

Mifflin County School District Planned Instruction

Title of Planned Instruction: AP Physics C: Mechanics

Subject Area: Science

Grade Levels: 11-12

Prerequisites: Biology I, Chemistry I, and Physics I. Prior or concurrent course work in calculus is highly recommended.

Course Description: The AP Physics C: Mechanics course provides students with a learning experience equivalent to that of a semester-long, calculus-based college course in physics that includes a laboratory component. The course is devoted to Newtonian mechanics. Introductory differential and integral calculus is used throughout the course and on the AP Physics C: Mechanics Exam. The course utilizes guided inquiry and student-centered learning to foster the development of critical thinking skills.

Required Time: 1 Year

Course Credit: 1 Credit

Major Text(s) and Resources:

Halliday, D., Resnick, and J. Walker. Fundamentals of Physics. 5th ed. New York: John Wiley & Sons, Inc., 1997

Young, Hugh D. and Roger A. Freedman. Sears and Zemansky's University Physics, 11th ed. San Francisco, CA: Pearson Education, Inc., 2004.

Names of District Subject Area Curriculum Writing Committee:

Raymond R. Hoppel
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Date of Board Approval:

Standard: 3.1.12 Unifying Themes

Units: All

Grade Level Objectives	Performance Indicators	Assessments
<p>A. Apply concepts of systems, subsystems, feedback and control to solve complex technological problems.</p>	<ul style="list-style-type: none"> • Apply knowledge of control systems concept by designing and modeling control systems that solve specific problems. • Apply systems analysis to predict results. • Analyze and describe the function, interaction and relationship among subsystems and the system itself. • Compare and contrast several systems that could be applied to solve a single problem. • Evaluate the causes of a system's inefficiency. 	<ul style="list-style-type: none"> • Student-designed and constructed projects with rubrics • Teacher observation of student discussions during design project work
<p>B. Apply concepts of models as a method to predict and understand science and technology.</p>	<ul style="list-style-type: none"> • Evaluate technological processes by collecting data and applying mathematical models (e.g., process control). • Apply knowledge of complex physical models to interpret data and apply mathematical models. • Appraise the importance of computer models in interpreting science and technological systems 	<ul style="list-style-type: none"> • Teacher observation of student discussions during design project work • Student-designed and constructed projects with rubrics • Teacher observation of student use of MacMotion software applications and probeware
<p>C. Assess and apply patterns in science and technology.</p>	<ul style="list-style-type: none"> • Assess and apply recurring patterns in natural and technological systems. • Compare and contrast structure and function relationships as they relate to patterns. • Assess patterns in nature using mathematical formulas. 	<ul style="list-style-type: none"> • Teacher observation of student discussions during design project work • Student-designed and constructed projects with rubrics • Teacher observation of student use of MacMotion software applications and probeware

D. Analyze scale as a way of relating concepts and ideas to one another by some measure.	<ul style="list-style-type: none"> • Compare and contrast various forms of dimensional analysis. • Assess the use of several units of measurement to the same problem. • Analyze and apply appropriate measurement scales when collecting data. 	<ul style="list-style-type: none"> • Constructed response word problems for mechanical efficiency, for example • Teacher observation of students' ongoing experiment work
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E. Evaluate change in nature, physical systems and man made systems.	<ul style="list-style-type: none"> • Evaluate fundamental science and technology concepts and their development over time (e.g., unified field theory, energy measurement). • Analyze how models, systems and technologies have changed over time. • Explain how correlation of variables does not necessarily imply causation. • Evaluate the patterns of change within a technology (e.g., changes in engineering in the automotive industry). 	<ul style="list-style-type: none"> • Teacher observation of students' ongoing experiment work • Constructed response word problems for mechanical efficiency, for example • Teacher observation of student discussions during design project work
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Standard: 3.2.12 Inquiry and Design

Units: All

Grade Level Objectives	Performance Indicators	Assessments
A. Evaluate the nature of scientific and technological knowledge.	<ul style="list-style-type: none"> • Know and use the ongoing scientific processes to continually improve and better understand how things work. • Critically evaluate the status of existing theories (e.g., wave theory of light, classification of subatomic particles). 	<ul style="list-style-type: none"> • Student-designed and constructed projects with rubrics • Constructed response tests with word problem calculations

<p>B. Evaluate experimental information for appropriateness and adherence to relevant science processes.</p>	<ul style="list-style-type: none"> • Evaluate experimental data correctly within experimental limits. • Judge that conclusions are consistent and logical with experimental conditions. • Interpret results of experimental research to predict new information or improve a solution. 	<ul style="list-style-type: none"> • Teacher observation of students' ongoing experiment work • Evaluation of student laboratory reports with guidelines
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<p>C. Apply the elements of scientific inquiry to solve multi-step problems.</p>	<ul style="list-style-type: none"> • Generate questions about objects, organisms and/or events that can be answered through scientific investigations. • Evaluate the appropriateness of questions. • Design an investigation with adequate control and limited variables to investigate a question. • Organize experimental information using analytic and descriptive techniques. • Evaluate the significance of experimental information in answering the question. • Project additional questions from a research study that could be studied 	<ul style="list-style-type: none"> • Evaluation of student laboratory reports with guidelines • Teacher observation of students' ongoing experiment work • Student-designed and constructed projects with rubrics
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<p>D. Analyze and use the technological design process to solve problems.</p>	<ul style="list-style-type: none"> • Assess all aspects of the problem, prioritize the necessary information and formulate questions that must be answered. • Propose, develop and appraise the best solution and develop alternative solutions. • Implement and assess the solution. • Evaluate and assess the solution, redesign and improve as necessary. • Communicate and assess the process and evaluate and present the impacts of the solution. 	<ul style="list-style-type: none"> • Evaluation of student laboratory reports with guidelines • Teacher observation of students' ongoing experiment work • Student-designed and constructed projects with rubrics
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Standard: 3.4.12 Physical Science, Chemistry and Physics

Units: All

Grade Level Objectives	Performance Indicators	Assessments
A. Explain concepts about the structure and properties of matter.	<ul style="list-style-type: none">• Classify and describe, in equation form, types of chemical and nuclear reactions.• Explain how radioactive isotopes that are subject to decay can be used to estimate the age of materials.• Explain how the forces that bind solids, liquids and gases affect their properties.• Apply the conservation of energy concept to fields as diverse as mechanics, nuclear particles and studies of the origin of the universe.• Apply the predictability of nuclear decay to estimate the age of materials that contain radioactive isotopes.• Quantify the properties of matter (e.g., density, solubility coefficients) by applying mathematical formulas.	<ul style="list-style-type: none">• Constructed response tests with word problem calculations• Evaluation of student laboratory reports with guidelines• Teacher observation of students' ongoing experiment work
B. Apply and analyze energy sources and conversions and their relationship to heat and temperature.	<ul style="list-style-type: none">• Determine the heat involved in illustrative chemical reactions.• Evaluate mathematical formulas that calculate the efficiency of specific chemical and mechanical systems.• Use knowledge of oxidation and reduction to balance complex reactions• Apply appropriate thermodynamic concepts (e.g., conservation, entropy) to solve problems relating to energy and heat.	<ul style="list-style-type: none">• Constructed response tests with word problem calculations• Evaluation of student laboratory reports with guidelines• Teacher observation of students' ongoing experiment work

<p>C. Apply the principles of motion and force.</p>	<ul style="list-style-type: none"> • Evaluate wave properties of frequency, wavelength and speed as applied to sound and light through different media. • Propose and produce modifications to specific mechanical power systems that will improve their efficiency. • Analyze the principles of translational motion, velocity and acceleration as they relate to free fall and projectile motion. • Analyze the principles of rotational motion to solve problems relating to angular momentum, and torque. • Interpret a model that illustrates circular motion and acceleration. • Describe inertia, motion, equilibrium, and action/reaction concepts through words, models and mathematical symbols. 	<ul style="list-style-type: none"> • Constructed response tests with word problem calculations • Evaluation of student laboratory reports with guidelines • Teacher observation of students' ongoing experiment work • Student-designed and constructed projects with rubrics • Teacher observation of student discussions during design project work
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Standard: 3.6.12 Technology Education

Unit(s):

Grade Level Objectives	Performance Indicators	Assessments
<p>B. Analyze knowledge of information technologies of processes encoding, transmitting, receiving, storing, retrieving and decoding.</p>	<ul style="list-style-type: none"> • Apply various graphic and electronic information techniques to solve real world problems (e.g., data organization and analysis, forecasting, interpolation). 	<ul style="list-style-type: none"> • Teacher observation of student use of MacMotion software applications and probeware
<p>C. Analyze physical technologies of structural design, analysis and engineering, personnel relations, financial affairs, structural production, marketing, research and design to real world problems.</p>	<ul style="list-style-type: none"> • Apply knowledge of construction technology by designing, planning and applying all the necessary resources to successfully solve a construction problem. • Compare resource options in solving a specific manufacturing problem. • Analyze and apply complex 	<ul style="list-style-type: none"> • Student-designed and constructed projects with rubrics • Constructed response word problems for mechanical efficiency, for example • Teacher observation of student discussions during design project work • Teacher observation of

	<p>skills needed to process materials in complex manufacturing enterprises.</p> <ul style="list-style-type: none"> • Apply advanced information collection and communication techniques to successfully convey solutions to specific construction problems. • Assess the importance of capital on specific construction applications. • Analyze the positive and negative qualities of several different types of materials as they would relate to specific construction applications. • Analyze transportation technologies of propelling, structuring, suspending, guiding, controlling and supporting. • Analyze the concepts of vehicular propulsion, guidance, control, suspension and structural systems while designing and producing specific complex transportation systems. 	<p>student use of MacMotion software applications and probeware</p> <ul style="list-style-type: none"> • Teacher observation of students' ongoing experiment work
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Standard: 3.7.12 Technological Devices

Units: All

Grade Level Objectives	Performance Indicators	Assessments
<p>A. Apply advanced tools, materials and techniques to answer complex questions.</p>	<ul style="list-style-type: none"> • Demonstrate the safe use of complex tools and machines within their specifications. • Select and safely apply appropriate tools, materials and processes necessary to solve complex problems that could result in more than one solution. • Evaluate and use technological resources to solve complex multi-step problems. 	<ul style="list-style-type: none"> • Teacher observation of students' ongoing experiment work • Evaluation of student laboratory reports with guidelines

<p>B. Evaluate appropriate instruments and apparatus to accurately measure materials and processes.</p>	<ul style="list-style-type: none"> • Apply and evaluate the use of appropriate instruments to accurately measure scientific and technologic phenomena within the error limits of the equipment. • Evaluate the appropriate use of different measurement scales (macro and micro). • Evaluate the utility and advantages of a variety of absolute and relative measurement scales for their appropriate application. 	<ul style="list-style-type: none"> • Evaluation of student laboratory reports with guidelines • Teacher observation of students' ongoing experiment work • Student-designed and constructed projects with rubrics • Teacher observation of student discussions during design project work
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<p>C. Evaluate computer operations and concepts as to their effectiveness to solve specific problems.</p>	<ul style="list-style-type: none"> • Describe and demonstrate software installation. • Analyze and solve hardware and advanced software problems. • Assess and apply multiple input and output devices to solve specific problems. 	<ul style="list-style-type: none"> • Teacher observation of student use of MacMotion software applications and probeware
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<p>D. Evaluate the effectiveness of computer software to solve specific problems.</p>	<ul style="list-style-type: none"> • Evaluate the effectiveness of software to produce an output and demonstrate the process. • Design and apply advanced multimedia techniques. • Analyze, select and apply the appropriate software to solve complex problems. • Evaluate the effectiveness of the computer as a presentation tool. 	<ul style="list-style-type: none"> • Teacher observation of student use of MacMotion software applications and probeware
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E. Assess the effectiveness of computer communications systems.	<ul style="list-style-type: none"> • Assess the effectiveness of a computer based communications system. • Transfer files among different computer platforms. • Analyze the effectiveness of on-line information resources to meet the needs for collaboration, research, publications, communications and productivity. • Apply knowledge of protocol standards to solve connectivity problems. 	<ul style="list-style-type: none"> • Teacher observation of student use of MacMotion software applications and probeware
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Standard: 3.8.12 Science, Technology and Human Endeavors

Units: All

Grade Level Objectives	Performance Indicators	Assessments
A. Synthesize and evaluate the interactions and constraints of science and technology on society.	<ul style="list-style-type: none"> • Compare and contrast how scientific and technological knowledge is both shared and protected. • Evaluate technological developments that have changed the way humans do work and discuss their impacts (e.g., genetically engineered crops). • Evaluate socially proposed limitations of scientific research and technological application. 	<ul style="list-style-type: none"> • Student-designed and constructed projects with rubrics • Teacher observation of student discussions during design project work • Teacher observation of students' ongoing experiment work

<p>B. Apply the use of ingenuity and technological resources to solve specific societal needs and improve the quality of life.</p>	<ul style="list-style-type: none"> • Apply appropriate tools, materials and processes to solve complex problems. • Use knowledge of human abilities to design or modify technologies that extend and enhance human abilities. • Apply appropriate tools, materials and processes to physical, informational or biotechnological systems to identify and recommend solutions to international problems. • Apply knowledge of agricultural science to develop a solution that will improve on a human need or want. 	<ul style="list-style-type: none"> • Student-designed and constructed projects with rubrics • Teacher observation of student discussions during design project work • Teacher observation of students' ongoing experiment work
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<p>C. Evaluate the consequences and impacts of scientific and technological solutions.</p>	<ul style="list-style-type: none"> • Propose solutions to specific scientific and technological applications, identifying possible financial considerations. • Analyze scientific and technological solutions through the use of risk/benefit analysis. • Analyze and communicate the positive or negative impacts that a recent technological invention had on society. • Evaluate and describe potential impacts from emerging technologies and the consequences of not keeping abreast of technological advancements (e.g., assessment alternatives, risks, benefits, costs, economic impacts, constraints). 	<ul style="list-style-type: none"> • Student-designed and constructed projects with rubrics • Teacher observation of student discussions during design project work • Teacher observation of students' ongoing experiment work
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**District Recommended Instructional Approach For the Course
To Drive Teacher's Instructional Activities**

- Design and use project rubrics consistently within each grade level or course
- Evaluate laboratory activities by observation and by assessment of lab reports written in a teacher-designed format and aligned within each grade level or course
- Encourage and support student-designed laboratory activities wherever possible
- Assess students with selected and constructed response written tests
- Assign homework that is clearly relevant to the planned course's performance objectives
- Utilize technological resources such as the Internet and Microsoft Office applications whenever possible to support student achievement of course objectives
- Value textbooks and other printed materials as a valid way to support student performance during laboratory exercises and class work
- Emphasize and assign value to the importance of reading, writing and mathematical skills during all lessons and activities
- Supplement curricular material as student interest and motivation designate

Suggested Unit Outline

- I. Kinematics
- II. Newton's laws of motion
- III. Work, energy, and power
- IV. System of particles, linear momentum
- V. Circular motion and rotation
- VI. Oscillations and gravitation