

# Physics, Part 2

## Course Outline & Objectives

### Course Description:

In Physics, Part 2, students extend their understanding of classical mechanics into wave behavior, electricity, magnetism, and modern physics. The course begins with mechanical and electromagnetic waves, including sound and light, before moving into electric forces, circuits, and magnetic interactions. Students then investigate how electric and magnetic fields are connected through electromagnetism and energy conversion in real-world technologies. The course concludes with an introduction to thermal physics and modern physics topics such as relativity, nuclear processes, and emerging fields like nanotechnology and dark matter research. Throughout the course, students will apply mathematical reasoning, graphical analysis, and modeling to explain physical systems and technological applications.

Credits - One Semester (0.5 Carnegie unit / CA: 5 credits)

Prerequisites: Algebra 1; Geometry; and Algebra 2 (co-requisite)

OR Integrated Math 1; Integrated Math 2; and Integrated Math 3 (co-requisite)

### Course Outline

#### Unit 1: Waves and Sound

- 1.1 Vibrations and Waves
- 1.2 Nature of Waves
- 1.3 Properties of Waves
- 1.4 Behavior of Waves
- 1.5 Standing Waves
- 1.6 Sound Waves and Their Properties
- 1.7 Behavior of Sound Waves
- 1.8 Resonance

#### Unit 2: Light

- 2.1 Light as a Wave, Light as a Particle, Color and Vision
- 2.2 Reflection and Its Importance
- 2.3 Image Formation in Plane Mirrors
- 2.4 Concave Mirrors
- 2.5 Convex Mirrors
- 2.6 Refraction and Light Rays
- 2.7 Mathematics of Refraction
- 2.8 Internal Reflection
- 2.9 Convergent Lenses
- 2.10 Diverging Lenses

### Next Generation Science Standards

#### In Unit 1 students will:

Explore how vibrations produce mechanical and electromagnetic waves. Analyze wave properties including frequency, wavelength, amplitude, and speed.

Investigate wave behaviors such as reflection, refraction, diffraction, and interference.

Examine standing waves and resonance in real-world systems.

Study how sound travels through different media and how medium affects sound speed.

Relate frequency to pitch and amplitude to loudness.

Apply wave concepts to everyday phenomena such as echoes and noise cancellation.

[ HS-PS4-1, HS-PS4-3, HS-PS4-5 ]

#### In Unit 2 students will:

Explain the principles of reflection and refraction.

Analyze image formation using plane, concave, and convex mirrors.

Investigate how convex and concave lenses form real and virtual images.

Use ray diagrams to predict image size, orientation, and location.

Apply mathematical relationships to model optical systems.

[ HS-PS4-1, HS-PS4-3, HS-PS4-4 ]

## Course Outline

### Unit 3: Electricity

- 3.1 Neutral vs Charged Objects, Charge Interactions, Conductors, Insulators, and Polarization
- 3.2 Electrical Force
- 3.3 Electrical Fields
- 3.4 Electrical Potential
- 3.5 Capacitors and Dielectrics

### Unit 4: Circuits

- 4.1 Current
- 4.2 Resistance
- 4.3 Series Circuits
- 4.4 Parallel Circuits
- 4.5 Batteries, Lights and Complex Circuits

### Unit 5: Magnetism

- 5.1 Introduction to Magnetism
- 5.2 Magnetic Fields & Electromagnetism
- 5.3 The Solenoid and Electromagnet
- 5.4 Force on a Moving Charge
- 5.5 Magnetic Induction
- 5.6 Electric Motors and Generators

### Unit 6: Modern Physics

- 6.1 Introduction to Thermal Physics
- 6.2 What Is Heat?
- 6.3 The Laws of Thermodynamics
- 6.4 Special & General Relativity
- 6.5 Nuclear Physics
- 6.6 Nanotechnology
- 6.7 Dark Matter and Dark Energy

## Next Generation Science Standards

### In Unit 3 students will:

Explore how electric charges interact through forces and electric fields. Investigate electric potential and how it relates to electric force and field strength. Examine the differences between conductors and insulators. Study how polarization occurs in materials exposed to electric fields. Analyze systems that store and transfer electrical energy, including capacitors and dielectrics. Connect microscopic charge behavior to macroscopic electrical phenomena.

[ HS-PS2-4, HS-PS3-2, HS-PS3-5 ]

### In Unit 4 students will:

Explore electric current as the flow of electric charge through a conductor. Investigate resistance and the factors that affect it, including material, length, and temperature. Apply Ohm's Law to analyze relationships between voltage, current, and resistance. Compare series and parallel circuits in terms of current, voltage, and total resistance. Analyze complex circuits that combine series and parallel elements. Explain how batteries and power sources maintain potential difference in circuits.

[ HS-PS2-1, HS-PS2-4, HS-PS3-2 ]

### In Unit 5 students will:

Explore magnetic fields and how they affect materials and moving charges. Analyze how electric currents produce magnetic fields. Investigate the force on moving charges in magnetic fields. Study electromagnetic devices such as solenoids, motors, and generators. Explain how electromagnetic induction produces electric current. Connect electromagnetism to energy conversion in real-world technologies.

[ HS-PS2-5, HS-PS2-4, HS-PS3-5 ]

### In Unit 6 students will:

Explore heat transfer through conduction, convection, and radiation. Analyze how specific heat influences temperature change. Apply the laws of thermodynamics to energy systems. Investigate Einstein's theories of special and general relativity conceptually. Examine nuclear structure and radioactive decay processes. Explore modern scientific frontiers such as nanotechnology, dark matter, and dark energy. Connect classical physics concepts to modern research and technology.

[ HS-PS3-1, HS-PS3-4, HS-PS1-8 ]