AP Physics C: Mechanics
Course Syllabus

General Course Organization

Course Description

AP Physics is a college-level course designed to explore the dynamics of relatively simple mechanical systems in a great deal of depth. Calculus will be our principle tool of analysis. Working carefully, we will discover that most of the motions we see in our every day lives are in fact governed by three simple ideas: force, energy, and momentum.

Lab Work

Laboratory inquires form the organizational backbone of the course. In each case, questions are posed and potential analytical techniques are suggested, but a procedure is not prescribed. Students are free to design their own approach and are expected bring their entire analytical arsenal to bear on each question. As the year progresses, the students' arsenals expand and the depth of analysis is expected to improve. This open-ended guided inquiry approach encourages students to explore each physical scenario in greater depth rather than simply searching for the "right" answer. It also develops in students a strong appreciation for uncertainty in laboratory analysis. Lab analyses will make use of a suite of Vernier sensors plus Vernier video analysis software for the Ipad and Excel-based analysis packages. For the formal labs, students will prepare formal reports of method, results, and discussions. For the mini labs, no formal reports are required.

Classroom Sessions

Classroom sessions are designed to supplement the laboratory inquiries. Because real physical phenomena involve the simultaneous application of multiple concepts (force *and* conservation of energy for example) classroom sessions will "spiral" through the important concepts. Relatively little classroom time will be spent in lecture. Instead, a governing principle will be briefly introduced and students will work collaboratively in pairs to examine various theoretical permutations of the concept.

Course Websites

This syllabus, daily course updates, plus links to all course handouts is available at:

http://corbett.k12.or.us/teacher-notes/mr-pearsons-notes/

In addition, you can check your course grade at:

http://corbett.k12.or.us/online-grades/

Course Prerequisites and Weighting

In order to be successful in this course, you will need to have obtained a B or better in Freshman Science and Algebra 2. You must also have completed or be simultaneously enrolled in AP Calculus. You may also enroll by instructor's consent. Your final marks in the course will be based upon the following weighting scheme:

Exams	35%
Laboratory Reports	25%
Daily Problem Sets	20%
Mini Labs	20%

Course timeline:

This course runs for the entire year (37 weeks). Corbett HS is in session 4 days per week, giving us 148 total class days. The final 8 class days occur after the AP testing window (all of you will be taking multiple AP exams), leaving us 140 class sessions to prepare for the AP exam. Of those available days, approximately 30 will be devoted to lab work (data collection, data analysis) and 6 will be devoted to exams. It's important that we use our class time very efficiently, meaning that your preparation prior to class is imperative. Translation – do your homework and come with questions!

Textbook

University Physics with Modern Physics second edition by Bauer W. and Westfall, G., McGraw Hill Publishing

Words from the Wise

This course is more narrowly focused that most AP classes, but what it lacks in breadth of coverage, it more than makes up for in depth of analysis. Ask lots of questions. Don't assume that you're the only one in the room who is confused. Form study groups because your peers are your best allies in this effort.

Formal Lab Investigations and Related Classroom Concepts

Lab One: Basic kinematics, essential quantities

Time Required: 2 days

Question:	How do position, velocity, and acceleration relate to one another?
Description:	Students produce motions using physics carts, rolling objects, and themselves to produce pre specified position, velocity, and acceleration vs. time graphs
Primary Concept(s):	Kinematics in 1 dimension
Laboratory Tools:	Vernier range finder, physics cart, pulleys, ramps as selected by

	student
Content Area(s) Addressed:	Newtonian Mechanics: Motion in one dimension

Lab Two: Motion under a constant force

Time Required: 2 days

Question:	How does an object move when acted upon by a constant force?
Description:	Students are provided a physics cart and asked to develop a mathematical description of the motion of the object under the influence of a constant force.
Primary Concept(s):	Newton's second law in the presence and absence of friction, kinematics in 1 dimension, application of linear regression
Laboratory Tools:	Vernier range finder, physics cart, pulleys, ramps as selected by student
Content Area(s) Addressed (See "learning objectives"):	Newtonian Mechanics: Motion in one dimension; Newton's laws of motion: Static equilibrium,. Dynamics of a single particle.

Lab Three: Motion of systems of two bodies

Time Required: 2 days

Question:	Can an unknown mass be measured using a pulley and a string?
Description:	Students are provided with a key and asked to find its mass. The Attwood's machine will have been introduced as a potential method for accomplishing this task.
Primary Concept(s):	Attwood's machine, vector addition of forces, Newton's second and third laws, applications of derivatives, vector analysis in 1 dimension
Laboratory Tools:	Vernier range finder, pulleys, lab masses as selected by student
Content Area(s) Addressed (See "learning objectives"):	Newton's laws of motion: Static equilibrium, Systems of two or more objects

Lab Four: Energy in pendulums

Time Required: 2 days

Question:	Is energy conserved in a pendulum?
Description:	Students analyze a simple pendulum for conservation of energy

Primary Concept(s):	Potential energy and force, kinetic energy, conservation of energy
Laboratory Tools:	Vernier range finder
Content Area(s) Addressed (See "learning objectives"):	Work, energy, and power: Work and the Work Energy Theorem; Forces and Potential Energy parts a,b, conservation of energy

Lab Five: Work, power, and machine efficiency

Time Required: 1 day

Question:	Can you build the most efficient 1 meter machine?
Description:	Students are provided with sample materials and asked to build a machine capable of moving a 1.0 kg mass 1.0 meters along a horizontal surface. Machine effectiveness will be computed according to: (work in + power)/total mass.
Primary Concept(s):	Work, power, friction, machine efficiency, power
Laboratory Tools:	Vernier range finder
Content Area(s) Addressed (See "learning objectives"):	Work, Energy, Power: Power; Systems of Particles, Linear Momentum: Impulse and Momentum;

Lab Six: Mass and the period of oscillation

Time Required: 1 day

Question:	Can the mass of a key be measured using a stop watch, a spring, and a mass?
Description:	Students are provided with a ruler, a spring, a mass, and a key and asked to measure the mass of they key.
Primary Concept(s):	Simple and damped harmonic oscillators, simple differential equations, Hooke's law, distance-dependant forces and potential energy functions.
Laboratory Tools:	Stop watch
Content Area(s) Addressed (See "learning objectives"):	Oscillations and Gravitation: Simple Harmonic Motion; Mass on a Spring parts; Pendulums and other oscillations;

Lab Seven: Gravity and the center of mass of a system

Time Required: 2 days

Question:	Does gravity act on the center of mass of a system of particles?
Description:	Students construct a system of particles by placing balls of clay of known masses on bent and unbent lengths of coat hanger. Students then compute the center of mass in each case and analyze the trajectory as the resulting object is tossed.
Primary Concept(s):	Center of mass of a system of discrete objects
Laboratory Tools:	Vernier video analysis software on Ipad
Content Area(s) Addressed (See "learning objectives"):	Systems of Particles, Linear Momentum: Center of Mass;

Lab Eight: Air resistance and parachutes

Time Required: 1 day

Question:	Can you build the best parachute?
Description:	Students are provided with candidate materials and a standard mass and asked to construct the best-possible parachute. Parachute performance is measure in terms of the total frictional force generated divided by the mass of the materials used.
Primary Concept(s):	Velocity-dependent forces, terminal velocity, conservation of energy
Laboratory Tools:	Vernier range finder
Content Area(s) Addressed (See "learning objectives"):	Newton's Laws of Motion: Dynamics of a Single Particle;

Lab Nine: Collisions of multiple bodies in two dimensions

Time Required: 3 days

Question:	Are billiard ball collisions elastic?
Description:	Using a standard pool table and billiard balls, students analyze multiple-body collisions for conservation of momentum and kinetic energy
Primary Concept(s):	Conservation of momentum and kinetic energy, vector analysis in 2 dimensions
Laboratory Tools:	VideoPoint, digital camcorder
Content Area(s) Addressed (See "learning objectives"):	Systems of Particles, Linear Momentum: Impluse and Momentum; Conservation of Linear Momentum;

Labs Ten and Eleven: Moment of inertia and angular acceleration

Time Required: 3 days

Question:	Can an unknown mass be measured using a wheel and a string?
Description:	First students measure the moment of inertia of a bicycle wheel by wrapping a string attached to a known mass around the wheel and measuring the resulting linear acceleration of the mass as it is dropped. Next, students are asked to compute the mass of an unknown object using the same wheel.
Primary Concept(s):	Moment of inertia, torque, circular motion, center of mass of continuous objects, angular acceleration
Laboratory Tools:	Vernier range finder
Content Area(s) Addressed (See "learning objectives"):	Circular Motion and Rotation: Uniform circular motion; Torque and Rotational Statics; Rotational Kinematics and Dynamics;

Labs Twelve: Conservation of angular momentum

Time Required: 2 days

Question:	Does a professional dancer conserve angular momentum?
Description:	Dancers from local troupe are recorded as they perform various rotational maneuvers and the motion quantitatively analyzed for conservation of angular momentum and energy loss due to friction
Primary Concept(s):	Moment of inertia, torque, rotational kinematics, conservation of angular momentum, conservation of linear and angular momentum in collisions
Laboratory Tools:	VideoPoint, digital camcorder
Content Area(s) Addressed (See "learning objectives"):	Circular Motion and Rotation: Uniform circular motion; Torque and Rotational Statics parts; Rotational Kinematics and Dynamics; Angular Momentum and its Conservation;

Lab Thirteen: Orbital mechanics

Time Required: 2 days

Question:	Can a comet on a collision course with Earth be deflected?
Description:	Using Real Physics (Ipad App) as visualization tool, students plot trajectory of a comet on a collision course for earth and compute the force required to deflect the comet and avoid the collision.
Primary Concept(s):	Universal Graviation, Kepler's laws, potential energy in inverse-square

	forces
Laboratory Tools:	Real Physics Ipad app, Excel
Content Area(s) Addressed	Oscillations and Gravitation: Newton's Law of Gravity; Orbits of Planets and Satellites;

Mini Labs (Generally 1 day in duration, no formal write up of results) – Concepts covered and equipment listed in parenthesis)

- Locating the center of mass of a hammer (Center of mass – Vernier video app)
- Centripetal human bowling (Centripetal force, linear velocity – PE carts and a rope)
- Centripetal human spin off (Moment of inertia – PE carts and a rope)
- How many accelerators does a car have (Newton's 2^{nd} law – 1 school bus)
- Measuring the angle of a access ramp (Vectors, NSL – 1 stop watch, physics cart)
- Energy stored in a spring (Intro to potential energy in a spring – frictionless cart, spring, meter stick)
- Keep your head dry (Centripetal force and period – stop watch, bucket, some water)