# APS DISTRICT HIGH SCHOOL SCIENCE CURRICULUM FRAMEWORK

**Course Title:** Biology I (Analytical) **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:

| | | |
|---|---|---|
| Biology I (Analytical) | 41121 | 17114144 |
| Biology I (Analytical) Bilingual | 4112B | 17118144 |
| Biology I (Analytical) | 060ME | 17112144 |
| Biology I (Analytical) | 061ME | 17112144 |
| Biology I (Analytical) | 062ME | 17112144 |

## *Important Notes:*

Biology I (Analytical) introduces the eight major themes outlined in the national AP Biology course description. This course builds a foundation designed to support AP Biology curriculum. Biology I (Analytical) introduces certain AP labs and concepts at a simpler level to help ensure successful completion of AP Biology. Labs and concepts are more complex and in depth than in regular Biology I. The student must be prepared for a demanding class that requires a good work ethic and extensive study. The student must expect frequent homework and out-of-class work.

**COURSE DESCRIPTION:** This laboratory course* is an accelerated course designed to prepare the student for higher-level life science courses, including but not limited to AP Biology. It is not a prerequisite for AP Biology, but this class greatly assists the student in his/her participation and success in the AP course. Biology I (Analytical) is designed to introduce important biological concepts and lab procedures in a manner accessible to all students. Along with additional standards from math, chemistry, and physical science, Biology I (Analytical) addresses the same standards as a regular Biology I class, but covers them in greater depth and provides a level of enrichment that lays a foundation for a deeper understanding and appreciation for the complexities of the life sciences.

*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 align with the State of New Mexico Science Standards (NM), the State of new Mexico Mathematics Standards (NM – MA), 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 (APS).

**ASSESSMENTS:**
Assessments may include the following: 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 adopted textbooks and ancillaries
- Supplemental reading material such as selections from *Doing Biology*, Hagen et al.
- Films/Videos (according to APS District procedural Directive)
- Library, both traditional and electronic
- Guest speakers
- Field trips
- Lab and research materials
- Microscopes
- *Modern Biology* – Otto, James and Albert Towle
- *Biology* – Miller, Kenneth and Joseph Levine – Prentice Hall – 2004
- *Essential Biology* – Campbell/Reece – Benjamin Cummings – 2001
- *The AP Biology Lab Manual* – The College Board
- *A Sourcebook for the Biological Sciences* – Evelyn Morholt et al.

**SUGGESTED TITLES/AUTHORS WEB SITES:**
- The Biology Place Website – http://www.biology.com - an interactive website
- Discover Magazine – http://www.discover.com
- Marshal Brain's How Stuff Works Website – http://www.howstuffworks.com/
- http://www.apcentral.collegeboard.com
- http://ww2.aps.edu
- http://lightyearspress.com/aptchmac.html

**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 |
|---|---|---|
| | | **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. Describes the essential components of an investigation, including appropriate methodologies, proper equipment, and safety precautions (NM – I.I.I.1). | 1 –4, 6 – 16. The student properly designs and performs a controlled experiment using the scientific method, gathers, interprets, discusses and reports results in both an oral and written format.<br>√ proper safety techniques<br>√ correct use of equipment<br>√ appropriate equipment<br>√ evidence of current scientific knowledge<br>√ effective communication skills<br>√ use of technology<br>√ quantitative data<br>√ critical thinking and insights |
| | 2. Designs and conducts scientific investigations that include (NM – I.I.I.2):<br>• testable hypotheses,<br>• controls and variables ,<br>• methods to collect, analyze, and interpret data,<br>• results that address hypotheses being investigated,<br>• predictions based on results,<br>• re-evaluation of hypotheses and additional experimentation as necessary, and<br>• error analysis. | |
| | 3. Uses appropriate technologies to collect, analyze, and communicate scientific data (e.g., computers, calculators, balances, microscopes) (NM – I.I.I.3). | 3, 11, 14. When researchers take cells apart to study the contents of the cells, they get a mixture of different molecules. To study one particular kind of molecule, researchers must separate that kind of molecule from all others. One method of separating molecules in mixtures is by electrophoresis, a process where an electrical current is applied to the ends of a gel containing a mixture of molecules. Negatively charged molecules move toward the positive end of the gel, and positively charged molecules move toward the negative end of the gel. The student separates various dyes using the process of electrophoresis. Using safety precautions, the student prepares agarose gels for electrophoresis, records |

| GRADE 9 - 12 | PERFORMANCE STANDARDS | ILLUSTRATIONS |
|---|---|---|
| | 4. Conveys results of investigations using scientific concepts, methodologies, and expressions, including (NM – I.I.I.4; APS – IV.5E):<br>• scientific language and symbols,<br>• diagrams, charts, and other data displays,<br>• mathematical expressions and processes (e.g., mean, median, slope, proportionality),<br>• clear, logical, and concise communication, and<br>• reasoned arguments.<br><br>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).<br><br>6. Understands how scientific processes produce valid, reliable results, including (NM – I.I.II.1):<br>• consistency of explanations with data and observations,<br>• openness to peer review,<br>• full disclosure and examination of assumptions,<br>• testability of hypotheses, and<br>• repeatability of experiments and reproducibility of results.<br><br>7. Uses scientific reasoning and valid logic to recognize(NM – I.I.II.2):<br>• faulty logic<br>• cause and effect<br>• the difference between observation and unsubstantiated inferences and conclusions<br>• potential bias.<br><br>8. Understands how new data and observations can result in new scientific knowledge (NM – I.I.II.3; APS - !V.1E).<br><br>9. Critically analyzes an accepted explanation by reviewing current scientific knowledge (NM - I.I.II.4).<br><br>10. Examines investigations of current interest in science (e.g., superconductivity, molecular machines, age of the universe) (NM – I.I.II.5). | the data and makes a sketch, analyzes results, and makes conclusions. The student explains in writing which of the dyes tested has the smallest and the largest molecules.<br>√ conduction of lab experiment<br>√ safety practices<br>√ record of data<br>√ analysis<br>√ reasonable conclusions<br>√ clear explanations<br>√ effective writing elements<br><br>5. The student researches and gathers data on the distance between North America and Europe over the past 500 years, analyzes the information, records the difference between these two points - 500 years ago and now, and supports the theory of plate tectonics through sea floor spreading. The student graphs and charts the data and uses the information to predict future and past movement. The student makes a presentation, either orally or in written form, and justifies his/her predictions.<br>√ organization of data<br>√ data supports theory<br>√ critical thinking/insights<br>√ defense of argument<br>√ clear communication<br>√ graphic organizers<br><br>OR<br><br>Using the concept of natural selection and theory of evolution, the student explains the affects of antibiotics, pesticides, and herbicides on the environment and the organisms they affect in the environment.<br>√ effective communication<br>√ explanation of theories<br><br>OR<br><br>The student investigates how natural selection shapes organisms that interact with each other (i.e., symbiotic or commensalistic relationships) and presents the results to the class (e.g., PowerPoint, skit). |

| GRADE 9 - 12 | PERFORMANCE STANDARDS | ILLUSTRATIONS |
|---|---|---|
| | 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).<br><br>12. Creates multiple displays of data to analyze and explain the relationships in scientific investigations (NM – I.I.III.1).<br><br>13. Uses mathematical models to describe, explain, and predict natural phenomena (NM – I.I.III.2; APS – I.16, I.18).<br><br>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).<br><br>15. Identifies and applies measurement techniques and consider possible effects of measurement errors (NM – I.I.III.4).<br><br>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 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.

**BENCHMARK:** The student understands the properties, underlying structure, and reactions of matter

| GRADE 9 - 12 | PERFORMANCE STANDARDS | ILLUSTRATIONS |
|---|---|---|
| | 1. Classifies matter in a variety of ways (e.g., element, compound, mixture, solid, liquid, gas, acidic, neutral, basic) (NM – II.I.I.1). | 1. Using electronic probes or pH / Litmus paper, the student determines the pH of various substances and charts them on a pH scale.<br>√ proper classification |
| | 2. Knows how to use properties to separate mixtures into pure substances (chromatography (NM – II.I.I.3). | 2. The student investigates through simple paper chromatography the leaf pigments associated with photosynthesis. The student measures the pigments, determines how far apart they are, and identifies them by their distance and color. He/She submits a written lab report to the instructor.<br>√ individual participation in the investigation<br>√ all required components<br>√ writing elements and conventions |
| | 3. Understands that matter is made of atoms and that atoms are made of subatomic particles (NM – II.I.I.5).<br><br>4. Understands atomic structure, including (NM – II.I.I.6):<br>• most space occupied by electrons,<br>• nucleus made of protons and neutrons,<br>• isotopes of an element,<br>• masses of proton and neutron 2000 times greater than mass of electron, and<br>• atom held together by proton-electron forces. | 1, 3, 4. Using "tinker-toy" style balls and stick models, the student constructs correct models of various biological molecules (e.g., glucose, glycerol).<br>√ understanding of atomic structure<br>√ individual participation in activities<br>√ accuracy of model |
| | 5. Knows how to express chemical reactions with balanced equations that show (NM – II.I.I.14):<br>• conservation of mass, and<br>• products of common reactions. | 5. The student studies, learns, and notes the relationship between the chemical formulas for photosynthesis and cellular respiration. He/She then, by working various problems, learns the concepts of the parts of a chemical equation as well as simple balancing of these equations.<br>√ ability to balance equations<br>√ accuracy |

| GRADE 9 - 12 | PERFORMANCE STANDARDS | ILLUSTRATIONS |
|---|---|---|
| | | √ understanding of chemical reactions |
| | 6. 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). | 6. The student conducts a catalase lab, observing enzymatic action in various samples of animal liver to understand the function of enzymes in living tissue.<br>√ adherence to lab procedures<br>√ observation 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:** A. The student understands how the survival of species depends on biodiversity and on complex interactions, including the cycling of matter and the flow of energy.
B. The student understands the genetic basis for inheritance and the basic concepts of biological evolution.
C. The student understands the characteristics, structures, and functions of cells.

| GRADE 9 - 12 | PERFORMANCE STANDARDS | ILLUSTRATIONS |
|---|---|---|
| | 1. Knows that an ecosystem is complex and may exhibit fluctuations around a steady state or may evolve over time (NM – II.II.I.1).<br><br>2. Describes how organisms cooperate and compete in ecosystems (e.g., producers, decomposers, herbivores, carnivores, omnivores, predator-prey, symbiosis, mutualism) (NM – II.II.I.2).<br><br>3. Understands and describes how available resources limit the amount of life an ecosystem can support (e.g., energy, water, oxygen, nutrients) (NM – II.II.I.3).<br><br>4. Critically analyzes how humans modify and change ecosystems (e.g., harvesting, pollution, population growth, technology) (NM – II.II.I.4).<br><br>5. Explains how matter and energy flow through biological systems (e.g., organisms, communities, ecosystems), how the total amount of matter and energy is conserved, but some energy is always released as heat to the environment (NM – II.II.I.5).<br><br>6. Describes how energy flows from the sun through plants to herbivores to carnivores and decomposers (NM – II.II.I.6). | 1 – 3, 5, 6. The student does a study on the importance of an organism in an ecosystem from around the school (e.g., Rio Grande, foothills, pond). The study can be on animal life, plant life, and microorganisms. The student focuses on the competition of plants, how they all work together to create a stable environment, and forms conclusions about the interrelationships of the organisms. He/She presents results in a formal paper.<br>√ organisms appropriate for ecosystem<br>√ organisms included on proper levels<br>√ reasonable conclusions<br>√ effective writing elements<br><br>4. As an introduction to the following investigation, the student recognizes that we are endangering our air and water resources by polluting them with harmful substances. The atmosphere, which also contains oxygen that our cells need, also contains many other chemicals that can damage our bodies. The pollution of our freshwater supply interferes with food chains and is costly to treat. The student works with a partner to engage in an investigation to look at the "big picture" of how air and water pollution can be detected by conducting tests to determine the types of pollutants that are present in samples of air and water taken from the area in which he/she lives. Using extreme care when handling the microscope and caution when handling the slides, the student follows the procedures outlined for this investigation (See *Biology* Lab Manual A – Ch. 6). After samples have been collected and procedures followed, the student analyzes the results and presents his/her findings and conclusions in an oral or written format. Information in the presentation should include how air pollution was measured, which areas had the least and most pollutants, what kind of weather creates most pollution, support for conclusions, and possible solutions for improvement of air and water.<br>√ completion of all steps of the investigation |

| GRADE 9 - 12 | PERFORMANCE STANDARDS | ILLUSTRATIONS |
|---|---|---|
| | | √ teamwork/collaboration<br>√ justifications for conclusions and improvements<br>√ safety practices<br>√ powerful presentation<br>√ effective communication<br><br>Extension: The student conducts a study of pollution in his/her community using the air and water pollution tests from the above investigations, makes a visual survey to evaluate land pollution, and locates findings on a map of the area. He/She identifies landmarks, roadways, and residential and commercial areas of the community. The student can color code or use symbols on the map to report the data. |
| | 7. Understands and explains the principles of photosynthesis (i.e., chloroplasts in plants convert light energy, carbon dioxide, and water into chemical energy) (NM – II.II.I.7). | 7. The student investigates through simple paper chromatography the leaf pigments associated with photosynthesis. The student measures the pigments, determines how far apart they are, and identifies them by their distance and color. He/She submits a written lab report to the instructor.<br>√ individual participation in the investigation<br>√ all required components<br>√ writing elements and conventions<br><br>OR<br><br>The student takes sealed jars and puts elodea in some, snails in others, and a combination of elodea and snails in some. He/She can design his/her own configuration of how many replications/variations to do. The student injects bromothymal blue (pH indicator) into the jars to determine the effect on pH with elodea present by itself, snails by themselves, or both together. The student predicts his/her results, analyzes the results and discusses the findings with the class.<br>√ analysis<br>√ participation in discussions<br>√ communication of results |
| | 8. Understands and explains the hierarchical classification scheme (i.e., domain, kingdom, phylum, class, order, family, genus, species), including (NM – II.II.I.8):<br>• classification of an organism into a category,<br>• similarity inferred from molecular structure (DNA) closely matching classification based on anatomical similarities, and | 8. The student designs a dichotomous key to identify objects or organisms and gives it to another student to classify selected objects. The student studies the specimen and selects the descriptions that apply to it until reaching a statement that characterizes it and names it.<br>√ properly grouped organisms<br>√ usefulness of design |

| GRADE 9 - 12 | PERFORMANCE STANDARDS | ILLUSTRATIONS |
|---|---|---|
| | • similarities of organisms reflecting evolutionary relationships. | Extension: Based on the school's resources, the student compares fake crabmeat to real crabmeat (or other variations) using protein electrophoresis. He/She goes through the classification of each to see how similar the proteins are and writes a lab report on his/her findings. In a class discussion, the student talks about the relationships. |
| | 9. Understands variation within and among species, including (NM – II.II.I.9):<br>• mutations and genetic drift, and<br>• factors affecting the survival of an organism natural selection.<br><br>10. Knows how DNA carries all genetic information in the units of heredity called genes, including (NM – II.II.II.1):<br>• the structure of DNA (e.g., subunits A, G, C, T) ,<br>• information-preserving replication of DNA, and<br>• alteration of genes by inserting, deleting, or substituting parts of DNA.<br><br>11. Uses appropriate vocabulary to describe inheritable traits (i.e., genotype, phenotype) (NM – II.II.II.2).<br><br>12. Explains the concepts of segregation, independent assortment, and dominant/recessive alleles (NM – II.II.II.3).<br>13. Identifies traits that can and cannot be inherited (NM – II.II.II.4).<br><br>14. Knows how genetic variability results from the recombination and mutation of genes, including (NM – II.II.II.5):<br>• sorting and recombination of genes in sexual reproduction result in a change in DNA that is passed on to offspring, and<br>• radiation or chemical substances can cause mutations in cells, resulting in a permanent change in DNA.<br><br>15. Understands the principles of sexual and asexual reproduction, including meiosis and mitosis (NM – II.II.II.6).<br><br>16. 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). | 9 – 16. The student collects data from classmates, family members, and relatives and distinguishes inheritance of traits based on phenotypic ratios. He/She describes/explains why some traits are present in higher numbers than others or why the trait is in some family members but not others. The student looks for a trait (e.g., attached earlobe, interlacing fingers, widow's peak), compares the actual ratio to the expected ratio, does a Punnett Square, and analyzes the results. Prior to this activity the student learns the proper vocabulary.<br>√ understanding of vocabulary<br>√ correct ratios<br>√ identification of traits<br>√ trait under study is the result of dominant/recessive<br>√ genes are segments of DNA<br>√ analysis of results<br>OR<br><br>The student conducts the "peanut lab." In this experiment, the student takes a handful of peanuts, looks at characteristics and variations among them, charts and graphs the differences in their characteristics, and draws conclusions. He/She compares results with those of other students.<br><br>OR<br><br>The student does a research project on tortoises, Galapagos finches, or peppered moths to look for variations and how characteristics can change over time. After the student has completed his/her research, he/she shares findings in a class discussion.<br><br>Extension: The student demonstrates DNA recombination by allowing a bacterial plasmid to take up a gene from jellyfish DNA that causes jellyfish to glow. When successful, the bacteria produces the new protein and glow by themselves. (Hint: Kits are available from biological supplies companies.). |

| GRADE 9 - 12 | PERFORMANCE STANDARDS | ILLUSTRATIONS |
|---|---|---|
| | 17. 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).<br><br>18. 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).<br><br>19. 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). | 17 – 19. As a springboard into the following activity, the student discusses how life began. Using hypotheses from scientists, the student considers that all life developed gradually from materials found in the oceans and that if certain kinds of proteins and carbohydrates are mixed together with water, coacervates (i.e., droplets showing lifelike characteristics) may form. Coacervates are not alive, but appear to ingest materials, grow, and reproduce. With this in mind, the student produces coacervates and observes their behavior to answer the essential question "How do coacervates act like living organisms?" Using safety precautions and extreme care with equipment, the student follows the procedures outlined in *Biology* Lab Manual A – Ch. 17. At the conclusion of the experiment, the student responds to questions that require the student to analyze the data recorded, draw conclusions, compare and contrast coacervates to similar living organisms, and to formulate hypotheses.<br>√ completion of all steps in the outlined procedures<br>√ synthesis<br>√ response to the essential question<br>√ safety practices<br>√ communication of results<br><br>Extension: The student researches (e.g., Internet, library) Sidney Fox's experiments on proteinoid microspheres, designs an experiment to make microspheres and compares their characteristics to living cells, and if possible (based on resources and teacher permission), performs the experiment. |
| | 20. 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).<br><br>21. Explains how natural selection favors individuals who are better able to survive, reproduce, and leave offspring (NM – II.II.II.12). | 20. The student solves mathematical equations using Hardy Weinberg exercises and problems.<br>√ accuracy<br><br>20, 21. The student explores the mutations within fruit flies or fast plants and sets up a lab with specific environmental conditions (e.g., mixture of flies, change food, change the temperature, change the light) to see which phenotype is most successful and which traits allow it to survive. He/She analyzes the data and presents in a lab report or oral presentation.<br><br>OR |

| GRADE 9 - 12 | PERFORMANCE STANDARDS | ILLUSTRATIONS |
|---|---|---|
| | 22. 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). | 17 – 22. After viewing various models and representations, the student creates a phylogenetic tree showing changes in species through a fossil record detailing subtle changes from earliest record through present form. The student explains how environmental factors support or select for one trait over another and predicts rate of change through rate of random mutations (e.g., mitochondria).<br>√ proper representation of model<br>√ clear explanation of why the surviving organism is fit<br>√ predictions |
| | 23. Knows that cells are made of proteins composed of combinations of amino acids (NM – II.II.III.1).<br><br>24. Knows that specialized structures inside cells in most organisms carry out different functions, including (NM – II.II.III.2):<br>• parts of a cell and their functions (e.g., nucleus, chromosomes, plasma, and mitochondria)<br>• storage of genetic material in DNA<br>• similarities and differences between plant and animal cells<br>• prokaryotic and eukaryotic cells. | 23 – 29. The student creates a concept map. Using organelles and other cell processes, prokaryotic and eukaryotic cells, and differentiation given on pieces of paper, the student shows the relationship between them and demonstrates their functions.<br>√ design of concept map<br>√ connections/relationships<br><br>Option: The student builds models to show protein structures. |
| | 25. Describes the mechanisms for cellular processes (e.g., energy production and storage, transport of molecules, waste disposal, synthesis of new molecules) (NM – II.II.III.3). | 25. See the illustration in this strand for performance standard # 7.<br><br>OR<br><br>The student learns that cellular respiration occurs in all living things. During this process, animals take in oxygen and release carbon dioxide by breathing. Because plants are different from animals in the way they breathe, the student designs and conducts an experiment to investigate how carbon dioxide is released from plants. Using proper laboratory procedures, the student follows the steps outlined for this investigation (See *Biology* Lab Manual A – Ch. 9.), analyzes findings, draws conclusions, and presents results to the class.<br>√ individual design of the experiment<br>√ safety practices<br>√ recording of data<br>√ analysis<br>√ conclusions<br>√ clear explanations<br>√ effective presentation |

| GRADE 9 - 12 | PERFORMANCE STANDARDS | ILLUSTRATIONS |
|---|---|---|
| | | Extension: Experimentation often raises questions that were not clearly addressed or answered through the results. The student designs an experiment that addresses one such question raised in the above investigation or designs an experiment that would be followed differently from the above.<br><br>Option: Using a respirometer to measure respiration under different conditions, the student shows the respiration of living organisms in a contained environment. |
| | 26. Knows how the cell membrane controls which ions and molecules enter and leave the cell based on membrane permeability and transport (i.e., osmosis, diffusion, active transport, passive transport) (NM – II.II.III.4). | 26. The student does the diffusion and osmosis lab to demonstrate passive transport and lack of active transport.<br>√ proper lab procedures<br>√ comprehension of main ideas |
| | 27. Explains how cells differentiate and specialize during the growth of an organism, including (NM – II.II.III.5):<br>• differentiation, regulated through the selected expression of different genes<br>• specialized cells, response to stimuli (e.g., nerve cells, sense organs). | 27, 29. The student observes and explains the differences in various Euglena cultures (e.g., presence of chlorophyll in the ones exposed to light and no chlorophyll in the ones not exposed to light).<br><br>Option: The student grows kidney beans in both light and dark environments and observes the differences in their structure and composition. |
| | 28. Knows that DNA directs protein building (e.g., role of RNA) (NM – II.II.III.6).<br><br>29. Describes how most cell functions involve chemical reactions, including (NM – II.II.III.7):<br>• promotion or inhibition of biochemical reactions by enzymes,<br>• processes of respiration (e.g., energy production, ATP), and<br>• communication from cell to cell by secretion of a variety of chemicals (e.g., hormones). | 28. The student understands the process of transcription and translation by playing the part (role playing) of a molecule.<br>√ credible portrayal<br>√ comprehension of key concepts |

**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.

**BENCHMARK:** 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. Describes the characteristics and the evolution of Earth in terms of the geosphere, the hydrosphere, the atmosphere, and the biosphere (NM – II.III.II.1). | 1. The student researches (e.g., Internet, library) how scientists (e.g., Miller and Urey) have formulated their own ideas of geological time and the development of organic molecules and presents (e.g., PowerPoint, poster) findings to the class.<br>√ individual participation<br>√ thorough research<br>√ current thoughts<br>√ effective presentation<br><br>OR<br><br>The student explores current research and findings to study basic processes of radioisotope dating and other methods of dating (e.g., paleomagnetism). He/She presents when each method is best used and the limitations of each method. The paper/presentation should include when methods can be combined to strengthen evidence.<br>√ thorough research<br>√ support for position<br>√ effective communication |
| | 2. Understands the changes in Earth's past and the investigative methods used to determine geologic time, including (NM – II.III.II.4):<br>• rock sequences, relative dating, fossil correlation, and radiometric dating , and<br>• geologic time scales, historic changes in life forms, and the evidence for absolute ages (e.g., radiometric methods, tree rings, paleomagnetism). | 2. The student investigates fossil remains of bacterial mats and other ancient life forms in rocks and reports findings to the class. After all reports are made, the class has a discussion to compare each other's findings.<br>√ active participation in discussions<br>√ personal presentation |
| | 3. 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). | |

| GRADE 9 - 12 | PERFORMANCE STANDARDS | ILLUSTRATIONS |
|---|---|---|
| | | 2, 3. As an introduction to the following activity, the student talks about radioisotope dating and establishes the fact that erosion takes a long time. With that in mind, the student designs a time scale based on known uniformitarianism.<br>√ accurate time scale<br>√ comprehension of key concepts |
| | 4. Describes the patterns and relationships in the circulation of air and water driven by the sun's radiant energy, including (NM – II.III.II.8):<br>• patterns in weather systems related to the transfer of energy,<br>• differences between climate and weather,<br>• global climate, global warming, and the greenhouse effect, and<br>• El Niño, La Niña, and other climatic trends. | 4. As part of the study of biomes and climate, the student learns what a biome is, specific physical features and climates of biomes, what causes them to exist, and the kinds of plants and animals that coexist and survive in a particular area determined by its soil, topography, and climate of that area. Using provided diagrams and figures, the student learns about latitude and radiant energy, effects of large bodies of water, and the effects of mountains on climate. Using the data in a table of temperatures and rainfall in a variety of cities of the U. S., the student, working in small groups, selects one city and makes a graph of average temperature and average precipitation versus month of the year for that city. The student uses that information to classify each city in a biome (descriptive table is provided). The group then shares the graph and compares it to the other city graphs to determine differences in yearly temperature range, precipitation, and classification of biome.<br>√ individual participation<br>√ teamwork/collaboration<br>√ interpretation of data<br>√ effective presentation<br>√ comparisons and contrasts<br>√ insights |
| | 5. Knows that Earth's system contains a fixed amount of natural resources that cycle among land, water, the atmosphere, and living things (e.g., carbon and nitrogen cycles, rock cycle, water cycle, ground water, aquifers) (NM – II.III.II.9).<br><br>6. Explains how layers of the atmosphere (e.g., ozone, ionosphere) change naturally and artificially (NM – II.III.II.11).<br><br>7. 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). | 5 – 7. The student, working in a group, creates a model showing the fluctuation, movement, and change of resources in the environment. To represent the different cycles, each student is assigned to a specific cycle (e.g., rock, water, carbon) and presents the model to the class. After each group has presented its model, each student examines all of the cycles and explains in writing the relationship among all of the cycles.<br>√ individual participation<br>√ teamwork/cooperation/collaboration<br>√ accurate and realistic model representation<br>√ effective presentation<br>√ writing conventions and elements<br>√ connections |

| GRADE 9 - 12 | PERFORMANCE STANDARDS | ILLUSTRATIONS |
|---|---|---|
| | | OR<br><br>The student researches water usage within Albuquerque and determines if our usage is sustainable due to growth. He/She also examines the city's efforts to reduce usage, new supply of water from the river, and the effects of our water usage on southern New Mexico. The student analyzes the data (as far as usage) and presents the data to the class.<br>√ thorough research<br>√ all required components<br>√ analysis of data<br>√ effective presentation<br><br>Extension: If the student does an exceptional job in his/her research and reporting the results, he/she can arrange to present the information and any new ideas to the city at a city council meeting or some other avenue. |

**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 9 - 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).<br><br>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).<br><br>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).<br><br>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).<br><br>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).<br><br>6. Analyzes the impact of digital technologies on the availability, creation, and dissemination of information (NM – III.I.I.6). | 1. Using a predetermined set of questions, the student participates in a Science Fiction – Science Fact Trivia game. For each response the student gives, he/she explains why he/she answered in that fashion.<br>√ individual participation<br>√ support for response<br><br>2 – 4, 6, 10. The student researches a particular technological item (e.g., golf club, elevators, guitars) and, either orally or in written format, presents the origin of that item, changes based on technology, and the pros and cons of the development.<br>√ thorough research<br>√ all required components<br>√ accuracy<br>√ analysis and organization<br>√ effective presentation<br><br>Option: If the written approach is taken, the instructor of the class can collaborate with the language arts teachers to work on the writing elements and conventions. This can be a duo project that satisfies certain requirements of both classes.<br><br>5, 11, 14 – 16. The student examines current news items (e.g., articles, TV, newspapers) on bioethics issues (e.g., cloning stem cell research). In small or large group discussions, the student discusses the particular stances, what ideas are out there, and benefits of having the information or advancement of the new knowledge.<br>√ accurate account of news item<br>√ differing viewpoints<br><br>OR |

| GRADE 9 - 12 | PERFORMANCE STANDARDS | ILLUSTRATIONS |
|---|---|---|
| | 7. Describes how human activities have affected ozone in the upper atmosphere and how it affects health and the environment (NM – III.I.I.7).<br><br>8. Describes uses of radioactivity (e.g., nuclear power, nuclear medicine, radiometric dating) (NM – III.I.I.8).<br><br>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).<br><br>10. 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).<br><br>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).<br><br>12. Explains how societies can change ecosystems and how these changes can be reversible or irreversible (NM – III.I.I.12).<br><br>13. Describes how environmental, economic, and political interests impact resource management and use in New Mexico (NM – III.I.I.13).<br><br>14. Identifies how science has produced knowledge that is relevant to individual health and material prosperity (NM – III.I.I.15).<br><br>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). | The student researches an issue (e.g., Is global warming real?) and seeks to find out why this idea might be put forth, if the idea is false, and why it is important to acknowledge.<br>√ thorough research<br>√ viable responses<br>√ support for argument<br><br>7. See Strand III, the illustration for performance standards # 5 – 7.<br><br>8. See Strand III, the illustration for performance standards # 2, 3.<br><br>9, 12, 13. The student listens to a guest speaker (e.g., someone from the Nature Center, NM Tech) talk about local environmental issues (e.g., Why is the vegetation dying in the Bosque?). After the lecture the student develops an action plan that deals with a particular school environment problem (e.g., conservation of water). The plan must outline specifically what is to be done, how the plan affects the problem, and the benefits of the plan.<br>√ understanding of an issue<br>√ viability of plan<br>√ specifics<br>√ problem solving |

| GRADE 9 - 12 | PERFORMANCE STANDARDS | ILLUSTRATIONS |
|---|---|---|
| | 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).<br><br>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).<br><br>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. Integrated consistently in the curriculum throughout the year is the career connection. Current textbooks interject the "real-life" aspect and applications in almost every chapter. The instructor takes every opportunity to insert that, whether it be through personal experiences or through questioning (e.g., What does a technician do? What is a phlebotomist?). The student talks about his personal career interest and explains where science is used in this career (e.g., mechanic, vet, park ranger).<br><br>OR<br><br>Either as a school-wide project or class project, the student participates in a Career Day Fair. The student listens to a variety of speakers (e.g., landscaper, electrician, forensics lab person) in the science fields talk about aspects of their jobs. After the fair the student either orally or in written format summarizes one career field that held special interest to him/her highlighting the science connection.<br><br>Options: The student helps in the organization of the event by suggesting and contacting some of the guest speakers. Some of these speakers could be personal connections that he/she has (e.g., parents, former students).<br>√ individual participation<br>√ listening skills<br>√ personal connections<br>√ scientific significance to career fields<br>√ effective presentation |

**STRAND VI:** MATHEMATICAL CONCEPTS AND APPLICATIONS
**CONTENT STANDARD:** The student demonstrates an understanding of geometric and data analysis concepts, principles, and relationships through meaningful experiences.

**BENCHMARKS:** A. The student analyzes characteristics and properties of two- and three-dimensional geometric shapes, develops mathematical arguments about geometric relationships, and uses visualization, spatial reasoning, and geometric modeling to solve problems.
B. The student selects and uses appropriate statistical methods to analyze data, formulates questions that can be addressed with data, and collects, organizes, and displays relevant data to answer them.

| GRADE 9 - 12 | PERFORMANCE STANDARDS | ILLUSTRATIONS |
|---|---|---|
| | 1. Demonstrates an understanding of simple aspects of a logical argument (NM – MA IIA.5):<br>• identifies the hypothesis and conclusion in logical deduction, and<br>• uses counterexamples to show that an assertion is false and recognizes that a single counterexample is sufficient to refute an assertion. | 1, 2. See Strand I, the illustration for performance standard # 5. |
| | 2. Demonstrates an understanding of inductive and deductive reasoning, explains the difference between inductive and deductive reasoning, and identifies and provides examples of each (NM – MA – IIA.6):<br>• for inductive reasoning, demonstrate understanding that showing a statement is true for a finite number of examples does not show it is true for all cases unless the cases verified are all cases. | |
| | 3. Understands the meaning of measurement data, categorical data, and of the term "variable" (NM – MA IIIB.1). | 3. The student studies scenarios and applies the Hardy-Weinberg formula to given data to determine the evolutionary probability of a population.<br><br>OR<br><br>The student uses Chi Square probability problems to determine expected inheritance of certain genetic traits using either virtual fly lab, an actual fly lab, or *Zea mays* color inheritance. |
| | 4. Understands the differences between the various methods of data collection (NM – MA IIIA.1). | 4. The student studies, learns, and notes the relationship between the chemical formulas for photosynthesis and cellular respiration. He/She then, by working various problems, learns the concepts of the parts of a chemical equation as well as simple balancing of these equations.<br>√ ability to balance equations<br>√ accuracy<br>√ understanding of chemical reactions |

| GRADE 9 - 12 | PERFORMANCE STANDARDS | ILLUSTRATIONS |
|---|---|---|
| | 5. Knows the characteristics of a well-designed and well-conducted survey (NM – MA IIIA.2):<br>• differentiates between sampling and census. | 5, 6. The student researches and presents actual examples (e.g., Dian Fossey, Jane Goodall, Fred Griffith) of experimental and discovery science to understand the validity of both methods. He/She designs virtual scenarios for both using proper scientific methods.<br>√ thorough research<br>√ connections and applications<br>√ effective presentation<br>√ creative scenario designs |
| | 6. Knows the characteristics of a well-designed and well-conducted experiment (NM – MA IIIA.3):<br>• differentiates between an experiment and an observational study<br>• recognizes sources of bias in poorly designed experiments.<br>7. Understands the role of randomization in well-designed surveys and experiments (NM – MA IIIA.4). | 6, 7. The student uses a sampling method in a designed experiment to draw conclusions about characteristics of certain larger groups. He/She refers to examples of the work of Schleiden, Schwann, and Virchow in the development of the cell theory.<br>√ understanding of sampling<br>√ reasonable conclusions |
| | 8. Solves problems involving the perimeter, circumference, area, volume, and surface area of common geometric figures (e.g., "Determine the surface area of a can of height h and radius r. How does the surface area change when the height is changed to 3h? How does the surface area change when the radius is changed to 3r? How does the surface area change when both h and r are doubled?") (NM – MA – IID.3). | 8. The student creates paper models that demonstrate that surface area increases more slowly than volume. He/She constructs four 1 cm cubes as well as a 2 cm cube and observes that although surface area has doubled, the volume has quadrupled. This principle is used to explain cell size and why cells cannot be larger than they are.<br>√ understanding of rates of change<br>√ accuracy<br>√ problem-solving strategies |
| | 9. Use trigonometric functions to solve for the length of the second leg of a right triangle given the angles and the length of the first leg. (e.g., "A surveyor determines that the angle subtended by a two-foot stick at right angles to his transit is exactly one degree. What is the distance from the transit to the base of the measuring stick?") (NM – MA IID.6). | 9. The student compares the growth rates of exotic and native trees. Using simply made "altimeters," he/she measures the heights of various sample trees of two different species. The student measures the distance from the tree, sights the tops of the trees through the altimeter, notes the angle of observation, and uses the tangent of the angle to determine the tree height. The student draws conclusions from this sampled data as to how exotic species can be an environmental threat.<br>√ trigonometric applications<br>√ completion of all tasks<br>√ accuracy<br>√ reasonable conclusions |

**STRAND VII:** LITERACY
**CONTENT STANDARD:** The student communicates biological 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 |
|---|---|---|
| | | Although the following 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. |
| | 1. Develops and demonstrates proficiency with the following strategies to approach reading for information across content areas: (APS – LA I.1):<br>• scans reading selection to determine whether a text contains relevant information,<br>• uses the headings and subheadings of the material to make predictions and to validate comprehension of text,<br>• reads and rereads to decode meaning, and<br>• reviews and summarizes essential elements of text for overview. | 1 – 3. Several of the lab activities described in this course are detailed, step-by step procedures that the student reads and follows carefully. See Strand I, illustration for performance standards # 3, 11, 14; Strand II, the illustration for performance standard # 5; Strand III, illustrations for performance standards # 4, and 17 – 19; Strand III, illustration for performance standard #25; Strand IV, illustration for performance standard # 4; Strand V, illustrations for performance standards # 5, 11, 14 – 16, and # 17, 18; and Strand VI, the illustration for performance standard # 4. |
| | 3. Identifies and uses roots, prefixes, and suffixes to determine meaning of words (APS – LA I.4). | |
| | 4. Uses textual evidence to develop and support an interpretation of a scientific process or concept (APS – LA II.2). | 4 – 8. See Strand I, 1st illustration; Strand I, the illustration for performance standards # 3, 11, 14; Strand II, the 2nd illustration; Strand III, 1st and 2nd illustrations; Strand III, the illustration for performance standard # 7; Strand IV, the illustration for performance standards # 5 – 7; and Strand V, 2nd illustration. |
| | 5. Develops increased competence in using the writing process to create a final product (APS – LA III.1). | |
| | 6. Develops increased competence in using elements of effective writing (APS – LA III.2). | |

| GRADE 9 - 12 | PERFORMANCE STANDARDS | ILLUSTRATIONS |
|---|---|---|
| | 7. Supports an informed opinion: (APS – LA III.6):<br>• uses appropriate language, reasoning, and organizational structure for the audience and purpose,<br>• provides relevant and convincing reasons, uses various types of evidence, and<br>• demonstrates an awareness of possible questions, concerns, or counterarguments.<br><br>8. Responds to a variety of written, electronic, and other media (APS – LA III.7).<br><br>9. Develops increased competence with speaking and language conventions (APS – LA IV.3).<br><br>10. Demonstrates appropriate discussion in group discussions (APS – LA V.2).<br><br>11. Evaluates the information, explanations, or ideas of others (APS – LA V.5).<br><br>12. Evaluates information to develop informed opinions (APS – LA VI.1).<br><br>13. Develops increased competence in using research strategies (APS – LA VI.5). | 9. See Strand I, 1st illustration; Strand III, 2nd illustration and the illustration for performance standards # 9 – 16; Strand III, the illustration for performance standard # 25, and Strand V, 2nd illustration.<br><br>10, 11. See Strand III, the illustration for performance standards # 17 – 19; Strand IV, 2nd illustration; Strand IV, the illustration for performance standards # 4 and # 5 – 7; Strand V, the illustrations for performance standards # 9, 12, 13 and # 17, 18.<br><br>12, 13. See Strand I, the illustration for performance standard # 5; Strand III, the illustrations for performance standards # 9 – 16 and # 17 – 19; Strand IV, 1st illustration; Strand V, 2nd illustration; and Strand VI, the illustration for performance standards # 5, 6. |