

Honors Physics

COURSE DESCRIPTION: This advanced course surveys all key areas: physical systems, measurement, kinematics, dynamics, momentum, energy, thermodynamics, waves, electricity, and magnetism, and introduces students to modern physics topics such as quantum theory and the atomic nucleus. Additional honors assignments include debates, research papers, extended collaborative laboratories, and virtual laboratories. The course gives a solid basis for moving on to more advanced college physics courses. The program consists of online instruction, virtual laboratories, and related assessments, plus an associated problem-solving book.

PREREQUISITES: Algebra II or Honors Algebra II and Pre-Calculus/Trigonometry, and teacher/school counselor recommendation

COURSE LENGTH: Two Semesters

REQUIRED TEXT: Physics: Problems and Solutions

MATERIALS LIST: No required materials for this course

COURSE OUTLINE:

Semester 1

Unit 1: Introduction to Physics

- Semester Introduction
- The History of Physics
- Physics and Society
- Physics and Science
- Physical Systems and Models

Unit 2: Physical Units and Measurement

- The Metric System: History and Use
- The Metric System: Base Units
- The Metric System: Derived Units
- Measurement and Scientific Notation
- Conversion Techniques

- Significant Figures
- Laboratory: Measurement and Significant Figures 1
- Laboratory: Measurement and Significant Figures 2

Unit 3: Graphing and Problem Solving

- Graphing Physical Data
- Graphs and Data Relationships
- Laboratory: Creating and Interpreting Graphs 1
- Laboratory: Creating and Interpreting Graphs 2
- Problem Solving Strategies: Units
- Problem Solving Strategies: Estimation
- Honors Project 1

Unit 4: Kinematics

- Rotation and Translation
- Frame of Reference
- Speed and Velocity
- Position-Time and Velocity-Time Graphs
- Laboratory: Kinematics 1
- Laboratory: Kinematics 2
- Acceleration
- Acceleration and Displacement
- Laboratory: Acceleration 1
- Laboratory: Acceleration 2

Unit 5: Forces

- Forces
- Inertia and Newton's First Law
- Newton's Second Law
- Mass and Weight
- Laboratory: Newton's Laws of Motion 1
- Laboratory: Newton's Laws of Motion 2
- Newton's Third Law

Unit 6: Net Forces and Vectors

- The Net Forces Problem
- Resolving Vectors
- Adding Vectors
- Laboratory: Working with Vectors
- Net Forces at Equilibrium
- Free Fall and Equilibrium
- Calculating Net Force I
- Calculating Net Force II
- Friction
- Laboratory: Net Force 1
- Laboratory: Net Force 2

Unit 7: Motion in Two Dimensions

- Projectile Motion
- Uniform Circular Motion
- Laboratory: Motion in Two Dimensions 1
- Laboratory: Motion in Two Dimensions 2
- Laboratory: Motion in Two Dimensions 3
- Angular Displacement and Torque
- Simple Harmonic Motion: Springs
- Simple Harmonic Motion: Pendulum
- Laboratory: Harmonic Motion 1
- Laboratory: Harmonic Motion 2
- Honors Project 2

Unit 8: Gravitation

- History of Gravitation
- Laboratory: Kepler's Laws
- Universal Gravitation
- Einstein and the Gravitational Field

Unit 9: Physics and Scientific Inquiry

- Physics Inquiry: Inductive Reasoning

- Physics Inquiry: Questions and Hypotheses
- Physics Inquiry: Experimentation
- Physics Inquiry: Data Collection and Analysis
- Physics Inquiry: Conclusions and Communicating

Unit 10: Semester Review and Test

Unit 11: Honors Project 1: Astronomical Distances

- Astronomical Distances

Units 12: Honors Project 2: Spacecraft Landing

- Biomechanics

Semester 2

Unit 1: Momentum

- Linear Momentum and Impulse
- Law of Conservation of Momentum
- Momentum in Collisions 1
- Momentum in Collisions 2
- Laboratory: Momentum 1
- Laboratory: Momentum 2
- Conservation of Angular Momentum

Unit 2: Work

- Work and Power
- Direction of Force and Work
- Laboratory: Work and Power
- Machines and Mechanical Advantage
- Laboratory: Simple and Compound Machines 1
- Laboratory: Simple and Compound Machines 2
- Honors Project 3

Unit 3: Energy

- Types of Energy and Their Conversions

- Kinetic and Potential Energy
- Conservations of Energy 1
- Conservations of Energy 2
- Laboratory: Conservation of Energy 1
- Laboratory: Conservation of Energy 2
- Energy During Collisions

Unit 4: Thermal Energy

- Kinetic-Molecular Theory
- Specific Heat
- Laboratory: Specific Heat 1
- Laboratory: Specific Heat 2
- States of Matter
- Heat During Change of State
- First Law of Thermodynamics
- Second Law of Thermodynamics and Entropy

Unit 5: Waves

- Characteristics of Waves 1
- Characteristics of Waves 2
- Sound: Vibration and Waves
- Qualities of Sound
- Laboratory: Sound 1
- Laboratory: Sound 2

Unit 6: Light

- The Electromagnetic Spectrum
- Diffraction and Interference
- Reflection
- Refraction
- Mirrors
- Lenses
- Laboratory: Optics 1
- Laboratory: Optics 2

- Laboratory: Optics 3

Unit 7: Electric Forces

- Static Electricity
- Electric Force
- Electric Fields
- Laboratory: Electrostatics 1
- Laboratory: Electrostatics 2
- Electric Potential
- Honors Project 4

Unit 8: Currents and Circuits

- Current and Circuits
- Current Electric Forces
- Series Circuits
- Parallel Circuits
- Combined Circuits
- Laboratory: Circuits 1
- Laboratory: Circuits 2

Unit 9: Magnetism

- Magnets and Magnetic Fields
- Forces in Magnetic Fields
- Electromagnetic Induction
- Laboratory: Magnetic Fields 1
- Laboratory: Magnetic Fields 2

Unit 10: Modern Physics

- Atomic Spectra and Quantum Theory
- The Nature of Light and the Photoelectric Effect
- Relativity
- Structure of the Nucleus
- Radioactivity

Unit 11: Semester Review and Test

Units 12: Honors Project 1: Mechanically Powered Toy

Unit 13: Honors Project 2: Solar Power