build their understanding of physical models as they explore and solve problems in these topics:

- Thermodynamics
- Electric Force, Field, and Potential
- Electric Circuits
- Magnetism and Electromagnetism
- Geometric Optics
- Waves, Sound, and Physical Optics
- Modern Physics

**Time/Credit for this Course:** One Full Academic Year / 1.2 credits

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## Wilson Area School District Planned Course Materials

**Course Title:** AP Physics 2

**Supplemental Books:** Knight , Jones, Field © 2015  
College Physics: a strategic approach AP ® Edition, 3rd Edition  
Pearson Education

**Teacher Resources:** AP Classroom  
[Phet.colorado.com](http://Phet.colorado.com)  
TIPERs / Ranking Tasks  
[Physicsclassroom.com](http://Physicsclassroom.com)  
AP Prep Books

- Baron's Test Prep
- Princeton Review

## Curriculum Map

<b><u>August:</u></b>	Review
<b><u>September:</u></b>	Unit 9: Thermodynamics
<b><u>October:</u></b>	Unit 10: Electric Force, Field, and Potential
<b><u>November:</u></b>	Unit 11: Electric Circuits
<b><u>December:</u></b>	Unit 11: Electric Circuits
<b><u>January:</u></b>	Unit 12: Magnetism and Electromagnetism
<b><u>February:</u></b>	Unit 13: Geometric Optics
<b><u>March:</u></b>	Unit 14: Waves, Sound, and Physical Optics
<b><u>April:</u></b>	Unit 15: Modern Physics
<b><u>May:</u></b>	Full-Course Recap / AP Exam
<b><u>June:</u></b>	Advanced Topics

## Curriculum Scope and Sequence

**Planned Course:** AP Physics 2

**Unit:** AP Physics 1 Review

**Time Frame:** 2 weeks

**State Standards:** 3.1.12.A, B, C, D, E; 3.2.12.A, B, C, D; 3.4.12.C; 3.7.12.A, B; 3.4.10.C

**Essential content/objectives:** At end of the unit, students will be able to:

- Use mathematical concepts learned in AP Physics 1
- Describe vector and scalar quantities and mathematics
- Explain conservation laws (mass, energy, charge, and momentum)
- Develop scientific procedures, data collection and evaluation, graphical analysis
- Express calculated answers within one position of the correct significant figures
- Perform order-of-magnitude estimates
- Use scientific notation in additive, multiplicative, and exponential calculations
- Solve problems requiring unit conversions and dimensional analysis
- Design experiments that minimize relative accuracy and precision errors
- Determine fundamental constants from experimental data using graphical linearization

**Core Activities:** Students will complete/participate in the following:

- Instructor-led discussions
- Individual conceptual assignments (TIPERs)
- Higher-order thinking questions
- AP Physics Style Question Review

**Extensions:**

- Research opportunities
- Advanced questions

**Remediation:** Small group reinforcement

**Instructional Methods:**

- Direct instruction
- Demonstrations

**Materials & Resources:**

- Computers
- Internet
- Lab equipment

**Assessments:**

- TIPERs
- Problem sets
- In-class Q & A

## Curriculum Scope and Sequence

**Planned Course:** AP Physics 2

**Unit:** Unit 9 - Thermal Physics

**Time Frame:** 10-16 Class Periods

**State Standards:** 3.2.6-8.B, 3.2.6-8.M, 3.2.6-8.N, 3.2.9-12.R

**Essential content/objectives:** At end of the unit, students will be able to:

- Describe temperature and temperature scales
- Describe the properties of an ideal gas
- Describe the pressure a gas exerts on its container in terms of atomic motion within that gas
- Explain thermal expansion (linear and volumetric)
- Describe the temperature of a system in terms of the atomic motion within that system
- Use kinetic molecular theory and the gas laws
- Describe the transfer of energy between two systems in thermal contact due to temperature differences of those two systems
- Describe the internal energy of a system
- Describe the behavior of a system using thermodynamic processes
- Solve heat, work, and internal energy (including PV diagrams) problems
- Describe the energy required to change the temperature of an object by a certain amount (specific heat, latent heat and calorimetry)
- Explain methods of heat transfer (conduction, convection, and radiation)
- Describe the rate at which energy is transferred by conduction through a given material
- Describe the change in entropy for a given system over time
- Additional AP Learning Objectives and Essential Knowledge can be found in the AP Physics 2 Course and Exam Description document on College Board's AP Physics 2 page: [AP Physics 2: Algebra-Based Course](#)

**Core Activities:** Students will complete/participate in the following:

- Instructor-led discussions
- Thermodynamics Lab
- Individual conceptual assignments (TIPERs)
- Inquiry labs

**Extensions:**

- Research opportunities
- Advanced questions

**Remediation:** Small group reinforcement

**Instructional Methods:**

- Direct instruction
- Demonstrations
- Lab activities
- Inquiry-based learning

**Materials & Resources:**

- Computers
- Internet
- Lab equipment

**Assessments:**

- TIPERs
- Lab reports
- Thermodynamics Problem sets
- In-class Q & A
- AP Classroom Topic Questions for Unit 9 Topics
- AP Classroom Unit 9 Progress Checks
- Unit 9 Exam

## Curriculum Scope and Sequence

**Planned Course:** AP Physics 2

**Unit:** Unit 10 - Electric Force, Field, and Potential

**Time Frame:** 14-21 Class Periods

**State Standards:** 3.2.9-12.L, 3.2.9-12.S

**Essential content/objectives:** At end of the unit, students will be able to:

- Describe the electric force that results from the interaction between two charged objects or systems
- Describe the electric and gravitational forces that result from interactions between charged objects with mass
- Describe the electric permittivity of a material or medium
- Differentiate conductors and insulators
- Describe methods of charging (friction, conduction, and induction)
- Solve for electric force and Coulomb's law
- Explain electric fields and field lines
- Describe the electric field produced by a charged object or configuration of point charges
- Describe the electric field generated by charged conductors or insulators
- Describe electric potential energy of a system
- Describe the electric potential due to a configuration of charged objects
- Describe the relationship between electric potential and electric field
- Describe capacitance and capacitors (geometry, factors affecting capacitance) and solve basic problems
- Apply the conservation of electric charge to various physical scenarios
- Describe changes in energy in a system due to a difference in electric potential between two locations
- Additional AP Learning Objectives and Essential Knowledge can be found in the AP Physics 2 Course and Exam Description document on College Board's AP Physics 2 page: [AP Physics 2: Algebra-Based Course](#)

**Core Activities:** Students will complete/participate in the following:

- Instructor-led discussions
- Coulomb's Law Lab
- Electrical Induction Activities
- Capacitance lab
- Individual conceptual assignments (TIPERs)

**Extensions:**

- Research opportunities
- Advanced questions

**Remediation:** Small group reinforcement

**Instructional Methods:**

- Direct instruction
- Demonstrations
- Lab activities
- Inquiry-based learning

**Materials & Resources:**

- Computers
- Internet
- Lab equipment

**Assessments:**

- TIPERs
- Lab reports
- Coulomb's Law and Electric Fields, Electric Potential Energy and Electric Potential, and Capacitor Problem sets
- In-class Q & A
- AP Classroom Topic Questions for Unit 10 Topics
- AP Classroom Unit 10 Progress Checks
- Unit 10 Exam

## Curriculum Scope and Sequence

**Planned Course:** AP Physics 2

**Unit:** Unit 11 - Electric Circuits

**Time Frame:** 12-20 Class Periods

**State Standards:** 3.2.9-12.M

**Essential content/objectives:** At end of the unit, students will be able to:

- Describe the movement of electric charges through a medium
- Describe the behavior of a circuit
  - What elements such as wires, batteries, resistors, lightbulbs, capacitors, switches, ammeters, and voltmeters are, including their symbols on a circuit diagram
  - The difference between an open, closed, and short circuit
- Describe resistance of an object using physical properties of that object
- Describe the electrical characteristics of elements of a circuit using Ohm's Law
- Use Ohm's Law to solve problems
- Describe the transfer of energy into, out of, or within an electrical circuit in terms of power
- Describe the equivalent resistance of multiple resistors connected to a circuit in series or parallel
- Describe a circuit with resistive wires and a battery with internal resistance
- Describe the measurement of current and potential difference in a circuit
- Describe a circuit or elements of a circuit by applying Kirchhoff's Loop rule
- Describe a circuit or elements of a circuit by applying Kirchhoff's Junction rule
- Be able to diagram and analyze simple and compound DC circuits using the methods outlined above
- Describe the equivalent capacitance of multiple capacitors in series or parallel
- Describe the behavior of a circuit containing combinations of resistors and capacitors (an RC circuit)
  - This includes calculating the time constant of an RC circuit and describing the charging time of said circuit
- Additional AP Learning Objectives and Essential Knowledge can be found in the AP Physics 2 Course and Exam Description document on College Board's AP Physics 2 page: [AP Physics 2: Algebra-Based Course](#)

**Core Activities:** Students will complete/participate in the following:

- Instructor-led discussions
- Ohm's Law Labs
- Compound Circuit Lab
- Electric Power Lab
- Kirchhoff's Rules Lab
- Individual conceptual assignments (TIPERs)
- Higher-order thinking questions
- Inquiry labs

**Extensions:**

- Research opportunities
- Advanced questions

**Remediation:** Small group reinforcement

**Instructional Methods:**

- Direct instruction
- Demonstrations
- Lab activities
- Inquiry-based learning

**Materials & Resources:**

- Computers
- Internet
- Lab equipment

**Assessments:**

- TIPERs
- Lab reports
- Ohm's Law, Compound DC Circuits, RC Circuits, and Electric Power Problem sets
- In-class Q & A
- AP Classroom Topic Questions for Unit 11 Topics
- AP Classroom Unit 11 Progress Checks
- Unit 11 Exam

## Curriculum Scope and Sequence

**Planned Course:** AP Physics 2

**Unit:** Unit 12 - Magnetism and Electromagnetism

**Time Frame:** 10-13 Class Periods

**State Standards:** 3.2.9-12.M, 3.2.9-12.S

**Essential content/objectives:** At end of the unit, students will be able to:

- Describe the properties of a magnetic field
- Describe the magnetic behavior of a material as a result of the configuration of magnetic dipoles in the material
- Describe the magnetic permeability of a material
- Describe the magnetic field produced by moving charged objects
- Describe the force exerted on moving charged objects by a magnetic field
- Describe the magnetic field produced by a current-carrying wire including using Ampere's Law
- Describe the force and/or torque exerted on a current-carrying wire by a magnetic field
- Describe the induced electric potential difference resulting from a change in magnetic flux
- Describe motional EMF and magnetic flux
- Calculate using Faraday's and Lenz's Laws
- Explain inductance (Mutual and Self-Inductance)
- Additional AP Learning Objectives and Essential Knowledge can be found in the AP Physics 2 Course and Exam Description document on College Board's AP Physics 2 page: [AP Physics 2: Algebra-Based Course](#)

**Core Activities:** Students will complete/participate in the following:

- Instructor-led discussions
- Magnetic Field Line Mapping activity
- Individual conceptual assignments (TIPERs)
- Higher-order thinking questions
- Inquiry labs

**Extensions:**

- Research opportunities
- Advanced questions

**Remediation:** Small group reinforcement

**Instructional Methods:**

- Direct instruction
- Demonstrations
- Lab activities
- Inquiry-based learning

**Materials & Resources:**

- Computers
- Internet
- Lab equipment

**Assessments:**

- TIPERs
- Lab reports
- Magnetic Fields, Faradays and Lenz's Laws Problem sets
- In-class Q & A
- AP Classroom Topic Questions for Unit 12 Topics
- AP Classroom Unit 12 Progress Checks
- Unit 12 Exam

## Curriculum Scope and Sequence

**Planned Course:** AP Physics 2

**Unit:** Unit 13 - Geometric Optics

**Time Frame:** 8-12 Class Periods

**State Standards:** 3.2.6-8.R

**Essential content/objectives:** At end of the unit, students will be able to:

- Describe light as a ray
- Describe the reflection of light from a surface, including using the Law of Reflection
- Describe the image formed by a mirror (planar and spherical mirrors) using both ray diagrams and the mirror equations
- Describe the refraction of light between two media, including using Snell's Law and the index of refraction of a material
- Describe the image formed by a single lens and a system of lenses (convex and concave lenses) using both ray diagrams and the lensmakers equations
- Describe the phenomenon of total internal reflection
- Describe the properties of an image formed by any optical device (reduced / magnified, inverted / upright, real / virtual)
- Describe optical devices (human eye, telescope, microscope, and lens aberrations)
- Additional AP Learning Objectives and Essential Knowledge can be found in the AP Physics 2 Course and Exam Description document on College Board's AP Physics 2 page: [AP Physics 2: Algebra-Based Course](#)

**Core Activities:** Students will complete/participate in the following:

- Instructor-led discussions
- Planar Mirror activity
- Spherical Mirror Lab
- Refraction/Snell's Law lab
- Lens Lab
- Individual conceptual assignments (TIPERs)
- Higher-order thinking questions
- Inquiry labs

**Extensions:**

- Research opportunities
- Advanced questions

**Remediation:** Small group reinforcement

**Instructional Methods:**

- Direct instruction
- Demonstrations
- Lab activities
- Inquiry-based learning

**Materials & Resources:**

- Computers
- Internet
- Lab equipment

**Assessments:**

- TIPERs
- Lab reports
- Planar Mirror, Spherical Mirror, Snell's Law, and Lens Problem sets
- In-class Q & A
- AP Classroom Topic Questions for Unit 13 Topics
- AP Classroom Unit 13 Progress Checks
- Unit 13 Exam

## Curriculum Scope and Sequence

**Planned Course:** AP Physics 2

**Unit:** Unit 14 - Waves, Sound, and Physical Optics

**Time Frame:** 14-23 Class Periods

**State Standards:** 3.2.9-12.T, 3.2.9-12.U, 3.2.9-12.V, 3.2.9-12.W, 3.2.9-12.X

**Essential content/objectives:** At end of the unit, students will be able to:

- Identify all the properties and anatomy of waves and wave pulses
- Calculate the speed of waves in different media such as wires based on physical properties of the media.
- Physically and mathematically model periodic waves
- Calculate the speed of a wave based on its frequency and wavelength
- Describe the various boundary behaviors of waves
- Understand the effect polarization has on mechanical and electromagnetic waves
- Describe the Doppler Effect and understand how it changes the properties of a wave
- Explain what a standing wave is, understanding concepts such as superposition and constructive / destructive interference
- Understand and explain / model the phenomenon of diffraction of a wave when it passes through an opening
- Describe the effects on a wave passing through two or more small slits as done in the famous Young's Double Slit experiment or as light passes through a diffraction grating
- Describe and explain the phenomenon of thin-film interference
- Additional AP Learning Objectives and Essential Knowledge can be found in the AP Physics 2 Course and Exam Description document on College Board's AP Physics 2 page: [AP Physics 2: Algebra-Based Course](#)

**Core Activities:** Students will complete/participate in the following:

- Instructor-led discussions
- Frequency v. wavelength lab
- Speed of sound lab
- Doppler effect demo
- Diffraction Grating Lab
- Individual conceptual assignments (TIPERs)
- Higher-order thinking questions
- Inquiry labs

**Extensions:**

- Research opportunities
- Advanced questions

**Remediation:** Small group reinforcement

**Instructional Methods:**

- Direct instruction
- Demonstrations
- Lab activities
- Inquiry-based learning

**Materials & Resources:**

- Computers
- Internet
- Lab equipment

**Assessments:**

- TIPERs
- Lab reports
- Wave property, Doppler Effect, Sound / Standing Wave / Harmonics, Diffraction / Double Slit / Diffraction Grating Problem sets
- In-class Q & A
- AP Classroom Topic Questions for Unit 14 Topics
- AP Classroom Unit 14 Progress Checks
- Unit 14 Exam

## Curriculum Scope and Sequence

**Planned Course:** AP Physics 2

**Unit:** Unit 15 - Modern Physics

**Time Frame:** 14-22 Class Periods

**State Standards:** 3.2.9-12.H, 3.2.9-12.V, 3.2.9-12.W

**Essential content/objectives:** At end of the unit, students will be able to:

- Describe the properties and behavior of an object that exhibits both particle-like and wave-like behavior
- Calculate the de Broglie wavelength of a particle like object
- Relate the energy of a photon to its frequency and wavelength
- Explain the nature and structure of the atom (Rutherford scattering, Bohr models of the atom)
- Use prior models such as centripetal forces and Coulomb's law to model the forces acting on an electron orbiting the nucleus of an atom
- Describe the emission or absorption of photons by atoms
- Describe the electromagnetic radiation emitted by an object due to its temperature (Blackbody Radiation)
- Describe an interaction between photons and matter using the photoelectric effect
- Describe the interaction between photons and matter using Compton Scattering
- Describe nuclear physics (nuclear force, binding energy, mass defect)
- Explain and use radioactivity (reactions and energy)
- Describe nuclear reactions (fission, fusion, and reactors)
- Describe the radioactive decay rate of given samples of material consisting of a finite number of nuclei. This includes half-life calculations
- Describe elementary particles and ionizing radiation
- Describe the processes by which individual nuclei decay via alpha, beta-minus, beta-plus, and gamma decay
- Additional AP Learning Objectives and Essential Knowledge can be found in the AP Physics 2 Course and Exam Description document on College Board's AP Physics 2 page: [AP Physics 2: Algebra-Based Course](#)

**Core Activities:** Students will complete/participate in the following:

- Instructor-led discussions
- Individual conceptual assignments (TIPERs)
- Higher-order thinking questions
- Inquiry labs

**Extensions:**

- Research opportunities
- Advanced questions

**Remediation:** Small group reinforcement

**Instructional Methods:**

- Direct instruction
- Demonstrations
- Lab activities
- Inquiry-based learning

**Materials & Resources:**

- Computers
- Internet
- Lab equipment

**Assessments:**

- TIPERs
- Lab reports
- Atomic Structure, Nuclear Decay Processes, and Atomic Absorption and Emission Problem sets
- In-class Q & A
- AP Classroom Topic Questions for Unit 15 Topics
- AP Classroom Unit 15 Progress Checks
- Unit 15 Exam

## Curriculum Scope & Sequence

**Planned Course:** AP Physics 2

**Unit:** Review

**Time Frame:** 3-4 weeks

**Essential Content /Objectives:** At the end of the unit, students will be able to:

- Comprehensively review each of the units above.

**Core Activities:** Students will participate in the following:

- AP style practice problems for each individual unit
- AP Practice Exams
- AP mix and match questions
- Timed quizzes and Exams

**Instructional Methods:**

- Instructor-supported activities
- Direct instruction
- Demonstrations
- Peer-to-peer knowledge sharing
- Whole-group problem solving.

**Materials & Resources:** Varies by topic

**Assessments:**

- AP Classroom Reviews
- Practice Exams