Course Title: Advanced Placement Physics B

Meeting Times: This class meets every other school day for 36 weeks. Each class period is 85 minutes in length. 30% of the class time will be dedicated to laboratory exercises.

Course Description:

AP Physics B provides an orderly development of the fundamental concepts and principles of physics with an emphasis on inquiry and critical thinking skills including: problem solving, mathematical reasoning, and experimental investigations. Topics of study from classical and modern physics include: Newtonian mechanics, fluid mechanics and thermal physics, electricity and magnetism, waves and optics, and atomic and nuclear physics. Laboratory work is an integral component of this course. Technology including graphing calculators, probeware, graphing and data analysis software, and physics apparatus is used throughout this course.

Though our system has an open enrollment policy, students should understand that this course is designed to be a second year physics course, and the equivalent of a yearlong introductory, algebra-based, college level physics course. The course requires a working knowledge of physics, algebra and basic trigonometry. The breadth, pace and depth of material covered exceeds the standard high school Physics course, as does the college-level textbook, laboratory work, and time and effort required of students. This course provides the physics foundations for college majors in the life sciences, pre-medicine, applied sciences, and non-science fields. AP Physics B provides a more conceptual understanding and approach than AP Physics C. Students are expected to take the AP Physics B Exam at the end of this course.

Course Purpose and Goals:

Philosophy

Scientific inquiry is the basis of this course. Scientific inquiry is defined as the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work. Scientific inquiry also refers to the activities through which students develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world (NSTA, 2004). This includes active use of the well-designed investigation in which students: 1) form testable questions and hypotheses, 2) design and conduct appropriate investigative procedures, including the identification and control of appropriate variables, 3) organize, display and critically analyze results, 4) draw inferences, summarize results and develop conclusions, and 5) communicate their results for critique by others. Based on the philosophy that scientific knowledge is best acquired through inquiry, the course uses a variety of techniques to promote inquiry in the classroom (ex. multiple revisions, high quality questioning, synthesis, making conclusions based on evidence, etc).

Instruction is designed and sequenced to provide students with learning opportunities in the appropriate settings. They include laboratories, classrooms, forms of technology, and field studies. Teaching strategies include in depth laboratory investigations, demonstrations, collaborative peer-to-peer discussions, and student hands-on experiences. Inquiry requires adequate and timely access to the technology of scientific investigations including computers, internet and online resources, probeware,

graphing calculators, databases, spreadsheets, word processes and presentation software, as well as the experimental apparatus of physics.

Goals

1. To understand the fundamental concepts and principles of physics through the investigation of physical phenomena, theories and experimental methods.
2. To develop problem solving skills, and mathematical reasoning, through the active asking and answering of testable questions, and employing the components of a well-designed experimental investigation.
3. To foster scientific habits of mind including curiosity, creativity, and objectivity.
4. To understand the interconnections of physics to the other sciences, society, culture, and technology.

Conceptual Organization

The students are exposed to the equivalent of a college introductory Physics course, meaning that the content and level of depth of the material is equivalent to a college level course. As with university courses, it is expected that students will be independent learners. Scientific inquiry is an integral component of this course, the elements of the well-designed investigation and the nature of the scientific methods are taught within the context of the topics, rather than treated as a separate introductory unit. As students investigate phenomena they extend their understanding of forming testable questions and hypotheses. Laboratory techniques are learned in the direct application of their use, rather than as a generic exercise isolated from their setting of application. Methods to collect, organize and display data are taught within the authentic use of real experimental data. This approach of learning uses the investigative skills within and throughout the authentic need of using and applying the skills.

The content and level of depth of the material is equivalent to a college level course. Topics within the course are developed in the historical and complexity developments of physics. Topics in mechanics precede Newton's laws, since the concepts of velocity and acceleration are fundamental to understanding force, work, energy and power. Impulse and momentum are covered before circular motion and rotation to provide appropriate understandings before investigating torque and harmonic motion. This work supports the study of kinetic theory and thermodynamics. Studies in electricity and magnetism precede topics in waves and optics in order to provide sequential understanding to the electromagnetic spectrum and atomic and nuclear physics.

The order of topics within the course, not only provides a logical and systemic study to physics, but also accommodates the frequent transfer of students within the schools of the system, so that transfer students can maintain a consistent flow of learning.

Course Format and Policies:

Below are the grading criteria and the grading scale for this course.

Grading Criteria

- Tests 40%
- Homework Complete 15%
- Homework Correct 15%
- Quizzes 10%
- Labs 20%

Grading Scale

A+	97 – 100%
A	93 – 96%
A-	90 – 92%
B+	87 – 89%
B	83 – 86%
B-	80 – 82%
C+	77 – 79%
C	73 – 76%
C-	70 – 72%
D+	67 – 69%
D	63 – 66%
D-	60 – 62%
F	Below 60%

Weighted grades are calculated for students completing the course and taking the requisite exam of an AP course.

Unweighted Scale A=4	Weighted Scale A=5
Unweighted Scale B=3	Weighted Scale B=4
Unweighted Scale C=2	Weighted Scale C=3
Unweighted Scale D=1	Weighted Scale D=2
Unweighted Scale F=0	Weighted Scale F=0

Homework will be assigned almost daily. The student is expected to have the homework assignment complete at the beginning of the next class period. There will also be daily quizzes at the beginning of each class period. All students need to be prepared for these quizzes daily.

Textbook, Materials and Other Resources:

Required Textbook

- Giancoli, Douglas C. (2003). *Physics principles with applications, 5th ed.,* Upper Saddle River, NJ: Prentice Hall/Pearson Education.

Supplemental Textbooks and Reading

- Puri, O. P., Zober, P. J. & Zober G. P. (2001). *Physics a laboratory manual,* Boston, MA: Pearson Custom Publishing.

Other Resources

- Laboratory classroom that includes the space, facilities and equipment to conduct hands-on, inquiry-based investigations.

- Data gathering, graphing, analysis and presentation software including databases, spreadsheets and Vernier and LabPro interfaces.
- TI 83+ or TI 84 Graphing calculators.
- Internet access and online resources.
    - Hwang, F. *NTNU Virtual Physics laboratory*, Retrieved on January 24, 2007 from http://www.phy.ntnu.edu.tw/java/index.html.
    - *Physics 2000*, Retrieved on January 24, 2007 from http://www.colorado.edu/physics/2000/cover.html.

Course Content Outline

Unit	Quarter	Week	Topics	Laboratory	Major Assessments
1 Describing Motion: Kinematics in One Dimension	1	1-2	Reference Frames & Displacement Average Velocity Instantaneous Velocity Acceleration Motion At Constant Acceleration	Graphical Analysis Measurements	Laboratory Journals
2 Kinematics in Two Dimensions: Vectors	1	2-3	Addition & Subtractions Of Vectors Projectile Motion Relative Velocity	Uniform Accelerated Motion	Laboratory Journals
3 Motion & Force: Dynamics	1	4-6	Force Mass Newton's First Laws Of Motion	Composition and Resolution of Forces Newton's Second Law of Motion	Test 1: Unit 1-3 Multiple Choice, Problems, Constructed Response Laboratory Journals
4 Circular Motion; Gravitation	1	7	Kinematics Of Uniform Circular Motion Dynamics Of Uniform Circular Motion Torque Newton's Law Of Universal Gravitation Satellites & "Weightlessness" Kepler's Laws	Acceleration Due to Gravity Atwood Machine Centripetal Force	Laboratory Journals
5 Work & Energy	1	8-10	Work Done By A Forces Work-Energy Principle Kinetic Energy Potential Energy Conservative & Nonconservative Forces The Law Of Conservation Of Energy Power	Friction	Test 2: Unit 4-5 Multiple Choice, Problems, Constructed Response Laboratory Journals

6 Linear Momentum	1	11	Momentum And Its Relation To Force Conservation Of Momentum Collisions & Impulse Elastic Collisions In One-Dimension Inelastic Collisions	Elastic Collisions Inelastic Collisions	Test 3: Unit 6 Multiple Choice, Problems, Constructed Response Laboratory Journals
7 Fluids	2	12	Pressure In Fluids Atmospheric & Gauge Pressure Pascal's Principle Buoyancy & Archimedes' Principle Fluids In Motion Bernoulli's Equation		Laboratory Journals
8 Vibrations & Waves	2	13	Simple Harmonic Motion Energy In Simple Harmonic Oscillator Period & Sinusoidal Nature Of SHM Simple Pendulum Wave Motion Types Of Waves Reflection & Interference Of Waves Standing Waves & Resonance	Vibratory Motion of a Spring Simple Pendulum Standing Waves	Test 4: Unit 7-8 Multiple Choice, Problems, Constructed Response Laboratory Journals
9 Sound	2	14-15	Characteristics Of Sound Intensity Of Sound Interference Of Sound Waves	Velocity of Sound	Test 5: Unit 9 Multiple Choice, Problems, Constructed Response Laboratory Journals
10 Temperature, Kinetic Theory, & Heat	2	16-17	Thermal Expansion Gas Laws & Absolute Temperature Ideal Gas Law Internal Energy Of An Ideal Gas Temp., Heat, & Internal Energy	Linear and Volumetric Expansion Specific Heat Change of Phase	Laboratory Journals Long Term Inquiry Project

11 Laws of Thermodynamics	2	18	Laws Of Thermodynamics Heat Engines		Test 6: Unit 11 Multiple Choice, Problems, Constructed Response Laboratory Journals Semester 1 Assessment Multiple Choice, Problems, Constructed Response
12 Electric Charge & Electric Field	3	19-20	Static Electricity Electric Charge In The Atom Insulators & Conductors Induced Charge Coulomb's Law The Electric Field	Electric Field	Test 7: Unit 12 Multiple Choice, Problems, Constructed Response Laboratory Journals
13 Electric Potential & Electric Energy: Capacitance	3	21-22	Electric Potential / Potential Difference Electric Potential & Electric Field Capacitance Dielectrics		Test 8: Unit 13 Multiple Choice, Problems, Constructed Response Laboratory Journals
14 Electric Currents	3	23-24	Electric Battery Electric Current Ohm's Law Resistivity Electric Power Power In Household Circuits	Electricity	Laboratory Journals
15 DC Circuits	3	25-26	Resistors In Series & Parallel EMF Kirchhoff's Rules Emfs In Series And Parallel Capacitors In Series & Parallel RC Circuits	Resistors and Ohm's Law Resistors in Series and Parallel	Test 9: Unit 14-15 Multiple Choice, Problems, Constructed Response Laboratory Journals

16 Magnetism	4	27-28	Electric Currents & Magnetic Fields Ampère's Law		Test 10: Unit 16 Multiple Choice, Problems, Constructed Response Laboratory Journals
17 Electromagnetic Induction	4	29-30	Induced EMF Faraday's Law Lenz's Law EMF In A Moving Conductor Inductance		Test 11: Unit 17 Multiple Choice, Problems, Constructed Response Laboratory Journals
18 Light	4	31-33	Light As EM Wave Reflection & Refraction Lenses & Mirrors Visible Spectrum & Dispersion Interference Diffraction	Snell's Law Lenses	Test 16: Unit 18 Multiple Choice, Problems, Constructed Response Laboratory Journals
19 Atomic & Nuclear Physics	4	34-36	Photon Theory Wave-Particle Duality Atomic Spectra Bohr Model Quantum Mechanics Mass-Energy Equivalence Conservation Of Nucleon Number Nuclear Reactions	Diffraction	Laboratory Journals Semester 2 Assessment Multiple Choice, Problems, Constructed Response Long Term Inquiry Project

Laboratory Experience

Laboratory investigations are an integral component of this course, making up 20% of the course grade. These investigations are equivalent to those in a college level laboratory course. The lab work in this course supports, enhances and extends the concepts and principles presented in the classroom. They also provide students with the opportunity to learn and apply new laboratory skills, foster collaborative relationships with others, and improve problem-solving skills.

The laboratory investigations are inquiry based, student-centered and are a primary vehicle for learning the fundamental concepts and principles of physics. This includes active use of the well-designed investigation in which students 1) form testable questions and hypotheses, 2) design and conduct appropriate investigative procedures, including the identification and control of appropriate variables, 3) organize, display and critically analyze results, and conduct error analysis, 4) draw inferences, summarize results and develop conclusions, and 5) communicate their results for critique by others. Laboratory investigations reflect a balance of structured, guided and open-ended inquiry.

Students are required to maintain and keep a laboratory journal. Because colleges often require students to present their laboratory materials from AP courses before granting college credit for laboratory, students are expected to retain their laboratory notebooks, reports, and other materials.

Lab Exercise	Description*	Goal	Time	Inquiry
Student Inquiry Project	Students select and investigate a topic of their choice in which they ask and answer a testable question using an experimental, well-designed investigation.	Demonstrate the skills and process of conducting a well-designed experimental investigation, and develop a deeper understanding to a topic of interest, selected by the student.	Semester long	Student Conducted
Graphical Analysis	Students will become familiar with the use of graphs in the analysis of experimental data.	Students will be able to use graphs to analyze experimental data.	0.5 hrs	Student Conducted
Measurements	Students will investigate the process of measurement and determine the accuracy of various measuring instruments.	Students will be gain the ability to make accurate measurements in a laboratory setting.	0.5 hrs	Student Conducted
Uniform Accelerated Motion	Students will study uniformly accelerated motion in this lab.	Students will gain a deeper understanding of uniformly accelerated motion.	1 hr	Student Conducted
Composition and Resolution of Forces	Students will use analytical, graphical, and experimental methods to determine the resultant of equilibrant of several sets of forces.	Students will be able to find the resultant and equilibrant of several sets of forces.	0.5 hrs	Student Conducted
Newton's Second Law of Motion	Students will determine experimentally the relationship between force, acceleration and mass.	Students will gain a deeper understanding of the relationship between force, acceleration and mass.	1 hr	Student Conducted
Acceleration Due to Gravity	Students will experimentally determine the acceleration constant due to gravity.	Students will understand that acceleration due to gravity is constant.	1 hr	Student Conducted

Atwood Machine	Students will study Newton's Second Law of Motion by the use of the Atwood Machine.	Students will be able to apply their knowledge of Newton's Second Law of Motion.	1.5 hrs	Student Conducted
Centripetal Force	Students will determine the relationship between the centripetal force and the frequency of rotation.	Students will gain a deeper understanding of the dynamics of rotational motion.	1.5 hrs	Student Conducted
Friction	Students will determine the coefficients of friction (static and kinetic) between two bodies.	Students will gain a deeper understanding of static and kinetic friction and be able to apply this understanding in a laboratory setting.	1 hr	Student Conducted
Elastic Collisions	Students will evaluate elastic collisions between bodies of equal masses.	Students will gain a deeper understanding of elastic collisions.	1.5 hrs	Student Conducted
Inelastic Collisions	Students will demonstrate the conservation of momentum for an inelastic collision.	Students will gain a deeper understanding of inelastic collisions.	1.5 hrs	Student Conducted
Vibratory Motion of a Spring	Students will verify the laws of simple harmonic motion for a spring.	Students will develop an understanding of Hooke's Law and the harmonic nature of springs.	1 hr	Student Conducted
Simple Pendulum	Students will study a simple pendulum and the factors that determine the period of the pendulum. Students will also use the pendulum to determine the acceleration due to gravity constant.	Students will gain a deeper understanding of pendulum motion and the factors that affect the period of a pendulum.	1.5 hrs	Student Conducted

Standing Waves	Students will study a transverse wave propagating through a string, observing the standing wave pattern produced in the string. Students will determine the linear mass density of the string.	Students will gain a deeper understanding of the properties of standing waves.	1 hr	Student Conducted
Velocity of Sound	Students will study the phenomenon of resonance and measure the velocity of sound in air.	Students will be able to experimentally measure the speed of sound in air.	1.5 hrs	Student Conducted
Linear and Volumetric Expansion	Students will determine the coefficients of linear and volumetric expansion of a solid.	Students will be able to experimentally determine the coefficients of linear and volumetric expansion for given solids.	1.5 hrs	Student Conducted
Specific Heat	Students will determine the specific heat of a solid using the method of mixtures.	Students will be able to experimentally determine the specific heat of a solid.	1.5 hrs	Student Conducted
Change of Phase	Students will determine the heats of fusion and vaporization of water.	Students will gain a deeper understanding of heats of fusion and vaporization and the role they play in the change of phase process.	1.5 hrs	Student Conducted
Electric Field	Students will explore, using computer simulated static charges, electric field lines and electric field intensity vectors that surround combinations of charges.	Students will be able to determine and draw electric field lines for sets of point charges.	0.5 hrs	Student Conducted

Electricity	Students will study methods of understanding electrical charges and their behavior.	Students will gain a deeper understanding of the nature of electric charges.	1.5 hrs	Student Conducted
Resistors and Ohm's Law	Students will investigate the properties of resistors and verify Ohm's Law.	Students will gain a hands-on understanding of resistance and learn how to apply Ohm's Law.	1.5 hrs	Student Conducted
Resistors in Series and Parallel	Students will show that current is the same and voltage is additive in a series circuit. Students will also show that voltage is the same and current is additive for a parallel circuit.	Students will be able to apply the relationships between voltage and current to series-parallel networks.	1 hr	Student Conducted
Snell's Law	Students will study Snell's law and determine the speed of light in water and ethanol.	Students will be able to experimentally determine the speed of light in a substance.	1.5 hrs	Student Conducted
Lenses	Students will determine the focal length of convex lenses.	Students will gain a deeper understanding of lenses and the properties of lenses.	1.5 hrs	Student Conducted
Diffraction	Students will determine the wavelength of a laser by means of a diffraction grating.	Students will gain a deeper understanding of the nature of light.	1.5 hrs	Student Conducted

* All laboratory experiments will be inquiry based and student-centered.

Assessment:

Assessment and evaluation are essential to learning and teaching. Ongoing assessment and evaluation are significant in supporting student achievement, motivating student performance and providing the basis upon which teachers make meaningful instructional decisions. All aspects of progress in science are measured using multiple methods such as authentic assessments, performance assessments, formative assessments, observational assessments, lab reports, projects, research activities, reports, and conventional summative assessments. Formative assessments are used to check student understanding while learning is occurring, and provide students and teachers with learning progress information. Formative assessments are not used to determine grades. Summative assessments, such as unit and semester tests, evaluate student achievement, and along with other measures such as laboratory and project work are data points used to determine the level of student performance.

Assessment Type	Goal	Description
Laboratory Journals	To assess understanding of chemistry concepts, principles, and application of skills and processes of the laboratory.	Students maintain laboratory journals of all lab work. It includes lab notes, data, graphs, and responses to questions, lab write-ups, error analysis, and further questions. Students are encouraged to keep their lab journals to demonstrate lab activity in a college AP review.
Unit Tests	To assess understanding of concepts, principles, applications, and techniques of physics.	45-60 minute tests containing multiple-choice items, problems to solve, and constructed response items.
Semester Assessments	To assess understanding of concepts, principles, applications, and techniques of physics for several units.	60-90 minute tests containing multiple-choice items, problems to solve, and constructed response items.
Long-term Student Inquiry Project	Demonstrate the skills and process of conducting a well-designed experimental investigation, and develop a deeper understanding to a topic of interest, selected by the student.	Students select and investigate a topic of their choice in which they ask and answer a testable question using an experimental, well-designed investigation.

Supporting Services:

Students are encouraged to work with the instructor before or after school as well as during seminar period for extra assistance in their studies. There are tutors available after school on Mondays as well.