

APS DISTRICT HIGH SCHOOL SCIENCE CURRICULUM FRAMEWORK

Course Title: Physics II Course Number: 44113

Department: Science ADS Number: 17334944

Prerequisites: Physics I, Algebra II, and Chemistry are highly recommended.

Length of Course: One Year Credit/PRI Area: .50 per Sem/Elective Grade Level(s): 11-12

Important Notes:

Concurrent enrollment in calculus is desirable for those students intending to take the AP Physics C exam.

COURSE DESCRIPTION:

The laboratory course* is designed to include topics beyond classical physics, by exploring concepts and theories not covered in a first year physics class. In this survey course the student participates in three concurrent areas of study. The first is a set of projects, both team and individual, providing hands-on exploration of physics fundamentals such as force and motion, waves, optics, electromagnetism, and energy transfer. The second area of study is modern physics, including relativity, lasers, high energy and particle, atomic and subatomic physics, radioactivity, quantum mechanics, string theory, stellar processes and evolution, and cosmology. The third area of concentration consists of working trigonometry-based physics problems on a regular basis in order to maintain strong basic skills.

*Lab Courses: A minimum of 250 minutes per week of directed class activity for 36 weeks, 40% of which must be lab oriented, for a total of 150 clock hours (90 hours of class plus 60 hours of lab) shall be required for one (1) unit of credit, excluding passing period. [APS Procedural Directives, Section I – Instruction, Basis for offering credit].

References in parentheses following each performance standard refer to and are aligned with the State of New Mexico Science Standards (NM) and the Albuquerque Public Schools Language Arts Standards (APS-LA).

STRATEGIES:

The “Illustrations” column in the Program of Studies provides exemplars of the performance standards, strategies, and best practices suggested by the science teachers in the Albuquerque Public Schools.

ASSESSMENTS:

The “Illustrations” column also incorporates a variety of assessments and “check for” items, suggested by science education teachers. Assessments include the following: authentic and performance-based assessment, cooperative learning, teacher observations, role playing, checklists, rubrics, tests, quizzes, and exams, laboratory work, formal and informal writing, individual and peer conferences, small group and full class discussions, oral and multimedia presentations, projects, demonstrations, and portfolios/notebooks.

SUGGESTED TEXTBOOKS AND INSTRUCTIONAL MATERIALS:

- *College Physics (5th Edition)* by [Jerry D. Wilson](#), [Anthony J. Buffa](#) (Prentice Hall; 2002)
- *Holt Physics* by Raymond A. Serway and Jerry S. Faughn (Sunders College Publishing; 1999)
- *Physics: Principles and Applications (5th Edition)* by Douglas C Giancoli (Pearson Education; 1997).

Video Series

- The Mechanical Universe (Annenberg)
- String Theory (Brian Greene)
- Cosmos (Carl Sagan)

SUGGESTED TITLES/AUTHORS WEB SITES:

- <http://particleadventure.org/particleadventure/frameless/unseen.html>
- <http://feh.eng.ohio-state.edu/Labs/HeatTransfer/HeatTransfer.html>
- <http://cougar.slvs.slv.k12.ca.us/~pboomer/labsphys/physlabook/lab8.html>
- <http://www.arachnoid.com/gravitation/index.html> – online demo
- <http://school.discovery.com/lessonplans/programs/temperatureandpressure/>
- <http://micro.magnet.fsu.edu/electromag/java/faraday2/>
- <http://www.physicsclassroom.com/Class/neewtlaws/U2L4a.html>
- <http://www.phy.ntnu.edu.tw/java/relativeVelocity/relativeVelocity.html>
- http://physics.bu.edu/~duffy/semester1/c20_wave_fvl.html
- <http://galileo.phys.virginia.edu/%7Eesnp9B/java/Ripple.html> – online demo
- http://physics.bu.edu/~duffy/semester1/c21_doppler.html – online demo on Doppler
- http://physics.bus.edu/~duffy/semester1/menu_semester1.html – simulations

Approved by HSCA:

12/04

STRAND I: SCIENTIFIC THINKING AND PRACTICE

CONTENT STANDARD: The student understands the processes of scientific investigations and uses inquiry and scientific ways of observing, experimenting, predicting, and validating to think critically.

BENCHMARKS:

- A. The student uses accepted scientific methods to collect, analyze, and interpret data and observations and to design and conduct scientific investigations and communicate results.
- B. The student understands that scientific processes produce scientific knowledge that is continually evaluated, validated, revised, or rejected.
- C. The student uses mathematical concepts, principles, and expressions to analyze data, develop models, understand patterns and relationships, evaluate findings, and draw conclusions.

GRADE 11-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	<ol style="list-style-type: none">1. Describes, designs and conducts scientific investigations using appropriate technology to subsequently convey results using scientific concepts in various data displays (NM-I.I.I.1,2,4).2. Uses mathematical models to describe, explain, and predict natural phenomena (NM-I.I.II.1).3. Identifies and applies measurement techniques and considers possible effects of measurement errors (NM-I.I.III.4).4. Uses mathematics to describe, explain, and predict natural phenomena, and to express and establish scientific relationships (e.g., scientific notation, vectors, dimensional analysis) (NM-I.I.III.5).	<p>NOTE: Illustrations include suggested activities for attaining each performance standard. A check (✓) refers to a key feature to look for while assessing student performance.</p> <p>1-4 The student participates in the physics labs and demonstrations described in Strands II and III. He/She properly designs, conducts, and conveys scientific investigations and applies the required skills and techniques to convey the results.</p> <ul style="list-style-type: none">✓ proper safety techniques✓ correct use of equipment✓ evidence of current scientific knowledge✓ effective communication skills✓ use of technology✓ critical thinking and insights

STRAND II: THE CONTENT OF SCIENCE – CLASSICAL PHYSICS**CONTENT STANDARD:** The student understands the structure and properties of matter, the characteristics of energy, and the interactions between matter and energy.**BENCHMARKS:**

A. The student understands the transformation and transmission of energy and how energy and matter interact.

B. The student understands the motion of objects and waves and the forces that cause them.

GRADE 11-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	<ol style="list-style-type: none"> 1. Uses kinematics to understand motion in one and two dimension, including vectors, vector algebra, components of vectors, coordinate systems, displacement, velocity and acceleration (NM-II.I.III.6). 2. Applies Newton’s laws of motion to single objects and systems of objects, both statically and dynamically, including friction and centripetal force (NM-II.I.II.8). 3. Understands the relationships between work, energy and power (NM-II.I.II.6): <ul style="list-style-type: none"> • work-energy theorem, conservative forces, conservation of energy, power. 4. Knows how to apply linear momentum and conservation of linear momentum to systems of particles (NM-II.I.III.8). 	<p>NOTE: The student participates in a set of hands-on activities directed towards an understanding of performance standards both at the conceptual and mathematical level. After each of the activities, the student submits a written report discussing results, conclusions, sources of error, and participates in a discussion relevant to the activity.</p> <ul style="list-style-type: none"> ✓ conceptual understanding ✓ mathematical application ✓ error analysis ✓ adherence of the teacher-directed report guidelines <p>NOTE: The student is encouraged to use the Excel spreadsheet program for calculations, data tables, and graphs for the following activities, unless otherwise noted. Excel is available either in the computer lab or on most students’ home computers.</p> <p>1-7 Newtonian Mechanics</p> <ul style="list-style-type: none"> • Hit the Cup – The student predicts the landing position of a ball bearing (or Hot Wheels) using a stopwatch, an incline, a meter stick, and a table. The student measures and calculates the speed of the ball or car from conservation of energy. • Collision – The student analyzes vector conservation of momentum in the collision of objects (e.g., air track, or metal balls on ramp). • Whirligig – The student swings an object to determine tangential velocity and centripetal force and measures and graphs period, velocity, and centripetal force and a relationship is developed. • Bleacher Run – The student walks and runs up bleachers and calculates work and power. • Hooke’s Law – The student analyzes the dynamics of a mass on a spring to determine mass, amplitude, and spring constant.

GRADE 11-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	<p>9. Understands the mechanical equivalent of heat, heat transfer, thermal expansion, and the difference between temperature and heat (NM-II.I.III.11).</p> <p>10. Applies the kinetic model and ideal gas law to systems of gases (NM-II.I.III.4).</p> <p>11. Determines thermodynamic relationships of PV diagrams and heat engines using the 1st and 2nd laws of thermodynamics (NM-II.I.II.4).</p> <p>12. Calculates charge, field, and potential of point charges and planar charge distributions, using Coulomb's law (NM-II.I.III.5).</p> <p>13. Determines charge, voltage, capacitance, area, spacing of parallel plate capacitors.</p> <p>14. Applies magnetostatics to determine the forces on moving charges or current-carrying wires in magnetic fields, including long current-carrying wires (NM-II.I.II.7).</p> <p>15. Describes electromagnetic induction using Faraday's Law and Lenz's Law (NM-II.I.III.5):</p> <ul style="list-style-type: none"> • diagram, and calculate, electric and magnetic fields. <p>16. Solves for current, voltage, resistance, and power in steady state direct current circuits, including capacitors in circuits – steady state.</p>	<p>9-11. Thermodynamics</p> <ul style="list-style-type: none"> • Specific Heat – The student uses calorimetry to calculate either mass, heat capacity, or temperature change, for two different materials. • PV Diagrams – The student interprets a variety of teacher-supplied PV diagrams, with an extension to student-created diagrams. <p>12-15. Electricity and Magnetism</p> <ul style="list-style-type: none"> • Electric Fields – The student measures and plots equipotential lines of various physical configurations with either semiconducting paper or conducting fluid. • Balloon Electrostatics – The student experiences electrostatic attraction and repulsion via rubbing balloons against cloth and measures the mass of the balloons and the angle formed. The student draws a free body diagram and solves for force and charge. • Capacitors – The student constructs capacitors with paper and aluminum foil and calculates and measures charge and capacitance. • Electromagnet – The student constructs electromagnets and discovers the relationship between current, number of turns, and magnetic field strength. He/She measures and graphs the force vs. current/turns with a scale and a relationship is developed. The student observes the interactions between two coils at various angles with an AC power supply and either a voltmeter or an oscilloscope, and a relationship vs. angle is developed. • DC Motor Project – The student constructs a simple motor to discover the properties of electricity and magnetic fields. He/She measures and graphs a RPM and torque vs. current and a relationship is developed. The student then calculates the torque. <p>16. Circuit Analysis.</p> <ul style="list-style-type: none"> • Ohm's Law – The student connects bulbs in series and parallel configurations to a battery to calculate and measure current, voltage, and power. An extension activity includes the addition of resistors to the circuit.

GRADE 11-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	<p>17. Identifies the properties of traveling waves and standing waves, including the Doppler effect and superposition (NM-II.I.III.10):</p> <ul style="list-style-type: none"> • calculates velocity, frequency, wavelength, and amplitude. <p>18. Knows the electromagnetic spectrum and the concept of dispersion of light (NM-II.III.I.5).</p> <p>19. Uses geometric optics to predict images due to reflection, plane and curved mirrors, and lenses (NM-II.I.III.11):</p> <ul style="list-style-type: none"> • applies Snell's Law to various substances. 	<ul style="list-style-type: none"> • DC Circuit Analysis – The student analyzes a variety of series, parallel and combination circuits using the SPICE circuit simulator on the PC. An unlimited-distribution free student demonstration version of this simulator is available from http://www.penzar.com and may be installed either in the computer lab, or on the student's home computer. • Electronics Project – The student chooses an electronics project from one of various references and simulates the circuit in SPICE and subsequently builds, measures, and demonstrates the device. He/She writes a written comparison between the measured and simulated performance. <p>17-19. Waves and Optics</p> <ul style="list-style-type: none"> • Slinky – The student determines the relationships between velocity, frequency, wavelength, tension, harmonics, and reflections using slinky toys. • Index of Refraction – The student uses geometry to determine the index of refraction of an unknown substance. This lab also includes reflection and total internal reflection. • Telescope Project – The student designs, mathematically analyzes, constructs, and measures either a Keplerian or Galilean telescope build from surplus lenses and a 2 inch mailing tube. (A star party is encouraged for students to view celestial objects, such as the moon or planets.)

STRAND III: THE CONTENT OF SCIENCE – MODERN PHYSICS

CONTENT STANDARD: The student understands the structure and properties of matter, the characteristics of energy, and the interactions between matter and energy on a very small scale and near the speed of light.

BENCHMARKS:

- A. The student understands the behavior of matter and energy at velocities near the speed of light.
- B. The student understands the theory of gravity.
- C. The student understands that the behavior of matter and energy at a very small scale is probabilistic.
- D. The student understands the accepted theory of the origin and evolution of the universe.
- E. The student understands the application of modern physics to society.

GRADE 11-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	<p>1. Applies Special Relativity and Lorentz Transformation to objects moving at relativistic speeds:</p> <ul style="list-style-type: none">• understands the differences between inertial and non-inertial frames,• understands experiments leading to the formulation of this theory, (e.g., Michelson-Morley), and• understands the application to particle physics,(e.g., cosmic ray induced muon lifetimes).	<p>NOTE: The student participates in a set of hands-on activities directed towards an understanding of performance standards both at the conceptual and mathematical level. After each of the activities, the student submits a written report discussing results, conclusions, sources of error, and participates in a discussion relevant to the activity.</p> <ul style="list-style-type: none">✓ conceptual understanding✓ mathematical application✓ error analysis✓ adherence of the teacher-directed report guidelines <p>1. Relativity</p> <ul style="list-style-type: none">• History – The student develops an understanding of the experiments confirming Special Relativity by forming teams. Each team chooses an experiment, creates a poster board and written report, and presents to the class.• Relativity – The student calculates mass, time, and length of objects moving near the speed of light, including the “Twins Paradox.”

<p>2. Conceptually understands General Relativity as a non-quantum theory of gravity:</p> <ul style="list-style-type: none"> • gravitational gradient, gravitational waves, black holes. <p>3. Understands the operational principles, and practical applications, of lasers:</p> <ul style="list-style-type: none"> • solid-state and resonant-cavity lasers, and • applications: medical, communications, entertainment, industrial, scientific. <p>4. Explains the role of particle accelerators to furthering our understanding of the universe:</p> <ul style="list-style-type: none"> • knows the fundamental operational principles and goals of accelerators such as CERN, Fermilab, etc., • knows the elements of the Standard Model, QED and QCD, • can calculate the equivalency of energy and mass, and • predicts the path of a charged particle in a magnetic field, such as a detector in a particle accelerator. <p>5. Describes various radioactive processes in the nucleus, such as alpha and beta decay.</p>	<p>2. General Relativity</p> <ul style="list-style-type: none"> • Event Horizon – The student calculates the radius of a black hole’s event horizon based on an escape velocity of c. • Gradient – The student calculates the gravitational gradient of a compact, massive object such as a neutron star, and calculates the tidal forces on an elongated orbiting body. • Simulation – The student views online simulations demonstrating the curvature of space by massive objects, behavior of neutron stars and black holes, and energy loss by gravitational wave radiation. <p>3. Lasers</p> <ul style="list-style-type: none"> • Laser Demonstration – The student witnesses demonstrations of both solid-state and resonant-cavity lasers. The student then diagrams the operational principles for each. • Application – The student chooses an area of application, creates an electronic presentation (e.g., PowerPoint), and presents to the class. This may be done in small teams. <p>4. Accelerators</p> <ul style="list-style-type: none"> • Accelerator Demonstration – The student views online demonstrations of the operation of various particle accelerators and then conceptually designs an accelerator on paper to achieve a required energy. • Model Demonstration – The student views online demonstrations and illustrations of the models of matter and energy, including the Standard Model, QED, and QCD. <p>5. Radioactivity</p> <ul style="list-style-type: none"> • Radioactivity – The student develops an understanding of lifetime (average, half-life) for a radioactive material, considers implications for radioactive wastes, applies radioactive count data in a graph to lifetime, and creates and examines macroscopic analogs to chain reactions, like mousetrap/Ping Pong™ ball arrangements, to gain the concept of a chain reaction. He/She derives the half-life equation and then applies it to a variety of problems, solving for half-life, original mass, or remaining mass. Various forms of radioactive decay (alpha, beta, etc.) are related to the nucleus. • Feynman Diagrams – The student constructs Feynman Diagrams for a series of real-world particle interactions.
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	<p>6. Predicts nuclear reactions using conservation of mass number and charge, and mass-energy equivalence.</p> <p>7. Examines the small-scale behavior of matter and energy using the principles of quantum mechanics:</p> <ul style="list-style-type: none"> • discusses the different interpretations of quantum reality (Copenhagen, Many Worlds, Sum-Over-Histories, etc.), • describes entanglement and non-locality, including Bell's Inequality and Aspect's experiment, • understands the application of quantum mechanics to technology (lasers, semiconductors, SQUIDs), • explores future applications such as quantum computing, • knows the major confirming experiments (Young's dual-slit, Aspect), and • Heisenberg Uncertainty Principle, Planck's Constant. <p>8. Explores Theories Of Everything (TOE's) that attempt to unify the four forces of nature with quantum mechanics:</p> <ul style="list-style-type: none"> • String theory, twisters, and • spacetime as a quantum foam. <p>9. Develops an awareness of the Big Bang theory and stellar evolution (NM-III.I.I.10):</p> <ul style="list-style-type: none"> • observational evidence, proposed timeline, • current age and state of the universe, • dark energy, dark matter, cosmological constant, • formation of stars, galaxies, clusters, and • H-R Diagram, stellar classification, fusion reactions. 	<p>6. Nuclear Reactions</p> <ul style="list-style-type: none"> • The student performs various mass number, charge, and mass equivalence calculations for various nuclear reactions and then relates these reactions to real-world applications (stars, nuclear medicine, etc.). <p>7. Matter and Energy</p> <ul style="list-style-type: none"> • Reading – The student reads a modern treatise on quantum mechanics such as “Schrodinger’s Kittens” by John Gribbin, forms discussion groups, and presents their interpretation to the class. • Simulation – The student views online simulations of quantum experiments, behavior, and computing. • Heisenberg – The student calculates the uncertainty in position or momentum for a variety of particle scenarios. <p>8. Strings – The student demonstrates an understanding of the theories of strings and twistors by viewing Brian Greene’s video series on strings and cosmology. For additional reading, students can read, <i>The Essential Universe</i> by Brian Greene.</p> <p>9. Cosmology</p> <ul style="list-style-type: none"> • Cosmos – The student demonstrates understanding of stellar processes and evolution by viewing relevant clips from Carl Sagan’s series, “Cosmos,” answering focus questions and participating in class discussions. They can also reference http://www.maa.mhn.de/Scholar/star_evol.html. • Luminosity – The student demonstrates understanding of the relationship between luminosity and spectrum via a light bulb driven from a variable power supply. • Stellar Evolution – The student determines a star’s stellar type and expected evolution using the H-R Diagram by being given parameters of several well-known stars. • WebQuest - The student embarks upon a web quest to research, runs online simulations and writes a report. He/She compares and contrasts the image of a celestial object captured at two or more different wavelengths and applies the mathematics of blackbody radiation to the spectra of various celestial objects.
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	<p>10. Calculates interference and diffraction effects (NM-II.I.III.11):</p> <ul style="list-style-type: none"> • slits and gratings. <p>11. Understands and explains the photoelectric effect and the concept of wave-particle duality:</p> <ul style="list-style-type: none"> • interprets an electron energy level diagram. 	<p>10. Interference</p> <ul style="list-style-type: none"> • Diffraction – The student observes diffraction using a laser and a diffraction grating. He/She geometrically derives the diffraction equation and then calculates either spacing, angle, or wavelength. • Crystallography - The student compares the wavelength and frequency ranges to physical objects comparable in size to the wavelength. The Bragg equation is introduced, and he/she calculates applications (e.g., determination of the crystal structure of salt) and the energy and momentum of a photon for various wavelengths. <p>11. Spectroscopy - The student utilizes spectrosopes (typically borrowed from the chemistry teacher) to examine emission spectra of different gases. The student calculates emission lines based upon the Rydberg equation and calculates percent error. He/She is introduced to color theory.</p>
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STRAND IV: SCIENCE AND SOCIETY**CONTENT STANDARD:** The student understands how scientific discoveries, inventions, practices, and knowledge influence and is influenced by individuals and societies.**BENCHMARKS:** The student examines and analyzes how scientific discoveries and their applications affect the world and explain how societies influence scientific investigations and applications.

GRADE 11 -12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	<ol style="list-style-type: none"> 1. Understands the scientific foundations of common technologies (e.g., radio, aircraft, rockets, X-rays, light) (NM-III.I.1.4). 2. Describes uses of radioactivity (e.g., nuclear power, nuclear medicine, radiometric dating) (NM-III.I.1.8). 3. Describes major historical changes in scientific perspectives (e.g., atomic theory, cosmology, relativity) and the experimental observations that triggered them (NM-III.I.1.10). 4. Describes New Mexico's role in nuclear science (e.g., Manhattan Project, VLA, Trinity Site, White Sands) (NM-III.I.1.14). 	<ol style="list-style-type: none"> 1. The student develops a How --- Works, including its origins and presents to students in a beginning physics course. <ul style="list-style-type: none"> ✓ understanding of physics concept ✓ presentation of accurate information in an intelligible manner ✓ notes based on presentation 2. The student researches a specific use of radioactivity and creates a poster to present to the class. Topic ideas may include Applications in Space, Fusion, Health Physics and Radiological Health, Nuclear Fuel, Nuclear Waste, and Radiation Instruments. <ul style="list-style-type: none"> ✓ use of research strategies (e.g., note taking, outlining, draft, final product, citation of sources) ✓ well-designed and accurate poster ✓ use of presentation techniques 3. The student reads articles from different time periods (e.g., decades) on a specific topic to trace the changing perspectives over a time period. One good site is http://www.project2061.org/tools/sfaol/chap10.htm. After investigating the changing perspective, the student creates an organizational tool (e.g., timeline, flow chart) depicting the changes. <ul style="list-style-type: none"> ✓ accurate summary of perspective ✓ appropriate organizational tool to depict perspectives ✓ bibliography of sources 4. The student visits the site http://www.vivanewmexico.com/science.html, chooses one of the topics on the site, and transfers the information into a PowerPoint presentation to give to the class. <ul style="list-style-type: none"> ✓ adherence to guideline observations for presentation (e.g., slide design, logical order, font) ✓ accurate information

GRADE 11 -12	PERFORMANCE STANDARDS	ILLUSTRATIONS
		<p>1-4 The student participates in interactive lectures, integrating science and society performance standards with content relative to the field of study, that includes question and answer sessions. The student develops a graphic organizer representing major milestones in physics.</p> <ul style="list-style-type: none"> ✓ participation ✓ correct answers in question and answer sessions ✓ correct responses to written assessment

STRAND V: LITERACY**CONTENT STANDARD:** The student communicates physics principles through reading, writing, and speaking opportunities.**BENCHMARK:** The student demonstrates proficiency in reading comprehension, specialized vocabulary, and a variety of writing and speaking requirements.

GRADE 11-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	<ol style="list-style-type: none"> 1. Develops and demonstrates proficiency with the following strategies to approach reading for information across content areas: (APS-LA I.1). 2. Identifies and uses roots, prefixes, and suffixes to determine meaning of words (APS-LA I.4). 3. Uses textual evidence to develop and support an interpretation of a scientific process or concept (APS-LA II.2). 4. Develops increased competence in using the writing process to create final products (APS-LA III.1). 5. Develops increased competence in using elements of effective writing (APS-LA III.2). 6. Supports an informed opinion (APS-LA III.6). 7. Responds to a variety of written, electronic, and other media (APS-LA III.7). 	<p>1, 3, 6, 7 The student selects and reviews a series of current science articles from an appropriate science journal or teacher-approved website and follows the steps outlined below.</p> <p>Step 1:</p> <ul style="list-style-type: none"> ✓ Identify the author and locate any biographical information that provides insight into who he/she is. ✓ What perspective does the author bring to the book (e.g., university professor, expert in the field, classroom educator)? <p>Step 2: Read the article and in writing answer questions that apply to your article:</p> <ul style="list-style-type: none"> What isn't clear or easy to understand? What do the author(s) expect you to know? What is the author trying to say? What is the author's message? <p>Step 3: Write a 50-70-word summary including why the article is interesting or important.</p> <ul style="list-style-type: none"> ✓ completion of the steps ✓ proper use of referencing author's thoughts ✓ use of bibliographic format for each article <p>(Based on <i>Questioning The Author: An Approach For Enhancing Student Engagement With Text</i> by I. Beck, et.al., International Reading Association, Newark, DE)</p> <p>2, 4, 5. The student writes extensions of labs or demonstrations presented in Strands II and III.</p> <ul style="list-style-type: none"> ✓ conceptual understanding ✓ lab writing process ✓ logical organization

	<p>8. Develops increased competence with speaking and language conventions (APS-LA IV.3).</p>	<p>8. Throughout the labs and demonstrations presented in Strands II and III, the student participates in small groups and class discussions.</p> <ul style="list-style-type: none"> ✓ active participation in discussions ✓ relevant questioning ✓ comprehension of lab concepts <p>Although the above examples represent specific instances where the literacy standards are met, multiple opportunities are presented throughout the year and throughout the curriculum where the student demonstrates reading, speaking, writing, and research strategies. They are reflected in every strand.</p>
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