
AP Physics C: Mechanics

Course Description

AP Physics provides a systematic introduction to the main principles of physics at the freshman college level, and follows Physics C format. Physics C provides a systematic introduction to the main principles of Physics and emphasizes the development of problem-solving ability. Strong emphasis is placed on solving a variety of challenging problems, with fundamental calculus use being introduced. The subject matter covers Linear and Rotational Mechanics, as well as Conservation Principles, with equal emphasis on these three areas. The laboratory components of the course offer many experiences dealing with advanced topics and skills while using both simple and sophisticated equipment. This course runs sequentially with AP Physics C: Electricity & Magnetism.

Additionally, other learning opportunities exist for students beyond the classroom. All students participate in our annual Fairfield High School Physics Olympics competition in which students compete in small groups and as a class. We have modeled this event after the AAPT Physics Olympics, but have included experiments of our own design. These activities have been created to provide a fun and safe learning event for students, and will also help them review for final exams. Centered on key physics concepts, the activities will engage students in hands-on, minds-on experiments and provide a culminating experience for the students that they won't soon forget. We also take a group of students to compete at Yale University's annual Physics Olympics. Also, guest lecturers from various institutions have been invited in to speak with students, and field trips to museums have been arranged.

Instructional Materials:

Primary Text: Giancoli; *Physics for Scientists and Engineers with Modern Physics*, Prentice Hall, 4th Edition, 2007

Secondary Text: Cutnell & Johnson, *Physics*, Wiley, 6th Edition, 2004

Technology: Computers equipped with Vernier probes and data acquisition and analysis software; Classic apparatus (e.g. Millikan Oil Drop, Ripple Tanks, Michelson

Interferometer, Franck-Hertz); TI Graphing calculators; Department website:
<http://www.fairfield.k12.ct.us/ludlowehs/cludlowehs26/physicswebsite/index.htm>

Overview: The course is conducted within a four marking period school year and meets five times per week. Three of those periods are 45 minute classes, and the other two are 90 minute extended lab periods, resulting in approximately 315 minutes of instructional time per week.

Lecture and discussion are used in conjunction with one another to aid in the development of problem-solving skills, as well as an understanding of the placement of concepts within a theoretical framework, and the historical perspective on the science of physics and experimental science.

Guided learning and inquiry, interactive lecture demonstrations, and student-centered instruction, foster the development of critical thinking skills. Developmental problem solving techniques, critical thinking skills, and emphasis on sound experimentation skills are also prominent features of the course.

Students are given the opportunity to investigate fundamental concepts in a laboratory environment through hands-on and student-centered experiments. Two double-lab periods are allotted for lab, and account for over half of the instructional time per week.

Students engage in the setup, development, and conduction of experiments. Students conduct investigations utilizing a wide variety of physical material including standard physics equipment as well as more advanced apparatus such as Frank-Hertz and Millikan's Oil Drop devices. Computer probes and other measuring devices like oscilloscopes and meters are used in the collection of data. Their analysis of data is compiled on-site and worked into comprehensive reports with attention to sound scientific procedures. Students keep a record of their lab work in an appropriate lab notebook.

Laboratory List: Two double-lab periods are allotted for lab, and account for over half of the instructional time per week. The following list includes open-ended investigations, physical law confirmation experiments, measurements of fundamental constants, and practical application of theory.

Newtonian Mechanics

1. Graphical Analysis of Linear Motion: Non-accelerated & Accelerated
2. Projectile Targeting
3. Force Table Vector Analysis
4. Newton's Second Law: Cart & Hanger
5. Centripetal Force Investigation
6. Measurement of Rotational Inertia
7. Balancing Torques
8. Momentum Conservation in Collisions & Explosions
9. Collisions in Two Dimensions
10. Work-Power-Energy Measurements
11. Conservation of Energy: Pendulum

12. Hooke's Law & SHM

Course Outline of Topics

I. Kinematics (4 weeks)

- i. Measurement & Units
- ii. Linear Motion
 - 1. Galileo's Analysis of Motion
 - 2. Gravitational Accelerations
 - 3. Graphical Analysis of Motion
 - 4. Introduction to Differential & Integral Calculus
- iii. Two dimensional linear motion
 - 1. Vector Analysis
 - 2. Projectiles

II. Newtonian Dynamics (4 weeks)

- i. Forces & Free-body Diagrams
- ii. Linear Motion
 - 1. Newton's Laws of Motion
 - 2. Pulley Systems & Atwood's Machine
 - 3. Friction & Drag
 - 4. Time-varying Forces
 - 5. Center of Mass
- iii. Two dimensional linear motion
 - 1. Inclines
 - 2. Equilibrium

III. Work, Energy & Power (2 weeks)

- i. Work/Energy Theorem
- ii. Power
- iii. Energy Conservation

IV. Linear Momentum (2 weeks)

- i. Linear Motion
 - 1. Systems of Particles & Collisions
 - 2. Momentum Conservation
 - 3. Impulse/Momentum Theorem

V. Circular Motion & Rotation (4 weeks)

- i. Circular Motion & Rotation
 - 1. Angular Kinematics
 - 2. Centripetal Acceleration
 - 3. Introduction to Differential & Integral Calculus
- ii. Circular Motion & Rotation
 - 1. Centripetal Force
- iii. Torque & Rotational Inertia
- iv. Circular Motion & Rotation
 - 1. Rotational Energy
 - 2. Angular Momentum

VI. Oscillations & Gravitation (4 weeks)

- i. Gravitational Dynamics
 - 1. Newton's Law of Gravitation
 - 2. Orbital Motion: Kepler's Laws
 - ii. Simple Harmonic Motion & Oscillations
 - 1. Springs
 - 2. Pendula
 - iii. Energy of Gravitational Systems
 - 1. Gravitational Potential
 - 2. Conservation
 - iv. Energy of Oscillating Systems
 - 1. Springs
 - 2. Pendula
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