APS DISTRICT HIGH SCHOOL SCIENCE CURRICULUM FRAMEWORK

Course Title: Introduction to Forensics **Course Number:** 43142

Department: Science **ADS Number:** 17187154

Prerequisites: Successful completion of Biology I and Chemistry I

Length of Course: One Year **Credit/PRI Area:** .5 per Semester*/Science **Grade Level(s):** 11 - 12

Important Notes:

Block scheduling allows times for comprehensive labs. Skills and knowledge in this course can be applied to the Law, Public Safety and Security career pathway as well as the Health Science career pathway.

*Valley High School will pilot this course in school year 2006-2007 with a review of the course in November, 2006 and March, 2007.

COURSE DESCRIPTION: The laboratory course* is designed as a course for the student interested in forensic science. The philosophical, rational, and practical framework that supports a forensic investigation is presented via an integrated curriculum. This course presents the unifying principles of forensic science, discusses the foundation of forensic science in the basic sciences and mathematics, and introduces the technique of integrating these areas in the determination of the cause of death. The student studies forensic anthropology, biochemistry, chemistry, botany, entomology, and physics as well as problem-solving techniques utilized in analyzing a crime scene. Other topics include ballistics, autopsies, mass disasters, epidemology of environmental disaster, biological weapons as well as toxicology, microbiology, and pathology. The instructor utilizes a variety of techniques (e.g., demonstration, lecture, laboratory case studies) and literacy strategies (e.g., reading, writing, speaking, research) to deliver the curriculum.

* 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 (.5 per semester), excluding passing period. (APS Procedural Directives – Section I – Instruction, Basis for offering credit).

References in parentheses following each performance standard align with the State of New Mexico Science Standards (NM), the State of New Mexico Mathematics Standards (NM – MA), the Albuquerque Public Schools Mathematics Standards (APS – MA), and the 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 forensic science teachers in the Albuquerque Public Schools (APS).

ASSESSMENTS:
Assessments may include: authentic and performance-based assessment, cooperative learning, teacher observations, checklists, tests and exams, formal and informal writing, small group and full class discussions, oral and multimedia presentations, projects, demonstrations, and portfolios. Assessments are based on appropriate rubrics.

SUGGESTED TEXTBOOKS AND INSTRUCTIONAL MATERIALS:

- Current state addopted textbooks
- *Criminalistics – An Introduction to Forensic Science*, Saferstein, R., Pearson/Prentice Hall
- *Bodies of Evidence* – Innes, Brian – Reader's Digest - 2000
- Supplementary materials
- Microscopes
- Laboratory environment

SUGGESTED TITLES/AUTHORS WEB SITES:

Approved by HSCA: March, 2006

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 communicates 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
	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 that include (NM - I.I.I.2): • 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 • error analysis. 3. Uses appropriate technologies to collect, analyze, and communicate scientific data (e.g., computers, calculators, balances, microscopes) (NM - I.I.I.3). 4. Conveys results of investigations using scientific concepts, methodologies, and expressions, including (NM - I.I.I.4; APS – MA IV.5E): • 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 • reasoned arguments.	**NOTE: Illustrations include suggested activities for attaining each performance standard. A check for (√) refers to a key feature to look for while assessing student performance.** 1 – 20. The student properly designs and performs a controlled experiment in a qualitative analysis lab (e.g., formation of chemical compounds in a natural environment and synthetically produced compounds) using a recognized scientific method, gathers data, and reports results in both an oral and written format. ✓ proper safety techniques ✓ correct use of equipment ✓ appropriate equipment ✓ evidence of current scientific knowledge ✓ effective communication skills ✓ use of technology ✓ properly conducted experiment ✓ quantitative data/analysis ✓ critical thinking and insights

GRADE 11 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	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). 6. Understands how scientific processes produce valid, reliable results, including (NM - I.I.II.1): • 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. 7. Uses scientific reasoning and valid logic to recognize (NM - I.I.II.2): • faulty logic • cause and effect • the difference between observation and unsubstantiated inferences and conclusions • potential bias. 8. Understands how new data and observations can result in new scientific knowledge (NM - I.I.II.3; APS – MA IV.1E). 9. Critically analyzes an accepted explanation by reviewing current scientific knowledge (NM - I.I.II.4). 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). 13. Uses mathematical models to describe, explain, and predict natural phenomena (NM - I.I.III.2; APS – MA I.16).	

GRADE 11 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	14. Uses technologies to quantify relationships in scientific hypotheses (e.g., calculators, computer spreadsheets and databases, graphing software, simulations, modeling) (NM - I.I.III.3). 15. Identifies and applies measurement techniques and consider possible effects of measurement errors (NM - I.I.III.4). 16. Uses mathematics to express and establish scientific relationships (e.g., scientific notation, vectors, dimensional analysis) (NM - I.I.III.5). 17. Understands the differences between the various methods of data collection (NM – MA IIIA.1). 18. Knows the characteristics of a well-designed and well-conducted survey (NM – MA IIIA.2): • differentiates between sampling and census and • differentiates between a biased and an unbiased sample. 19. Knows the difference of a well-designed and well-conducted experiment (NM – MA IIIA.3): • differentiates between an experiment and an observational study and • recognizes sources of bias in poorly designed experiments. 20. Understands the role of randomization in well-designed surveys and experiments (NM – MA IIIA.4).	

STRAND II: THE CONTENT OF SCIENCE-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 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
		NOTE: Most of the labs described in this course are based on a student or a team of students setting up a scenario which involves a crime scene that has been set up to inform another group and that group solving the situation based on the information given. The "solving" team describes the outcome to the "setting up" team, which determines if the "solving" team is right or wrong.
	1. Identifies different forms of energy, including kinetic, gravitational (potential), chemical, thermal, nuclear, and electromagnetic (NM – II.I.II.1).	1 – 3, 5, 9 – 11. The student learns about and attempts various mixture separation techniques including distillation, diffusion, mass spectrometry, chromatography, spectrophotometry, and electrophoresis. These techniques are used to separate toxins, perform qualitative analysis, and quantify the toxins. ✓ active participation in all activities ✓ analysis ✓ comprehension of main concepts
	2. Explains how thermal energy (heat) consists of the random motion and vibration of atoms and molecules and is measured by temperature (NM – II.I.II.2).	2, 5, 11. The student estimates the time of death of a body based on environmental conditions and their effect on body temperature. ✓ application of scientific principles ✓ accuracy
	3. 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).	
	4. Understands how heat can be transferred by conduction, convection, and radiation, and how heat conduction differs in conductors and insulators (NM - II.I.II.4).	4, 6, 7, 11, 15 – 19. As an introduction to fundamental concepts, the student, through lectures and textbook readings, learns about forces, work, and energy; how one affects the other; how to convert one to the other, and how energy is created via a bullet/cartridge (i.e., inside cartridge heat expands gas, which propels the bullet with a force proportional to the mass of the bullet and the amount of gunpowder). This knowledge leads to an introduction of terminal ballistics (e.g., how bullet interacts with the
	5. 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).	

GRADE 11 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	6. Understands 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.(NM - II.I.II.6).	object it is striking - perforating or penetrating wounds). The student learns about an EMG (i.e., type of gun that creates an extreme amount of force based on electromagnetic energy). As an application of all he/she has learned, the student calculates forces based on given data (e.g., type of gun and bullets used) and creates a trajectory model (i.e., gravity vs. mass) to try to figure out how far the bullet goes. Scenario: A person is hit by a bullet. Using bullet and trajectory data, (e.g., rods, lasers) the group responsible for solving this crime has to determine where the shooter was, how far away he/she was, and where the victim was (e.g., standing, sitting). In preparation for this activity, the student completes a worksheet with designated questions and practices with a "body" (e.g., pumpkin) that has entry and exit wounds. ✓ understanding of the relationship between mass, acceleration, and force; force and energy ✓ understanding of the effect of gravity on trajectory ✓ understanding of terminal ballistics vs. force ✓ problem-solving techniques ✓ teamwork/collaboration ✓ reading analysis ✓ connections
	7. Understands that electromagnetic waves carry energy that can be transferred when they interact with matter (NM - II.I.II.7). 8. 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 (NM – II.I.II.8): • 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. 9. Knows that each kind of atom or molecule can gain or lose energy only in discrete amounts (NM – II.I.II.9). 10. Explains how wavelengths of electromagnetic radiation can be used to identify atoms, molecules, and the composition of stars (NM – II.I.II.10).	7 – 10. The student explores the use of electromagnetic waves in ballistic applications, traces evidence location, and identifies compounds. ✓ understanding of electromagnetic waves ✓ connections ✓ accuracy

GRADE 11 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	11. Understands the concept of equilibrium (i.e., thermal, mechanical, and chemical) (NM - II.I.II.11). 12. Knows that there are four fundamental forces in nature: gravitation, electromagnetism, weak nuclear force, and strong nuclear force (NM - II.I.III.1). 13. Knows 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 (NM - II.I.III.2). 14. Knows 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 (NM - II.I.III.3). 15. Understands the relationship between force and pressure, and how the pressure of a volume of gas depends on the temperature and the amount of gas (NM - II.I.III.4). 16. Explains how electric currents cause magnetism and how changing magnetic fields produce electricity (e.g., electric motors, generators) (NM - II.I.III.5). 17. Represents the magnitude and direction of forces by vector diagrams (NM - II.I.III.6). 18. Knows 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) (NM - II.I.III.7). 19. Applies Newton's Laws to describe and analyze the behavior of moving objects, including (NM - II.I.III.8): • 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.	12 - 14. The student first learns about fluid (e.g., blood) dynamics, specific gravity and density aspects, and its special characteristics [e.g., water composition, consistent behavior (angles, location of objects)]. Scenario: Using butcher paper and thin red paint, the "setting up" team spatters "blood" with a stick or another object. The "solving" team determines if the "blood" came at a high or low speed and how it got on the paper. ✓ correct solution and description of the scenario ✓ relationship between gravity and "blood-spattered" patterns ✓ communication skills ✓ teamwork/collaboration

GRADE 11 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	20. Describes relative motion using frames of reference (NM - II.I.III.9).	20, 22. The student learns about explosives and forces exerted by expanding gas or energy around a bomb or other type of explosive. The student realizes the impact and devastation of an explosion via pictures and visual presentations (e.g., PowerPoint of World Trade Center and 9/11 event). Scenario: The student examines information on an explosion scene. Task: The student determines the type of explosive used, the location of the scene, and if energy was expanding or lessening leaving the scene. ✓ correct solution and description of the scenario ✓ communication skills ✓ teamwork/collaboration
	21. Describes wave propagation using amplitude, wavelength, frequency, and speed (NM - II.I.III.10). 22. Explains how the interactions of waves can result in interference, reflection, and refraction (NM - II.I.III.11). 23. Describes how waves are used for practical purposes (e.g., seismic data, acoustic effects, Doppler effect) (NM - II.I.III.12).	21, 23. The student studies amplitude, frequency, and speed as determining factors that are consistent patterns occurring in voice recognition. He/She learns that voice recognition is a specialty area in crime detection that is becoming more widespread. Historically, this technique tends to be used more by specialists (e.g., FBI). Through lecture and the use of a CD-ROM put out by Duke University, the student learns about crime situations where voice recognition techniques were used to solve them. Using this knowledge, the student identifies a variety of voice patterns and makes comparisons based on the waves and amplitudes of the waves. ✓ application of concepts ✓ accuracy ✓ listening skills

STRAND III: THE CONTENT OF SCIENCE-LIFE
CONTENT STANDARD: The student understands the properties, structures, and processes of living things and the interdependence of living things and their environments.

BENCHMARKS: The student understands the genetic basis for inheritance and the basic concepts of biological evolution.

GRADE 11 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	1. Knows how DNA carries all genetic information in the units of heredity called genes, including (NM – II.II.II.1): • the structure of DNA (e.g., subunits A, G, C, T), • information-preserving replication of DNA, and • alteration of genes by inserting, deleting, or substituting parts of DNA. 2. Uses appropriate vocabulary to describe inheritable traits (i.e., genotype, phenotype) (NM – II.II.II.2). 3. Explains the concepts of segregation, independent assortment, and dominant/recessive alleles (NM – II.II.II.3). 4. Identifies traits that can and cannot be inherited (NM – II.II.II.4). 5. Knows how genetic variability results from the recombination and mutation of genes, including (NM – II.II.II.5): • sorting and recombination of genes in sexual reproduction result in a change in DNA that is passed on to offspring and • radiation or chemical substances can cause mutations in cells, resulting in a permanent change in DNA. 6. Understands the principles of sexual and asexual reproduction, including meiosis and mitosis (NM – II.II.II.6). 7. Knows that most cells in the human body contain 23 pairs of chromosomes including one pair that determines sex, and that human females have two X chromosomes and human males have an X and a Y chromosome (NM – II.II.II.7).	1 – 7. The student acquires technical knowledge about DNA and genetics through a variety of techniques including DNA phylogeny activity showing structural similarities between species; protein synthesis activity demonstrating amino acids common between species and shared genetic compositions; DNA fingerprinting exercise to trace genetic disorders, show DNA structure, describe mutations, trace inheritance, and follow human origin; explore the work of Mendel to relate genotype and phenotype; complete statistical analysis of the genetic probabilities of dominant and recessive traits; and relate these traits to natural selection and species fitness. ✓ foundational understanding of genetics ✓ participation in all activities ✓ analysis ✓ application of lab procedures ✓ connections

GRADE 11 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	8. Describes the evidence for the first appearance of life on Earth as one-celled organisms, over 3.5 billion years ago, and for the later appearance of a diversity of multicellular organisms over millions of years (NM – II.II.II.8). 9. Critically analyzes the data and observations supporting the conclusion that the species living on Earth today are related by descent from the ancestral one-celled organisms (NM - II.II.II.9). 10. Understands the data, observations, and logic supporting the conclusion that species today evolved from earlier, distinctly different species, originating from the ancestral one-celled organisms (NM – II.II.II.10). 11. Understands that evolution is a consequence of many factors, including the ability of organisms to reproduce, genetic variability, the effect of limited resources, and natural selection (NM – II.II.II.11). 12. Explains how natural selection favors individuals who are better able to survive, reproduce, and leave offspring (NM – II.II.II.12). 13. Analyzes how evolution by natural selection and other mechanisms explains many phenomena including the fossil record of ancient life forms and similarities (both physical and molecular) among different species (NM – II.II.II.13).	8 – 13. The student participates in a variety of activities that involve research, experimentation, and discussion. He/She learns: • pathogenic capabilities, prokaryotic/eukaryotic cellular structure, reproductive advantages and limitations, and phylogenic characteristics (Microbiology); • structural similarities between species, commonly coded amino acids, shared compositions, DNA fingerprinting to trace genetic inheritance, sex-linked heredity used to trace human origin, and reproduction ability versus natural selection (DNA unit); and • skeletal differences used to show the identity of unidentified skeletal remains, population effects on species characteristics, measuring and describing skeletal differences and similarities between species, how environmental factors have shaped the human skeleton, and how variability in those factors results in change (Forensic Anthropology). ✓ individual participation in all activities ✓ active participation in discussions ✓ articulation of ideas and concepts learned ✓ adherence to lab procedures ✓ analysis/insights

STRAND IV: THE CONTENT OF SCIENCE-EARTH AND SPACE
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 11 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	1. Understands the scale and contents of the universe, including (NM - II.III.I.1): • range of structures from atoms through astronomical objects to the universe • objects in the universe such as planets, stars, galaxies, and nebulae. 2. Predicts changes in the positions and appearances of objects in the sky (e.g., moon, sun) based on knowledge of current positions and patterns of movements (e.g., lunar cycles, seasons) (NM - II.III.I.2). 3. Understands how knowledge about the universe comes from evidence collected from advanced technology (e.g., telescopes, satellites, images, computer models) (NM - II.III.I.3).	1 – 3. The student learns that crimes have sometimes been solved by astrological evidence (e.g., Zodiac killer) and that lunar events have determined when people commit crimes. Forensic astronomy is being used to predict when the next event might occur. To gain a grasp of this knowledge, the student reads about, listens to lectures, and participates in activities regarding planet alignment, the solar system, definition of objects, the basis for the astrological calendar, and the prediction of an event (e.g., sequences and series). ✓ individual participation in discussions and activities ✓ application of theories ✓ comprehension of main ideas
	4. Describes the key observations that led to the acceptance of the Big Bang theory and that the age of the universe is over 10 billion years (NM - II.III.I.4).	4. The student participates in an investigation to discern between provable science and cultural beliefs and phenomena and to separate the two theories. The student comes up with an argument and participates in a debate that discusses both sides of the argument and allows the student to see another person's viewpoint. ✓ relevant issue ✓ active participation in the debate ✓ support for argument ✓ flexibility in thinking
	5. Explains how objects in the universe emit different electromagnetic radiation and how this information is used (NM - II.III.I.5). 6. Examines the role that New Mexico research facilities play in current space exploration (e.g., Very Large Array, Goddard Space Center) (NM - II.III.I.7).	5, 6. The student researches what is being done at the Very Large Array regarding radiation and what the bodies in the solar system are doing. He/She discusses findings in either a small or large group setting. ✓ thorough research ✓ relevant information ✓ active participation in discussions ✓ awareness of research going on in New Mexico

GRADE 11 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	7. Explains plate tectonic theory and understand the evidence that supports it (NM - II.III.II.5).	7, 9, 10. The student first learns about body decomposition rates based on location of the body, its burial site, temperatures, and soil compositions. He/She also considers the Earth's composition and how areas are different from each other. With this knowledge the student engages in a variety of experiments: • Pigs feet are placed in several different locations and then examined after three weeks and six weeks. The student records the rates of decomposition each time using a pre-established rating scale. • The student describes plate tectonics, thermal activity, and volcanic activity to explain how the Earth's crust is being recycled and why soils are different in different parts of the planet. • The student examines different geographical areas to determine decomposition rates based on water retention. ✓ determination of relative spread of decomposition ✓ name and classification of soils ✓ water retention (i.e., how much water the soil holds) ✓ completion of all activities ✓ effective communication
	8. Describes how stars are powered by nuclear fusion, how luminosity and temperature indicate their age, and how stellar processes create heavier and stable elements that are found throughout the universe (II.III.I.6). 9. 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). 10. Describes convection as the mechanism for moving heat energy from deep within Earth to the surface and discuss how this process results in plate tectonics, including (NM - II.III.II.7): • geological manifestations (e.g., earthquakes, volcanoes, mountain building) that occur at plate boundaries • impact of plate motions on societies and the environment (e.g., earthquakes, volcanoes).	8. The student learns how forensic science is being used in arson investigation and how fuel composition (e.g., color, heat) tells you what is being burned. In a lab activity, the student burns small samples and records in a chart what is being burned, what the fuel was (e.g., carbon, magnesium, sulphur) based on its color of flame and smoke. ✓ correct identification of accelerant

STRAND V: 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 11 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	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). 2. Understands how advances in technology enable further advances in science (e.g., microscopes and cellular structure; telescopes and understanding of the universe) (NM - III.I.I.2). 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). 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). 5. Understands that applications of genetics can meet human needs and can create new problems (e.g., agriculture, medicine, cloning) (NM - III.I.I.5).	1 – 4, 10. The student listens to a lecture on the history of forensic science and through that learns some of the technological advances made over time and some of science's constraints (e.g., expense). Interesting tidbits of information and stories revealed in this historical perspective: • The Chinese used fingerprinting 3000 years ago. • DNA is probably the most reliable source for crime detection but used as a last resort because of its expense. • Many years ago a farmer in China killed his neighbor. The sheriff or lawman had all the men bring their farm equipment (e.g., sickles) and lay them on the ground. Flies attracted to the sickle covered in blood, even though it had been wiped clean, solved that crime. Option: The student listens to a guest speaker. In this case, the APD Crime lab sends a representative out to the class who talks about present cases. The student gets a first hand look at a case and how it is solved. ✓ listening skills ✓ appropriate behaviors ✓ synthesis of information ✓ effective communication/personal reflection 5, 11. As a spring board to activities, the student starts with Mendelian genetics and works up to future goals and trends in genetics. This leads to discussions about ethics, DNA, and how human genomes can pinpoint diseases with genetic information. What this will do to change human population is an essential question that the student theorizes about. The student engages in a variety of labs and activities based on DNA evidence: • Punnett squares to determine his/her own traits. • Electrophoresis lab (e.g., plot diagrams) – uses gelatin with different plots to determine DNA similarities

GRADE 11 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
		• Lab to remove DNA from bovine liver to determine its genetic "fingerprint**" (OR)** • fingerprinting experiments (e.g., can be used to determine paternity, diseases, heredity) The student follows standard lab procedures submitting lab write-ups which include his/her hypothesis, data, calculations, and conclusions. ✓ completion of all lab activities ✓ safety practices ✓ written lab reports ✓ clear communication ✓ all required tasks
	6. Analyzes the impact of digital technologies on the availability, creation, and dissemination of information (NM - III.I.I.6).	6. The student participates in a discussion on the Automated Fingerprinting Identification System (AFIS). AFIS is a sophisticated, digital computerized system that makes available and disseminates information, identifies the specific information, and stores it for future use. This digital technology has helped solve crimes. After learning about advances in technology, the student participates in a fingerprinting lab. Scenario: The student takes several fingerprints of individuals, thereby, creating evidence. Task: A team of students dust the fingerprints left as evidence and use them to identify who the "culprit" is. ✓ application of knowledge ✓ individual participation ✓ problem-solving skills
	7. Describes how human activities have affected ozone in the upper atmosphere and how it affects health and the environment. 8. Describes uses of radioactivity (e.g., nuclear power, nuclear medicine, radiometric dating) (NM - III.I.I.8). 9. 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 - III.I.I.9). 10. Describes major historical changes in scientific perspectives (e.g., atomic	7 – 9, 12 – 14. Using scientific inquiry, the student investigates through a variety of exercises how human activity affects health (e.g., skin cancer): • acid rain lab – The student creates an acid rain environment in a terrarium or aquarium that has the same effects as an acid rain storm and attempts to answer the questions why science has created its own problem that it has to fix and what are the environmental effects (e.g., ozone depletion, CFC). • The student participates in a discussion regarding WIPP and the ecological implications that may result. He/She may also examine population increases and the strain that that puts on science and technology. The student examines population growth rates of different nations and looks at that information to see how it impacts

GRADE 11 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	theory, germs, cosmology, relativity, plate tectonics, evolution) and the experimental observations that triggered them (NM - III.I.I.10). 11. Knows 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) (NM - III.I.I.11). 12. Explains how societies can change ecosystems and how these changes can be reversible or irreversible (NM - III.I.I.12). 13. Describes how environmental, economic, and political interests impact resource management and use in New Mexico (NM - III.I.I.13). 14. Describes New Mexico's role in nuclear science (e.g., Manhattan Project, WIPP, national laboratories) (NM - III.I.I.14). 15. Identifies how science has produced knowledge that is relevant to individual health and material prosperity (NM - III.I.I.15). 16. 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). 17. 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). 18. 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).	education, crime, and income. ✓ clear description and measure of harmful effects ✓ relationship between factors (e.g., population and energy, resource use and criminal behavior) ✓ inquiry techniques ✓ active participation in discussions 15 – 17. The student acquires basic concepts in his/her study of epidemiology (i.e., branch of medicine which treats of the origin, nature, pathology, and prevention of epidemic diseases) and applies that knowledge to the following : Scenario: A group of students constructs a mock disease outbreak (e.g., symptoms). Task: Using forensic ability, another student team determines what the disease is, when it started, and how it was brought to the area. Based on the diagnosis, the team devises an educational platform (e.g., ad, brochure) that informs the public. The platform serves to educate the public about scientific knowledge and attempts to change cultural beliefs. ✓ correct identification of the disease ✓ solution of the epidemic ✓ creative educational platform ✓ functionality of the platform ✓ persuasive skills ✓ support for argument 18, 19. The student listens to a variety of guest speakers: • Bureau of Alcohol, Tobacco, and Firearms (BATF) • FBI agent • APD detective

GRADE 11 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	19. 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).	• Odontologist (dental expert) • Pathologist • Entomologist • Graphologist (handwriting analyist) Before the class visitations, each speaker has been asked to address the career connection. In other words, what can be done in this field and the science behind it. In preparation for the visits, the student writes three questions specific to careers (pre-approved) that he/she wants answered. ✓ discussion and interaction ✓ listening skills ✓ appropriate behaviors ✓ audience response

STRAND VI: LITERACY
CONTENT STANDARD: The student communicates forensic principles through reading, writing, and speaking opportunities.

BENCHMARKS: A. The student demonstrates proficiency in reading comprehension, specialized vocabulary, and a variety of writing and speaking requirements.
B. The student synthesizes and evaluates information to solve problems across the curriculum.

GRADE 11 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	Unless otherwise indicated, the following standards are aligned to the APS 9th grade Language Arts Standards.	**Note:** The very nature of science courses entails that the student be involved in research, exploration, and experimentation This requires the student to read through his/her research studies; write up findings in the form of lab reports; work with other students collaboratively, requiring whole or small group discussions; listening to other's viewpoints whether it be through print, video, or guest speaker; and display data in an organized fashion. Consequently, literacy strategies are reflected in every strand. The following citations illustrate specific examples of these strategies although numerous opportunities are presented throughout the year and throughout the curriculum.
	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. 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).	1 – 3. See Strand II, 3rd illustration; Strand IV, 1st illustration and the illustration for performance standards #7, #9, #10; and Strand V, the illustration for performance standards #15 – #17.
	4. Develops increased competence in using the writing process to create a final product (APS – LA III.1). 5. Develops increased competence in using elements of effective writing (APS – LA III.2).	4 – 7. See Strand I, the 1st illustration and Strand V, the 2nd illustration.

GRADE 11 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	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.	
	7. Responds to a variety of written, electronic, and other media (APS – LA III.7).	
	8. Develops increased competence with speaking and language conventions (APS – LA IV.3).	8. See Strand IV, 2nd illustration and Strand IV, the illustration for performance standards #7, #9, #10.
	9. Listens to and analyzes a presentation or discussion (APS – LA V.1).	9. See Strand II, last illustration; Strand IV, 1st illustration and the illustration for performance standard # 8; Strand V, 1st illustration and the illustrations for performance standards #6, #7 – #9; #12 – #14, and #18, #19.
	10. Conducts research and collects data from in-depth field studies (APS – LA VI.1).	10 – 15. See Strand I illustration; Strand III, the illustration for performance standards #8 - #13; Strand IV, the 2nd and the 3rd illustrations; and Strand V, the illustrations for performance standards #6 and #7.
	11. Obtains and sends information electronically to support advanced research (APS – LA VI.2).	
	12. Uses a variety of technology (APS – LA VI.5).	
	13. Recognizes and continues to use the elements of formal citations to document sources (APS – LA VI.6).	
	14. Synthesizes information from multiple research studies to draw conclusions and inferences that go beyond those found in any of the individual studies (APS – LA VI.9).	
	15. Synthesizes and organizes information from a variety of sources to inform and persuade an audience (APS – LA VI.9).	
	16. Researches, defines, and presents issues of individual or public concern [APS – LA VI.5 (12)]: • organizes and delivers a presentation that takes a clear stance on an issue and specifies supporting evidence for any claims made,	16 – 18. The student learns through lectures, guest speakers, and statistical analysis about national crime statistics and other census information. He/She identifies connections between demographic information and crime numbers. The student presents findings to the class with data

GRADE 11 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	• uses a variety of resources (e.g., media centers, on-line resources, interviews, personal reflection, • specifies the nature of an issue, including claims made and the reasoning that supports those claims, and • conducts research and in-depth analyses of information. 17. Identifies and analyzes the philosophical assumptions and basic beliefs underlying an author's work [APS – LA II.1 (12)]. 18. Analyzes the effects of the attitudes and values of a period in which the text was written [APS – LA II.10 (12)].	supporting his/her argument that a particular crime is related to the chosen demographic. The student reviews media and literature presenting both sides of laws concerning federal law enforcement agencies. He/She describes how the author's or the presenter's viewpoint reflects one side or both sides of the law. The student learns how the time period, national circumstances, and cultural views may determine legal standards. ✓ thorough research ✓ presentation of both sides ✓ support for position ✓ statistical analysis ✓ connections ✓ effective presentation

STRAND IV: CAREER AND LIFE PATHWAYS
CONTENT STANDARD: The student identifies and explores interests and opporutnities as they relate to the field of forensic science and investigation.

BENCHMARK: The student demonstrates the knowledge, skills and training needed to pursue career opportunities in the field of forensic science and investigation.

GRADE 11 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	1. Analyzes and integrates positive behavior, conduct, and social manners in the workplace and community (CR: 1-A-D). 2. Demonstrates an awareness of opportunities in forensic science (CR: 1-A-D). 3. Integrates career goals, skills, and interests with exploration of post secondary options (CR: 1-A-D). 4. Demonstrates responsible behavior related to employability (e.g., the ability to function as a proactive productive team member in the workplace) (CR: 4A). 5. Demonstrates procedures for maintaining positive public relations and working cooperative with school personnel (CR: 4D). 6. Demonstrates a broad range of student skills (e.g., problem solving, decision making, critical thinking, team building, leadership) (CR: 5D, 5E). 7. Works cooperatively and collaboratively with others (e.g., respect of diverse views and perspectives (CR: 5C).	1 – 7. Through a variety of activities, the student meets the standards addressed in this strand. He/She: • experiences a job shadow/mentoring situation in a selected career in forensic science and reports his/her experience upon return to class. • listens to a guest speaker. After each guest speaker, the student writes a summary of what he/she learned with a personal reflection piece. • participates in activities to discover career interests and abilities and identifies the educational requirements for these careers. The results of that research are presented through a research paper, a PowerPoint presentation or group demonstration or project. ✓ appropriate behaviors ✓ listening skills ✓ effective communication/personal reflection ✓ thorough research ✓ relevant information ✓ synthesis of information ✓ a variety of resources ✓ skills development (e.g., critical thinking, leadership) ✓ distinguishment among various careers in the forensics field ✓ recognition of the different levels of education needed for career positions