

HIGH SCHOOL CURRICULUM FRAMEWORK

Course Title: AP Physics Course Number: 1731

Department: Science ADS Number: 1731

Prerequisites: Algebra I & II, Geometry

Length of Course: Two Semesters Credit/PRI Area: 0.5 credits per semester. Total of one credit Grade Level(s): 11-12

Important Notes: Emphasis is first year college preparatory level. National AP exam is required for AP credit. The student will receive a grade on a 5-point scale. A lab is not offered at this time.

COURSE DESCRIPTION

This is a high school general physics course. Course topics are:

- * Newtonian Mechanics – including gravitation, work, energy, and systems of particles.
- * Fluid and thermal physics – including kinetic theory, heat, and thermodynamic laws.
- * Electricity and Magnetism – including Faraday’s and Lenz’s laws, electrostatics, and circuits.
- * Waves and Optics – including light and sound.
- * Atomic and nuclear physics – including wave-particle duality, and quantum effects.

SYLLABUS

1. Units of Study:

- a) Newton’s Laws: Units, standards, and the SI system; Kinematics; Gravitation.
- b) Energy and Work: Kinetic energy and potential energy; Mechanical energy; Momentum; Electric charge and field; Magnetism and induction.
- c) Force and Motion: Dynamics; Rotation; Angular momentum; Energy transformations.
- d) Thermodynamics: Heat; Temperature and atomic kinetic theory; Gases, liquids, and solids; Entropy.
- e) Waves: Sound waves; Electromagnetic waves and light; optics; Quantum mechanics.

2. Skills:

- a) Scientific thinking and practice: Prepares students to ask scientific questions and conduct research to find solutions. Critical thinking is required.
- b) Content of Science: Knowledge and skills provide the foundation that students need for critical thinking and problem solving.
- c) Science and society: Prepares students to understand the ways in which science influences the individual and society.

STRATEGIES: Paideia Methodology

Didactic: Lecture, guided discussion, and textbook chapter summary review.

Intellectual Coaching: All students present problem solving on the board to the other students. Solution methods are shared with the class.

Seminar: Related media topics are shared, with consideration of individual impacts.

ASSESSMENTS

Oral: Class participation with demonstration of problem solving.

Tests: Chapter tests and semester final exams.

Class work: Chapter problem sets submitted prior to chapter test.

SUGGESTED TEXTBOOKS AND INSTRUCTIONAL MATERIALS

Physics by Douglas Giancoli : A college textbook.

SUGGESTED TITLES/AUTHORS WEB SITES

Various.

SEMINAR PIECES OR USE

Seminar pieces are brief historical backgrounds of a scientist or a branch of physics.

STRAND I: SCIENTIFIC THINKING AND PRACTICE

CONTENT STANDARD 1: UNDERSTAND THE PROCESSES OF SCIENTIFIC INVESTIGATIONS AND USE INQUIRY AND SCIENTIFIC WAYS OF OBSERVING, EXPERIMENTING, PREDICTING, AND VALIDATING TO THINK CRITICALLY.

A. BENCHMARK: *Understand that scientific processes produce scientific knowledge that is continually evaluated, validated, revised, or rejected.*

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
11-12	<ol style="list-style-type: none">1. Understand how scientific processes produce valid, reliable results, including:<ul style="list-style-type: none">• consistency of explanations with data and observations• openness to peer review• full disclosure and examination of assumptions• testability of hypotheses• repeatability of experiments and reproducibility of results.2. Use scientific reasoning and valid logic to recognize:<ul style="list-style-type: none">• faulty logic• cause and effect• the difference between observation and unsubstantiated inferences and conclusions• potential bias3. Understand how new data and observations can result in new scientific knowledge.4. Critically analyze an accepted explanation by reviewing current scientific knowledge.5. Examine investigations of current interest in science (e.g., superconductivity, molecular machines, age of the universe).6. Examine the scientific processes and logic used in investigations of past events (e.g., using data from crime scenes, fossils), investigations that can be planned in advance but are only done once (e.g., expensive or time-consuming experiments such as medical clinical trials), and investigations of phenomena that can be repeated easily and frequently.	<p>In this course, the student will:</p> <ul style="list-style-type: none">* Use science process and thinking skills.* Manifest science interests and attitudes.* Understand important science concepts and principles.* Communicate effectively using science language and reasoning.* Demonstrate awareness of the social and historical aspects of science.* Understand the nature of science.

STRAND I: SCIENTIFIC THINKING AND PRACTICE**CONTENT STANDARD 1: UNDERSTAND THE PROCESSES OF SCIENTIFIC INVESTIGATIONS AND USE INQUIRY AND SCIENTIFIC WAYS OF OBSERVING, EXPERIMENTING, PREDICTING, AND VALIDATING TO THINK CRITICALLY.**

C. BENCHMARK: *Use mathematical concepts, principles, and expressions to analyze data, develop models, understand patterns and relationships, evaluate findings, and draw conclusions.*

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
11-12	<ol style="list-style-type: none"> 1. Create multiple displays of data to analyze and explain the relationships in scientific investigations. 2. Use mathematical models to describe, explain, and predict natural phenomena. 3. Use technologies to quantify relationships in scientific hypotheses (e.g., calculators, computer spreadsheets and databases, graphing software, simulations, modeling). 4. Identify and apply measurement techniques and consider possible effects of measurement errors. 5. Use mathematics to express and establish scientific relationships (e.g., scientific notation, vectors, dimensional analysis). 	<p>The first requirement of the College Board course description is:</p> <p>The student will be able to read, understand, and interpret physical information – verbal, mathematical, and graphical.</p> <p>Also, the student will use basic mathematical reasoning – arithmetic, algebraic, geometric, trigonometric, or calculus, where appropriate – in a physical problem.</p>

STRAND II: CONTENT OF SCIENCE: PHYSICAL SCIENCE**CONTENT STANDARD I: UNDERSTAND THE STRUCTURE AND PROPERTIES OF MATTER, THE CHARACTERISTICS OF ENERGY, AND THE INTERACTIONS BETWEEN MATTER AND ENERGY.**

A. BENCHMARK: *Understand the properties, underlying structure, and reactions of matter.*

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
11-12	<p>Properties of Matter</p> <ol style="list-style-type: none"> 1. Classify matter in a variety of ways (e.g., element, compound, mixture; solid, liquid, gas; acidic, basic, neutral). 2. Identify, measure, and use a variety of physical and chemical properties (e.g., electrical conductivity, density, viscosity, chemical reactivity, pH, melting point). 3. Know how to use properties to separate mixtures into pure substances (e.g., distillation, chromatography, solubility). 4. Describe trends in properties (e.g., ionization energy or reactivity as a function of location on the periodic table, boiling point of organic liquids as a function of molecular weight). 	<p>Physics is the science of Nature in the broadest sense. Physicists study the behaviour and interactions of matter and energy, which are referred to as physical phenomena. Physics is the study of matter, energy, motion, and forces. This class is concerned with the fundamental components of the universe, the forces they exert on one another, and the results produced by these forces.</p>

STRAND II: CONTENT OF SCIENCE: PHYSICAL SCIENCE
CONTENT STANDARD I : UNDERSTAND THE STRUCTURE AND PROPERTIES OF MATTER, THE CHARACTERISTICS OF ENERGY, AND THE INTERACTIONS BETWEEN MATTER AND ENERGY.

A. BENCHMARK: *Understand the properties, underlying structure, and reactions of matter.*

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
11-12	<p>Structure of Matter</p> <p>5. Understand that matter is made of atoms and that atoms are made of subatomic particles.</p> <p>6. Understand atomic structure, including:</p> <ul style="list-style-type: none"> • most space occupied by electrons • nucleus made of protons and neutrons • isotopes of an element • masses of proton and neutron 2000 times greater than mass of electron • atom held together by proton-electron electrical forces <p>7. Explain how electrons determine the properties of substances by:</p> <ul style="list-style-type: none"> • interactions between atoms through transferring or sharing valence electrons • ionic and covalent bonds • the ability of carbon to form a diverse array of organic structures. <p>8. Make predictions about elements using the periodic table (e.g., number of valence electrons, metallic character, reactivity, conductivity, type of bond between elements).</p> <p>9. Understand how the type and arrangement of atoms and their bonds determine macroscopic properties (e.g., boiling point, electrical conductivity, hardness of minerals).</p> <p>10. Know that states of matter (i.e., solid, liquid, gas) depend on the arrangement of atoms and molecules and on their freedom of motion.</p> <p>11. Know that some atomic nuclei can change, including:</p> <ul style="list-style-type: none"> • spontaneous decay • half-life of isotopes • fission • fusion (e.g., the sun) • alpha, beta, and gamma radiation. 	<p>From the introduction of the textbook:</p> <p>“Physics is the most basic of the sciences. It deals with the behavior and structure of matter.”</p>

STRAND II: CONTENT OF SCIENCE: PHYSICAL SCIENCE
CONTENT STANDARD I : UNDERSTAND THE STRUCTURE AND PROPERTIES OF MATTER, THE CHARACTERISTICS OF ENERGY, AND THE INTERACTIONS BETWEEN MATTER AND ENERGY.

A. BENCHMARK: *Understand the properties, underlying structure, and reactions of matter.*

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
11-12	<p>Chemical Reactions</p> <p>12. Know that chemical reactions involve the rearrangement of atoms, and that they occur on many timescales (e.g., picoseconds to millennia).</p> <p>13. Understand types of chemical reactions (e.g., synthesis, decomposition, combustion, redox, neutralization) and identify them as exothermic or endothermic.</p> <p>14. Know how to express chemical reactions with balanced equations that show: conservation of mass products of common reactions.</p> <p>15. Describe how the rate of chemical reactions depends on many factors that include temperature, concentration, and the presence of catalysts.</p>	<p>From the textbook table of contents:</p> <p>Table of Contents</p> <ol style="list-style-type: none"> 1. Introduction. 2. Describing Motion: Kinematics in One Dimension. 3. Kinematics in Two Dimensions; Vectors. 4. Motion and Force: Dynamics. 5. Circular Motion; Gravitation. 6. Work and Energy. 7. Linear Momentum. 8. Rotational Motion. 9. Bodies in Equilibrium; Elasticity and Fracture. 10. Fluids. 11. Vibrations and Waves. 12. Sound. 13. Temperature and Kinetic Theory. 14. Heat. 15. The Laws of Thermodynamics. 16. Electric Charge and Electric Field 17. Electric Potential 18. Electric Currents 19. DC Currents 20. Magnetism 21. Induction 22. Electromagnetic Waves 23. Geometric Optics 24. Wave Nature of Light 25. Instrumentation 26. Relativity 27. Models of the Atom 28. Quantum Mechanics 29. Molecules and solids 30. Nuclear Physics

STRAND II: CONTENT OF SCIENCE: PHYSICAL SCIENCE
CONTENT STANDARD I : UNDERSTAND THE STRUCTURE AND PROPERTIES OF MATTER, THE CHARACTERISTICS OF ENERGY, AND THE INTERACTIONS BETWEEN MATTER AND ENERGY.

B. BENCHMARK: *Understand the transformation and transmission of energy and how energy and matter interact.*

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
11-12	<p>Energy Transformation and Transfer</p> <ol style="list-style-type: none"> 1. Identify different forms of energy, including kinetic, gravitational (potential), chemical, thermal, nuclear, and electromagnetic. 2. Explain how thermal energy (heat) consists of the random motion and vibrations of atoms and molecules and is measured by temperature. 3. Understand that energy can change from one form to another (e.g., changes in kinetic and potential energy in a gravitational field, heats of reaction, hydroelectric dams) and know that energy is conserved in these changes. 4. Understand how heat can be transferred by conduction, convection, and radiation, and how heat conduction differs in conductors and insulators. 5. Explain how heat flows in terms of the transfer of vibrational motion of atoms and molecules from hotter to colder regions. 6. Understand that the ability of energy to do something useful (work) tends to decrease (and never increases) as energy is converted from one form to another. 	<p>From the textbook: Chapters 6, 13, 14, & 15.</p>

STRAND II: CONTENT OF SCIENCE: PHYSICAL SCIENCE
CONTENT STANDARD I : UNDERSTAND THE STRUCTURE AND PROPERTIES OF MATTER, THE CHARACTERISTICS OF ENERGY, AND THE INTERACTIONS BETWEEN MATTER AND ENERGY.

B. BENCHMARK: *Understand the transformation and transmission of energy and how energy and matter interact.*

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
-------	-----------------------	---------------

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
11-12	<p>Interactions of Energy and Matter</p> <p>7. Understand that electromagnetic waves carry energy that can be transferred when they interact with matter.</p> <p>8. Describe the characteristics of electromagnetic waves (e.g., visible light, radio, microwave, X-ray, ultraviolet, gamma) and other waves (e.g., sound, seismic waves, water waves), including:</p> <ul style="list-style-type: none"> • origin and potential hazards of various forms of electromagnetic radiation • energy of electromagnetic waves carried in discrete energy packets (photons) whose energy is inversely proportional to wavelength. <p>9. Know that each kind of atom or molecule can gain or lose energy only in discrete amounts.</p> <p>10. Explain how wavelengths of electromagnetic radiation can be used to identify atoms, molecules, and the composition of stars.</p> <p>11. Understand the concept of equilibrium (i.e., thermal, mechanical, and chemical).</p>	<p>From the textbook:</p> <p>Chapters 11, 22, & 24.</p>

STRAND II: CONTENT OF SCIENCE: PHYSICAL SCIENCE
CONTENT STANDARD I : UNDERSTAND THE STRUCTURE AND PROPERTIES OF MATTER, THE CHARACTERISTICS OF ENERGY, AND THE INTERACTIONS BETWEEN MATTER AND ENERGY.

B. BENCHMARK: Understand the motion of objects and waves, and the forces that cause them.

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
11-12	<p>Forces</p> <p>1. Know that there are four fundamental forces in nature: gravitation, electromagnetism, weak nuclear force, and strong nuclear force.</p> <p>2. Know that every object exerts gravitational force on every other object, and how this force depends on the masses of the objects and the distance between them.</p> <p>3. Know that materials containing equal amounts of positive and negative charges are electrically neutral, but that a small excess or deficit of negative charges produces significant electrical forces.</p> <p>4. Understand the relationship between force and pressure, and how the pressure of a volume of gas depends on the temperature and the amount of gas.</p> <p>5. Explain how electric currents cause magnetism and how changing magnetic fields produce electricity (e.g., electric motors, generators).</p>	<p>From the textbook:</p> <p>Chapters 11, 22, & 24.</p>

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
	6. Represent the magnitude and direction of forces by vector diagrams. 7. Know that when one object exerts a force on a second object, the second object exerts a force of equal magnitude and in the opposite direction on the first object (i.e., Newton 's Third Law).	

STRAND II: CONTENT OF SCIENCE: PHYSICAL SCIENCE
CONTENT STANDARD I : UNDERSTAND THE STRUCTURE AND PROPERTIES OF MATTER, THE CHARACTERISTICS OF ENERGY, AND THE INTERACTIONS BETWEEN MATTER AND ENERGY.

C. BENCHMARK: *Understand the motion of objects and waves, and the forces that cause them.*

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
11-12	Motion 8. Apply Newton 's Laws to describe and analyze the behavior of moving objects, including: <ul style="list-style-type: none"> • displacement, velocity, and acceleration of a moving object • Newton 's Second Law, $F = ma$ (e.g., momentum and its conservation, the motion of an object falling under gravity, the independence of a falling object's motion on mass) • circular motion and centripetal force. 9. Describe relative motion using frames of reference. 10. Describe wave propagation using amplitude, wavelength, frequency, and speed. 11. Explain how the interactions of waves can result in interference, reflection, and refraction. 12. Describe how waves are used for practical purposes (e.g., seismic data, acoustic effects, Doppler effect).	The textbook table of contents shows coverage of all these subjects.

STRAND III: SCIENCE AND SOCIETY
CONTENT STANDARD: UNDERSTAND HOW SCIENTIFIC DISCOVERIES, INVENTIONS, PRACTICES, AND KNOWLEDGE INFLUENCE, AND ARE INFLUENCED BY, INDIVIDUALS AND SOCIETIES.

A. **BENCHMARK:** *Examine and analyze how scientific discoveries and their applications affect the world, and explain how societies influence scientific investigations and applications.*

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
11-12	<p>Science and Technology</p> <ol style="list-style-type: none"> 1. Know how science enables technology but also constrains it, and recognize the difference between real technology and science fiction (e.g., rockets vs. antigravity machines; nuclear reactors vs. perpetual-motion machines; medical X-rays vs. Star-Trek tricorders). 2. Understand how advances in technology enable further advances in science (e.g., microscopes and cellular structure; telescopes and understanding of the universe). 3. Evaluate the influences of technology on society (e.g., communications, petroleum, transportation, nuclear energy, computers, medicine, genetic engineering) including both desired and undesired effects, and including some historical examples (e.g., the wheel, the plow, the printing press, the lightning rod). 4. Understand the scientific foundations of common technologies (e.g., kitchen appliances, radio, television, aircraft, rockets, computers, medical X-rays, selective breeding, fertilizers and pesticides, agricultural equipment). 5. Understand that applications of genetics can meet human needs and can create new problems (e.g., agriculture, medicine, cloning). 6. Analyze the impact of digital technologies on the availability, creation, and dissemination of information. 7. Describe how human activities have affected ozone in the upper atmosphere and how it affects health and the environment. 8. Describe uses of radioactivity (e.g., nuclear power, nuclear medicine, radiometric dating). 	<p>The course textbook contains word problems at the end of each chapter which clearly draw on real-world analysis of problems, and how they affect the individuals of society.</p>

STRAND III: SCIENCE AND SOCIETY

CONTENT STANDARD: UNDERSTAND HOW SCIENTIFIC DISCOVERIES, INVENTIONS, PRACTICES, AND KNOWLEDGE INFLUENCE, AND ARE INFLUENCED BY, INDIVIDUALS AND SOCIETIES.

A. **BENCHMARK:** *Examine and analyze how scientific discoveries and their applications affect the world, and explain how societies influence scientific investigations and applications.*

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
-------	-----------------------	---------------

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
11-12	<p>Science and Society</p> <p>9. Describe how scientific knowledge helps decision makers with local, national, and global challenges (e.g., Waste Isolation Pilot Project [WIPP], mining, drought, population growth, alternative energy, climate change).</p> <p>10. Describe major historical changes in scientific perspectives (e.g., atomic theory, germs, cosmology, relativity, plate tectonics, evolution) and the experimental observations that triggered them.</p> <p>11. Know that societal factors can promote or constrain scientific discovery (e.g., government funding, laws and regulations about human cloning and genetically modified organisms, gender and ethnic bias, AIDS research, alternative-energy research).</p> <p>12. Explain how societies can change ecosystems and how these changes can be reversible or irreversible.</p> <p>13. Describe how environmental, economic, and political interests impact resource management and use in New Mexico .</p> <p>14. Describe New Mexico 's role in nuclear science (e.g., Manhattan Project, WIPP, national laboratories).</p>	The course textbook contains word problems at the end of each chapter which clearly draw on real-world analysis of problems, and how they affect the individuals of society.

STRAND III: SCIENCE AND SOCIETY
CONTENT STANDARD: UNDERSTAND HOW SCIENTIFIC DISCOVERIES, INVENTIONS, PRACTICES, AND KNOWLEDGE INFLUENCE, AND ARE INFLUENCED BY, INDIVIDUALS AND SOCIETIES.

A. BENCHMARK: *Examine and analyze how scientific discoveries and their applications affect the world, and explain how societies influence scientific investigations and applications.*

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
11-12	<p>Science and Individuals</p> <p>15. Identify how science has produced knowledge that is relevant to individual health and material prosperity.</p> <p>16. Understand that reasonable people may disagree about some issues that are of interest to both science and religion (e.g., the origin of life on Earth, the cause of the Big Bang, the future of Earth).</p> <p>17. Identify important questions that science cannot answer (e.g., questions that are beyond today's science, decisions that science can only help to make, questions that are inherently outside of the realm of science).</p> <p>18. Understand that scientists have characteristics in common with other individuals (e.g., employment and career needs, curiosity, desire to perform public service, greed, preconceptions and biases, temptation to be unethical, core</p>	The course textbook contains word problems at the end of each chapter which clearly draw on real-world analysis of problems, and how they affect the individuals of society.

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
	values including honesty and openness). 19. Know that science plays a role in many different kinds of careers and activities (e.g., public service, volunteers, public office holders, researchers, teachers, doctors, nurses, technicians, farmers, ranchers).	