

# Montclair High School

## Course Syllabus

**Department: Science**

**Course: AP Physics C Part 1 (Mechanics)**

**Level: Advanced Placement**

**Credits: 6**

### Course Description:

The Advanced Placement (AP) Program provides an opportunity for high school students to pursue and receive credit for college-level course work. The AP B Physics program is intended to be representative of Algebra based courses commonly offered in American colleges. The AP Physics C program is intended to be representative of calculus-based courses commonly offered in American colleges and universities. The AP Physics C: Mechanics course is the first part of a three-part sequence that in college is sometimes a very intensive one-year course, but usually extends over three semesters. The subject matter of the AP Physics C: Mechanics course is principally Newtonian mechanics. This course serves as the foundation for students majoring in the medical arts, physical sciences, or engineering. Strong emphasis is placed on solving a variety of challenging problems, some requiring calculus. Calculus is used wherever appropriate in formulating physical principles or in applying them to physical problems. The calculus skills required will be developed as an integral part of this course.

### Standards:

HS-PS2-1, PS2-2, PS2-3, PS3-1, PS3-2, PS3-3, PS2-4, PS4

### Anchor Text(s):

Text Title	Publisher/Author	Year/Edition	ISBN	Text Distribution
Fundamentals of Physics (Chapters 1-21)	Wiley & Sons/ David Halliday	2000	9780471320005	Hard copy

### Supplementary Materials:

Ancillary Materials, Hand calculator, instructional notes, Student notebook, Problem worksheets

### Units of Study:

Unit 0: Measurement

1-1 Measuring Things

1-2 The International System of Units

1-3 Changing Units

1-4 Length

1-5 Time

1-6 Mass

Unit 1: Motion Along a Straight Line

2-1 Motion

2-2 Position and Displacement

2-3 Average Velocity and Average Speed

2-4 Instantaneous Velocity and Speed

2-5 Acceleration

2-6 Constant Acceleration: A Special Case

2-7 Another Look at Constant Acceleration

2-8 Free-fall Acceleration

Unit 2: Vectors

3-1 Vectors and Scalars

3-2 Adding Vectors Graphically

3-3 Components of Vectors

3-4 Unit Vectors

3-5 Adding Vectors by Components

3-6 Vectors and the Laws of Physics

3-7 Multiplying Vectors

Unit 3: Motion in Two & Three Dimensions 4-1  
Moving in Two or Three Dimensions  
4-2 Position and Displacement  
4-3 Average Velocity and Instantaneous Velocity  
4-4 Average Acceleration and Instantaneous Acceleration  
4-5 Projectile Motion  
4-6 Projectile Motion Analyzed  
4-7 Uniform Circular Motion  
4-8 Relative Motion in One Dimension  
4-9 Relative Motion in Two Dimensions

Unit 4: Force and Motion  
5-1 What Causes an Acceleration  
5-2 Newton's First Law  
5-3 Force  
5-4 Mass  
5-5 Newton's Second Law  
5-6 Some Particular Forces  
5-7 Newton's Third Law  
5-8 Applying Newton's Laws  
6-1 Friction  
6-2 Properties of Friction  
6-3 The Drag Force and Terminal Speed  
6-4 Uniform Circular Motion

Unit 5: Energy and Work  
7-1 Energy  
7-2 Work  
7-3 Work and Kinetic Energy  
7-4 Work Done by a Gravitational Force  
7-5 Work Done by a Spring Force  
7-6 Work Done by a General Variable Force  
7-7 Power  
8-1 Potential Energy  
8-2 Path Independence of Conservative Forces  
8-3 Determining Potential Energy Values  
8-4 Conservation of Mechanical Energy  
8-5 Reading a Potential Energy Curve  
8-6 Work Done on a System by an External Force  
8-7 Conservation of Energy

Unit 6: Linear Momentum and Impulse  
9-1 A Special Point  
9-2 The Center of Mass  
9-3 Newton's Second Law for a System of Particles  
9-4 Linear Momentum  
9-5 The Linear Momentum of a System of Particles  
9-6 Conservation of Linear Momentum  
9-7 Systems with Varying Mass: A Rocket

9-8 External Forces and Internal Energy Changes  
10-1 What is a Collision?  
10-2 Impulse and Linear Momentum  
10-3 Momentum and Kinetic Energy in Collisions  
10-4 Inelastic Collisions in One Dimension  
10-5 Elastic Collisions in One Dimension  
10-6 Collisions in Two Dimensions

Unit 7: Rotational Kinematics  
11-1 Translation and Rotational  
11-2 The Rotational Variables  
11-3 Are Angular Quantities Vectors?  
11-4 Rotation with Constant Angular Acceleration  
11-5 Relating Linear and Angular Variables  
11-6 Kinetic Energy of Rotation  
11-7 Calculating the Rotational Inertia  
11-8 Torque  
11-9 Newton's Second Law for Rotation  
11-10 Work and Rotational Kinetic Energy  
12-1 Rolling  
12-2 The Kinetic Energy of Rolling  
12-3 The Forces of Rolling  
12-4 The Yo-Yo  
12-5 Torque Revisited  
12-6 Angular Momentum  
12-7 Newton's Second Law in Angular Form  
12-8 The Angular Momentum of a System of Particles  
12-9 The Angular Momentum of a Rigid Body Rotating About a Fixed Axis  
12-10 Conservation of Angular Momentum

Unit 8: Static Equilibrium of a Rigid Body 13-1  
Equilibrium  
13-2 The requirements of Equilibrium  
13-3 The Center of Gravity  
13-4 Some Examples of Static Equilibrium  
13-5 Indeterminate Structures (Optional)  
13-6 Elasticity (Optional)

Unit 9: Gravitation  
14-1 The World and the Gravitational Force  
14-2 Newton's Law of Gravitation  
14-3 Gravitation and the Principle of Superposition  
14-4 Gravitation Near Earth's Surface  
14-5 Gravitation Inside Earth's Surface  
14-6 Gravitational Potential Energy  
14-7 Planets and Satellites: Kepler's Laws  
14-8 Satellites: Orbits and Energy  
14-9 Einstein and Gravitation (Optional)

## Proficiencies:

### By the end of this course, students will:

1. Read, understand, and interpret physical information: verbal, mathematical, and graphical.
2. Describe and explain the sequence of steps in the analysis of a particular physical phenomenon or problem; that is, describe the idealized model to be used in the analysis, including assumptions where necessary, state the principles or definitions that are applicable, specify relevant limitations on applications of these principles, carry out and describe the steps of the analysis, verbally or mathematically, and interpret the results or conclusions, including discussion of particular cases of special interest.
3. Use mathematical reasoning (algebraic, geometric, trigonometric, or calculus, as appropriate) in the analysis of a physical situation or problem.
4. In the achievement of these goals, a deep understanding of the principles of physics is more important than a general survey of these principles.

## Evaluation & Assessment:

Quizzes & Tests	70%
Labs/Projects	20%
Homework/Classwork	10%

The Final Grade will consist of each marking period (22.5% each), the midterm exam (5%) and the final exam (5%)

## Laboratory Activities:

Prior to beginning any lab activities, all students must have submitted a Safety Contract which has been duly signed by both the student and their parent/guardian. This contract will be kept on file by the teacher for the duration of the course

- **Graphic Analysis Lab 1:** Plotting, basic curves, slopes, and equations.
- **Graphic Analysis Lab 2:** Linear regression
- **Graphic Analysis Lab 3:** Excel, data tables, and graphs.
- **Analysis of Data Lab:** (old PSSC Lab, Purpose to find relation between height of water in can, the diameter of hole in can and the time to drain the can of water.
- **Slide Ruler Lab:** Make a simple slide ruler from 1 cycle semi-log graph paper and learn to use it to multiple and divide.
- **Significant Figures, Errors, and Uncertainty Lab:** Measurements and error.
- **Fermi Question Lab:** Estimate Order of Magnitude without calculators.
- **Inertial Balance Lab:** Compare inertial and gravitational mass.
- **Vector Racing Lab:** Graph Paper Vector Racing Game explained by Douglas R. Hofstadter in Scientific American (in about 1970 I believe)  
**Vector Force Lab:** The resolution of vectors.
- **Coast Guard Search and Rescue Lab:** Based on wind and current data students will attempt to find lost fisherman.
- **Constant Velocity & Uniform Acceleration Lab:** Confirm the relations between position, velocity & acceleration.
- **Uniformly Accelerated Motion Lab:** Cart rolling down an inclined plane.
- **Acceleration Due To Gravity Lab 3:** Tape timer and a body in free fall.
- **Acceleration Due To Gravity Lab 2:** Using CPO Gravity Drop and Photo Gates.

- **Newton's Second of Law Motion Lab:** Block attached to a cord that runs over a pulley and varying the mass at the free end of the cord.
- **Friction Lab:** Measuring the coefficients of static and kinetic friction.
- **The Atwood Machine Lab:** Measuring acceleration and using a pulley and two sets of masses.
- **Centripetal Force Lab 1:** Measuring the centripetal force acting on a mass traveling in a horizontal circle at constant speed. From PSSC.
- **Centripetal Force Lab 2:** Same as above only using Pasco rotational table and equipment.
- **Conservation of Momentum in Collisions Lab 1:** Studying one-dimensional collisions using dynamic carts.
- **Conservation of Momentum in Collisions Lab 2:** Studying one and two-dimensional collisions using hover discs.
- **Simple Pendulum Lab:** Determining the period and frequency of a simple pendulum and demonstrating the independence of the mass of the bob to period and frequency.
- **Acceleration Due To Gravity Lab 3:** Using the simple pendulum to measure the acceleration due to gravity.
- **Hooke's Law Lab 1:** Measuring elongation and spring constants.
- **Hooke's Law Lab 2:** Vibratory motion, mass, and measuring the acceleration due to gravity.
- **Torques Lab:** Balancing a meter stick with various masses hanging at various locations.
- **Rotational Inertia Lab:** Determine rotational inertia of various objects.