APS DISTRICT HIGH SCHOOL SCIENCE CURRICULUM FRAMEWORK

Course Title: Chemistry I (Material Science) **Course Number:** SEE BELOW

Department: Science **ADS Number:** SEE BELOW

Prerequisites: None

Length of Course: One Year **Credit/PRI Area:** .50 per Sem /Science **Grade Level(s):** 9-12

COURSE AND ADS NUMBERS:

Chemistry I	42131	17214144	Chemistry I (Material Science)	060MP	17212144	Chemistry I (Material Science)	062MP	17212144
Chemistry I (Material Science) bilingual	4213B	17218144	Chemistry I (Material Science)	061MP	17212144			

Important Notes:

It is strongly recommended that the student has successfully completed Algebra I prior to taking Chemistry I(Material Science). This course will meet college entrance requirements.

COURSE DESCRIPTION:

The laboratory course* is designed so, the student studies chemistry concepts with an emphasis on the properties and structure of the matter in our world, from natural materials such as stone, to extracted materials such as metals, to manufactured materials such as plastics. Chemistry concepts include, but are not limited to, scientific measurement, atomic theory and bonding, classification and periodic trends, chemical reactions, and nuclear chemistry. In addition, the student studies relationships (e.g., electromagnetic radiation, radioactivity, structure of the Earth, ground water, use of natural resources) between chemistry and the Earth. Specific materials studied include metals, polymers, ceramics, glasses, and composites. Scientific thinking and practice (e.g., extensive laboratory activities, critical thinking, problem solving), science and society, and literacy are integrated throughout all science courses.

*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].

Sample school course catalog description (for students):Did you know that aluminum used to be more valuable than gold? What makes safety glass safe? What would life be like without semiconductors and polymers? This course provides answers to these and many more questions about our material world. Material Science is the study of the "stuff" of our world – from natural materials such as stone, to extracted materials such as metals, to manufactured materials such as plastics. This class covers the following concepts: properties of matter and energy; atomic theory and bonding; the scale of objects from atoms to galaxies, natural resources and how they are used; the structure of the Earth; manufacturing; and specific materials made of metals, polymers, ceramics, glasses, and composites.

References in parentheses following each performance standard refer to and are aligned with the New Mexico Science Standards (NM) and the APS language arts standards (APS-LA).

STRATEGIES:
The "Illustrations" column provides exemplars of the performance standards, strategies, and best practices suggested by the high school science teachers in the Albuquerque Public Schools.

ASSESSMENTS:
Assessments include authentic and performance-based assessment, peer and self evaluations, teacher observations, models and simulations, checklists, rubrics, tests and exams, formal and informal writing, oral presentations, group discussions, multimedia presentations, projects and demonstrations. The "Illustrations" column also incorporates a variety of assessments.

SUGGESTED TEXTBOOKS AND INSTRUCTIONAL MATERIALS:
- State adopted textbooks and ancillary materials (chemistry and geology)
- Supplementary materials
- Films/videos – World of Chemistry video series – Annenberg/CPB http://www.learner.org/resources/series61.html
- Internet

SUGGESTED TITLES/AUTHORS WEB SITES:
- *Materials Science and Technology Teacher Handbook* – ASM Materials Camp. This may also be downloaded from http://science-ed.pnl.gov/msthandbook.stm This handbook is a source of demonstrations and labs). Free.
- *Materials Science and Technology* modules, produced by the University of Illinois Urbana-Champaign. Available modules include energy, metals, ceramics, concrete, semiconductors, composites, and polymers. These may be downloaded ad http://mase1.mse.uiuc.edu/~tw/. Free.
- *ChemSource* – http://chemmovies.unl.edu/chem_source/pdf/ChemSource.html. This has a number of relevant modules that include both activities and teacher notes. Free.
- *Material Science Technology – Energy Concepts*: http://www.eci-info.com/material_science.html. This is a series of books and lab manuals, including solids, metals, polymers, ceramics, and composites. Each teacher module notebook is about $40.00.
- *Materials World Modules* – http://www.materialsworldmodules.org/. This series includes nine modules, priced at $32.00 for each teacher module book.
- APS Materials Science education website http://manzano.aps/science/materials/

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 9-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	1. Describes the essential components of an investigation, including appropriate methodologies, proper equipment, and safety precautions (NM-I.I.I.1). 2. Designs and conducts scientific investigations including, • testable hypotheses, • controls and variables, • methods to collect, analyze, and interpret data, • results that address hypotheses being investigated, • predictions based on results, • re-evaluation of hypotheses and additional experimentation as necessary, and • error analysis (NM-I.I.I.2). 3. Uses appropriate technologies (e.g., computers, calculators, balances, microscopes) to collect, analyze, and communicate scientific data (NM-I.I.I.3).	**NOTE: Illustrations include suggested activities for attaining each performance standard. A check (√) refers to a key feature to look for while assessing student performance.** 1 – 16. The student properly designs and performs controlled experiments using accepted procedures, gathers and analyzes data, and reports results in both an oral and written format. √ reasonable and testable statement √ identification of independent/dependent variables and controls √ experimental design √ proper safety technique √ correct selection and use of appropriate equipment √ evidence of understanding √ organization of data √ quantitative/qualitative data √ analysis of data √ multiple trials to verify data √ defensible conclusion based on data √ critical thinking and insights √ use of technology √ effective communication skills √ writing conventions

GRADE 9-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
		-FOR EXAMPLE-
	4. Conveys results of investigations using scientific concepts, methodologies, and expressions, including, • scientific language and symbols, • diagrams, charts, and other data displays, • mathematical expressions and processes (e.g., mean, median, slope, proportionality), • clear, logical, and concise communication, and • reasoned arguments (NM-I.I.I.4).	1 – 4, 6, 7, 12, 15. Individually or as part of a small group, the student researches the manufacture of concrete, designs an experiment to make concrete by varying at least one factor (e.g., composition, drying time, temperature, addition of catalyst), tests the sample, and interprets the results. √ thorough experimental design √ appropriate use of equipment √ descriptive narrative of background research √ accurate purpose of objective √ identification and test of appropriate concrete properties √ narrative conclusion supported by data √ data and results presented in a variety of ways (e.g., graphical, written, PowerPoint)
	5. Understands how scientific theories are used to explain and predict natural phenomena (e.g., plate tectonics, ocean currents, structure of atom) (NM-I.I.I..5).	5, 8. See Strand II (Content of Physical Science) Illustration #5, 6.
	6. Understands how scientific processes produce valid, reliable results, including, • consistency of explanations with data and observations, • openness to peer review, • full disclosure and examination of assumptions, • testability of hypotheses, and • repeatability of experiments and reproducibility of results (NM-I.I.II.1).	6. See Strand I (Scientific Thinking and Practice) Illustration 1 – 4, 6, 7, 12, 15.
	7. Uses scientific reasoning and valid logic to recognize the following: • faulty logic, • cause and effect, • the difference between observation and unsubstantiated inferences and conclusions, and • potential bias (NM-I.I.II.2).	

GRADE 9-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	8. Understands how new data and observations can result in new scientific knowledge (NM-I.I.II.3).	
	9. Critically analyzes an accepted explanation by reviewing current scientific knowledge (NM-I.I.II.4).	9 – 11. See Strand III (Content of Earth and Space Science) Illustration #3, 5, 7.
	10. Examines investigations of current interest in science (e.g., superconductivity, molecular machines, age of the universe) (NM-I.I.II.5).	
	11. Examines 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 (NM-I.I.II.6).	
	12. Creates multiple displays of data to analyze and explain the relationships in scientific investigations (NM-I.I.III.1).	12 – 16. See Strand II (Content of Physical Science) Illustration #10, 17, 19, 24.
	13. Uses mathematical models to describe, explain, and predict natural phenomena (NM-I.I.III.2).	13 – 16. See Strand II (Content of Physical Science) Illustration #10, 17, 19, 24.
	14. Uses technologies (e.g., calculators, computer spreadsheets and databases, graphing software, simulations, modeling) to quantify relationships in scientific hypotheses (NM-I.I.III.3).	
	15. Identifies and applies measurement techniques and considers possible effects of measurement errors (NM-I.I.III.4).	15. See Strand II (Content of Physical Science), Illustration #1, 2.
	16. Uses mathematics to express and establish scientific relationships (e.g., scientific notation, vectors, dimensional analysis) (NM-I.I.III.5).	

STRAND II: THE CONTENT OF PHYSICAL SCIENCE
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 properties, underlying structure, and reactions of matter.
B. The student understands the transformation and transmission of energy and how energy and matter interact.

GRADE 9-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	Properties of Matter	
	1. Classifies matter in a variety of ways (e.g., element, compound, mixture, solid, liquid, gas, acidic, basic, neutral) (NM-II.I.I.1).	1, 2. The student measures the density and/or other properties of various polymer samples and uses the results to classify polymer type for consumer recycling. √ selection and use of equipment √ precise and accurate measurements √ accurate classification √ documented calculations with formulas and units
	2. Identifies, measures, and uses a variety of physical and chemical properties (e.g., electrical conductivity, density, viscosity, chemical reactivity, pH, melting point) (NM-II.I.I.2).	2, 4. The student develops and describes a relative metal reactivity series by testing various metals in a solution of copper (II) chloride. He/She discusses the implications of findings (e.g., Why is gold, not magnesium, used for jewelry?). √ safe use of chemicals √ correct results √ reasonable implications
	3. Knows how to use properties to separate mixtures into pure substances (e.g., distillation, chromatography, solubility) (NM-II.I.I.3). 4. Describes 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) (NM-II.I.I.4).	3, 12 – 14, 18, 24. The student isolates elemental copper from copper ore using a variety of chemical and physical methods (e.g., electrochemical, solubility, precipitation), writes chemical equations for each transformation, and classifies reactions by type and direction of energy flow. √ proper use of equipment √ clean isolation of copper √ correct balanced equations and reaction type √ identification of energy flow (e.g., endothermic/exothermic) √ differences between element, compound, and mixture √ demonstration of origin and use of natural resources

GRADE 9-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	Structure of Matter 5. Understands that matter is made of atoms and that atoms are made of subatomic particles (NM-II.I.I.5). 6. Understands atomic structure, including the following: • 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, and • atom held together by proton-electron electrical forces (NM-II.I.I.6).	5, 6. As part of a class project, the student traces the development of atomic theory by relating it to historical uses of materials in society (e.g., Stone Age, Bronze Age, pottery, alchemy, Periodic Table, polymers, semiconductors). The research includes the following: • active contribution to time line, • historical context of materials' use, • description of atomic structure, • evidence that supports the existence and structure of the atom, • evidence of how ideas have changed over time, and • material and technology relationship (e.g., Why were there no semiconductors until the 20th century?). √ participation √ accurate description (e.g., narrative, illustration, model) of atomic structure √ characterization of protons, electrons, neutrons √ evidence that supports contemporary atomic theory, specifically the works of Dalton, Thomson, Rutherford, Bohr supporting atomic cited √ logical conclusions that relate technology, historical context, scientific understanding, and materials usage
	7. Explains how electrons determine the properties of substances by • interactions between atoms through transferring or sharing valence electrons, • ionic and covalent bonds, and • the ability of carbon to form a diverse array of organic structures (NM-II.I.I.7).	7, 9. The student creates a graphic organizer (e.g., flip book, foldable) that relates the macroscopic properties (e.g., hardness, density, conductivity, thermal properties) of metals, ceramics, and polymers to the type and arrangement of atoms and their bonds. The organizer includes the following: • ionic, covalent, metallic, hydrogen bonding, • atomic, ionic, and molecular structure of materials, and • cross-linking, grain boundaries, microstructure, crystal form. √ thoroughness √ correct relationship between structure and properties √ correct use of vocabulary 7, 9, 12, 13, 15. The student investigates the effect of a factor

GRADE 9-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
		(e.g., composition, temperature, use of a hardener) on free radical polymerization with an epoxy resin. He/She uses the hardening time to measure the rate of reaction. The student collects quantitative data for at least three sets of data, uses the data to calculate relative rates and effects, and communicates the findings in written and graphical form. √ sound experimental design √ appropriate data collection √ determination of relative rate of reaction √ clear communication of results and conclusions √ writing conventions
	8. Makes predictions about elements using the periodic table (e.g., number of valence electrons, metallic character, reactivity, conductivity, type of bond between elements) (NM-II.I.I.8).	8. The student identifies valence electrons, the type of bonding, and reactivity of an element based on its location on the Periodic Table. √ accurate predictions
	9. Understands how the type and arrangement of atoms and their bonds determine macroscopic properties (e.g., boiling point, electrical conductivity, hardness of minerals) (NM-II.I.I.9).	
	10. Knows that states of matter (i.e., solid, liquid, gas) depend on the arrangement of atoms and molecules and on their freedom of motion (NM-II.I.I.10).	10, 17, 19, 24. The student interprets a heating curve and phase diagrams of water, relating energy, temperature, and pressure to its physical state and the arrangement and motion of its molecules. √ correct identification of water's phase in a specified region of a diagram √ accurate illustrations of relative molecular spacing and motion √ description of how heat is transferred √ accurate explanation of flat portions of heating curve √ distinction between temperature and heat √ relationship among temperature, pressure, molecular motion, structure, state
	11. Knows that some atomic nuclei can change, including, • spontaneous decay, • half-life of isotopes, • fission, • fusion (e.g., the sun), and • alpha, beta, and gamma radiation (NM-II.I.I.11).	11. See Strand III (Content of Earth and Space Science) Illustration #3, 5,7.

GRADE 9-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	Chemical Reactions 12. Knows that chemical reactions involve the rearrangement of atoms and that they occur on many timescales (e.g., picoseconds to millennia) (NM-II.I.I.12).	12 – 14. See Strand II (Content of Physical Science) Illustration #3, 12 – 14, 18, 24.
	13. Understands types of chemical reactions (e.g., synthesis, decomposition, combustion, redox, neutralization) and identifies them as exothermic or endothermic (NM-II.I.I.13).	
	14. Knows how to express chemical reactions with balanced equations that show • conservation of mass, and • products of common reactions (NM-II.I.I.14).	14. See Strand II (Content of Physical Science) Illustration #3, 12-14, l8, 24.
	15. Describes how the rate of chemical reactions depends on many factors that include temperature, concentration, and the presence of catalysts (NM-II.I.I.15).	15. See Strand II (Content of Physical Science) Illustration #7, 9, 12, 13, 15.
	Energy Transformation and Transfer 16. Identifies different forms of energy, including kinetic, gravitational (i.e., potential), chemical, thermal, nuclear, and electromagnetic (NM-II.I.II.1).	16, 20 – 23. The student conducts the flame test with a variety of elements, observing the color and the line spectrum. He/She relates the observation on the macroscopic scale to the movement of electrons on the atomic level. The student researches and describes applications of electromagnetic radiation to the identification of unknowns (e.g., drugs, composition of stars, elements). √ proper use of lab equipment and safety procedures √ clear description of observation including a drawing of line spectrum √ clear description of how a specific spectral line is related to electron movement • discrete energy levels • color's relationship to wavelength, frequency, energy, electron transition √ line spectrum specific to each element √ transfer of energy traced √ well-written narrative of application √ understanding of how spectra are used to identify unknowns in labs and stars

GRADE 9-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	17. Explains how thermal energy (i.e., heat) consists of the random motion and vibrations of atoms and molecules and is measured by temperature (NM-II.I.II.2).	17. See Strand II (Content of Physical Science) Illustration #10, 17, 19.
	18. Understands 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 knows that energy is conserved in these changes (NM-II.I.II.3).	18. See Strand II (Content of Physical Science) Illustration #3, 12 – 14, 18, 24.
	19. Explains how heat flows in terms of the transfer of vibrational motion of atoms and molecules from hotter to colder regions (NM-II.I.II.5).	19. See Strand II (Content of Physical Science) Illustration #10, 17, 19, 24.
	Interactions of Energy and Matter 20. Understands that electromagnetic waves carry energy that can be transferred when they interact with matter (NM-II.I.II.7).	20 – 23. See Strand II (Content of Physical Science) Illustration #16, 20 – 23.
	21. Describes 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, • origin and potential hazards of various forms of electromagnetic radiation, and • energy of electromagnetic waves carried in discrete energy packets (i.e., photons) whose energy is inversely proportional to wavelength (NM-II.I.II.8).	
	22. Knows that each kind of atom or molecule can gain or lose energy only in discrete amounts (NM-II.I.II.9).	
	23. Explains how wavelengths of electromagnetic radiation can be used to identify atoms, molecules, and the composition of stars (NM-II.I.II.10).	
	24. Understands the concept of equilibrium (i.e., thermal, mechanical, and chemical) (NM-II.I.II.11).	24. See Strand II (Content of Physical Science) Illustration #10, 17, 19 and Illustration #16, 20 – 23. -AND- See Strand II (Content of Physical Science) Illustration #3, 12 – 14, 18, 24.

STRAND III: THE CONTENT OF EARTH AND SPACE SCIENCE
CONTENT STANDARD: The student understands the structure of Earth, the solar system, and the universe, the interconnections among them, and the processes and interactions of Earth's systems.

BENCHMARKS: A. The student examines the scientific theories of the origin, structure, contents, and evolution of the solar system and the universe and their interconnections.
B. The student examines the scientific theories of the origin, structure, energy, and evolution of Earth and its atmosphere and their interconnections.

GRADE 9-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	1. Understands the scale and contents of the universe, including, • range of structures from atoms through astronomical objects to the universe, and • objects in the universe such as planets, stars, galaxies, and nebulae (NM-II.III.I.1).	1. The student constructs a logarithmic scale model of objects in the universe from extremely small (e.g., atoms) to extremely large (e.g., galaxies). √ accuracy of scale √ accurate placement of objects (e.g., proton, molecule, red giant) within scale √ accurate placement of atomic scale, micro scale, macro scale √ differentiation between logarithmic vs. linear scales
	2. Explains how objects in the universe emit different electromagnetic radiation and how this information is used (NM-II.III.I.5).	2. See Strand II (Content of Physical Science) Illustration #16, 20 – 23. -AND- The student examines and interprets blackbody radiation diagrams [e.g., Hertzsprung-Russell diagrams for stars, emission spectra for elements, thermal (IR) spectra and blackbody radiation charts for glowing iron or tungsten wires] that relate visible color to temperature or energy. He/She explains the uses and applications of these diagrams. *(Note: Reference – http://webexhibits.org/causesofcolor)* √ interpretation of color and temperature √ explanation of uses and applications
	3. Recognizes that radiometric data indicate that Earth is at least 4 billion years old and that Earth has changed during that period (NM-II.III.II.2).	3, 5, 7. The student participates in public advocacy for/against the opening of a uranium mine in New Mexico (e.g., public service announcement, newspaper op-ed piece, brochure, radio show, debate). The piece is supported by scientific principles and includes the following: • description of uranium mining and processing, • properties of uranium including radioactivity with nuclear equations and half life, • uses of uranium including Manhattan Project, depleted uranium,

GRADE 9-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
		radiometric dating, • alpha, beta, gamma radiation, • disposal, including WIPP, and • risk analysis. √ thoroughness √ accuracy √ relevance to local interests √ appropriate nuclear equations √ accurate simple half-life calculations √ clear communication √ persuasive argument based on accepted scientific reasoning
	4. Describes the internal structure (e.g., core, mantle, crust) of Earth and the structure of Earth's plates (NM-II.III.II.3). 5. Understands the changes in Earth's past and the investigative methods used to determine geologic time, including the following: • rock sequences, relative dating, fossil correlation, and radiometric dating , and • geologic time scales, historic changes in life forms, and the evidence (e.g., radiometric methods, tree rings, paleomagnetism) for absolute ages (NM-II.III.II.4). 6. Knows that Earth's systems are driven by internal (i.e., radioactive decay and gravitational energy) and external (i.e., the sun) sources of energy (NM-II.III.II.6). 7. Describes the composition and structure of Earth's materials, including, • the major rock types (i.e., sedimentary, igneous, metamorphic) and their formation, and • natural resources (e.g., minerals, petroleum) and their formation (NM-II.III.II.10). 8. Explains how the availability of ground water through aquifers can fluctuate based on multiple factors (i.e., rate of use, rate of replenishment, surface changes, and changes in temperature) (NM-II.III.II.12).	4 – 8. Independently or as part of a class project, the student contributes to creating two maps of the Earth that show the distribution of natural resources (e.g. minerals, fossil fuels, water). The first map shows the surface distribution of these resources; the second map shows the internal structures and cycles of the Earth from the core to the ozone layer. He/She compares the two maps, looking for correlations between internal structures/cycles and resources found at or near the surface (e.g., What types of minerals are found in volcanic regions? Why is oil only found in certain regions? How are salt caves related to ground- water?). √ accurate, thorough maps √ depiction of relative abundance and value of resources √ knowledge of the rock cycle √ knowledge of Earth's structure √ reasonable correlations √ distinction between renewable and nonrenewable resources 7. See Strand II (Content of Physical Science) Illustration #3, 12 – 14.

STRAND IV: SCIENCE AND SOCIETY
CONTENT STANDARD: The student understands how scientific discoveries, inventions, practices, and knowledge influence, and are influenced by, individuals and societies.

BENCHMARK: The student examines and analyzes how scientific discoveries and their applications affect the world and explains how societies influence scientific investigations and applications.

GRADE 9-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	Science and Technology	
	1. Knows how science enables technology but also constrains it, and recognizes 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) (NM-III.I.I.1).	1. See Strand II (Content of Physical Science) Illustration #3, 12 – 14, 18, 24, and Strand III (Content of Earth and Space Science) Illustration #3, 5, 7.
	2. Understands how advances in technology (e.g., microscopes and cellular structure, telescopes and understanding of the universe) enable further advances in science (NM-III.I.I.2).	1 – 3, 9, 10, 14, 15. See Strand II (Content of Physical Science) Illustration #5, 6.
	3. Evaluates 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) (NM-III.I.I.3).	3, 4, 7, 8, 10 – 15, 17, 18. See Strand III (Content of Earth and Space Science) Illustration #3, 5, 7. -AND- 3, 4, 14. See Strand II (Content of Physical Science) Illustration #1, 2.
	4. Understands 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) (NM-III.I.I.4).	4, 18. See Strand I (Scientific Thinking and Practice) Illustration #1-4, 6, 7, 12, 15.
	5. Analyzes the impact of digital technologies on the availability, creation, and dissemination of information (NM-III.I.I.6).	5. See Strand II (Content of Physical Science) Illustration #5, 6, and Strand III (Content of Earth and Space Science) Illustration #3, 5, 7.
	6. Describes how human activities have affected ozone in the upper atmosphere and how it affects health and the environment (NM-III.I.I.7).	6. See Strand III (Content of Earth and Space Science) Illustration #4 – 8.
	7. Describes uses of radioactivity (e.g., nuclear power, nuclear medicine, radiometric dating) (NM-III.I.I.8).	7, 8. See Strand III (Content of Earth and Space Science). Illustration #3, 5, 7.

GRADE 9-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	Science and Society	
	8. Describes 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) (NM-II.I.I.9).	
	9. Describes major historical changes in scientific perspectives (e.g., atomic theory, germs, cosmology, relativity, plate tectonics, evolution) and the experimental observations that triggered them (NM-III.I.I.10).	9. See Strand II (Content of Physical Science) Illustration #5, 6.
	10. Knows that societal factors (e.g., government funding, laws and regulations about human cloning and genetically modified organisms, gender and ethnic bias, AIDS research, alternative-energy research) can promote or constrain scientific discovery (NM-III.I.I.11).	10 – 15. See Strand III (Content of Earth and Space Science) Illustration #3, 5, 7.
	11. Explains how societies can change ecosystems and how these changes can be reversible or irreversible (NM-III.I.I.12).	
	12. Describes how environmental, economic, and political interests impact resource management and use in New Mexico (NM-III.I.I.13).	
	13. Describes New Mexico's role in nuclear science (e.g., Manhattan Project, WIPP, national laboratories) (NM-III.I.I.14).	
	Science and the Individual	
	14. Identifies how science has produced knowledge that is relevant to individual health and material prosperity (NM-III.I.I.15).	14. See Strand II (Content of Physical Science) Illustration #2, 4.
	15. Understands 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) (NM-III.I.I.16).	15. See Strand II (Content of Physical Science) Illustration #5, 6, and Strand III (Content of Earth and Space Science) Illustration #3, 5, 7.
	16. Identifies 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) (NM-III.I.I.17).	16. See Strand III (Content of Earth and Space Science) Illustration #3, 5, 7.

GRADE 9-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	17. Understands 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 values including honesty and openness) (NM-III.I.I.18). 18. Knows 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) (NM-III.I.I.19).	17, 18. See Strand III (Content of Earth and Space Science) Illustration #3, 5, 7.

STRAND V: LITERACY
CONTENT STANDARD: The student communicates chemical 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 9-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	1. Develops and demonstrates proficiency with the following strategies to approach reading for information across content areas: (APS – LA I.1): • scans reading selection to determine whether a text contains relevant information, • uses the headings and subheadings of the material to make predictions and to validate comprehension of text, • reads and rereads to decode meaning, and • reviews and summarizes essential elements of text for overview.	1. See Strand I (Scientific Thinking and Practice) Illustration #1 – 4, 6, 7, 12, 15. 1, 3 – 8. See Strand II (Content of Physical Science), Illustration #5, 6, and Strand III (Content of Earth and Space Science) Illustration #3, 5, 7.
	2. Identifies and uses roots, prefixes, and suffixes to determine meaning of words (APS – LA I.4).	2. The student relates science vocabulary and nomenclature to Greek and Latin roots (e.g., homo/hetero, mono/bi/tetra/ambi, therm, geo, chemo, endo/exo, photo, kineto, hypo/hyper, hydro, terra, and the origins of the names of the elements). √ accuracy √ application
	3. Uses textual evidence to develop and support an interpretation of a scientific process or concept (APS – LA II.2).	3 – 5, 8. See Strand I (Scientific Thinking and Practice) Illustration #1-4, 6, 7, 12, 15.
	4. Develops increased competence in using the writing process to create a final product (APS – LA III.1).	4 – 6, 8. See Strand II (Content of Physical Science) Illustration #7, 9, 12, 13, 15.
	5. Develops increased competence in using elements of effective writing (APS – LA III.2).	
	6. Supports an informed opinion (APS – LA III.6): • uses appropriate language, reasoning, and organizational structure for the audience and purpose, • provides relevant and convincing reasons, uses various types of evidence, and • demonstrates an awareness of possible questions, concerns, or counterarguments.	6. See Strand II (Content of Physical Science) Illustration #7, 9, 12, 13, 15.
	7. Responds to a variety of written, electronic, and other media (APS – LA III.7).	7. See Strand III (Content of Earth and Space Science) Illustration #3, 5, 7.

GRADE 9-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	8. Develops increased competence with speaking and language conventions (APS – LA IV.3).	8. See Strand I (Scientific Thinking and Process) Illustration #1-4, 6, 7, 12, 15; Strand II (Content of Physical Science) Illustrations #5, 6, #7, 9, 12, 13, 15; and Strand III (Content of Earth and Space Science) Illustration #3, 5, 7.