

# APS DISTRICT HIGH SCHOOL SCIENCE CURRICULUM FRAMEWORK

Course Title: Environmental Science AP Course Number: 44135

Department: Science ADS Number: 17524944

Prerequisites: C or better in Algebra I, Biology I and Chemistry I are highly recommended.

Length of Course: One Year Credit/PRI Area: .50 per Sem/Elective Grade Level(s): 10-12

## *Important Notes:*

### **COURSE DESCRIPTION:**

This laboratory class\* is designed to provide the student with the scientific principles, concepts and methodologies required to understand, identify, and analyze environmental problems both natural and man-made, and to examine alternative solutions for resolving and/or preventing them. The course is interdisciplinary, covering topics in the fields of geology, biology, chemistry, geography, and physics. The student examines the following themes: science is a process; energy conversions underlies all ecological processes; the Earth itself is one interconnected system; humans alter natural systems; environmental problems have cultural and social contexts; and human survival depends on developing practices that will achieve sustainable systems. The student is encouraged, but is not required, to take the AP exam at the end of the school year. The student may be expected to complete some course assignments outside the school year (i.e., summer).

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

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

**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:**

- *Environment* by Peter Raven, et.al. (Harcourt College Publishers, 2003)
- *Environment: Principles, Connections, and Solutions* by Tyler Miller (Brooks/Cole, 2002)
- *Environmental Science: A Global Concern* by William P. Cunningham, et.al., (McGraw Hill, 2003)
- *Environmental Science: A Study of Interrelationships* by Eldon Enger, et.al., (McGraw Hill, 2002)
- *Environmental Science: Earth as a Living Planet* by Daniel Botkin, et.al., (John Wiley & Sons, 2002)
- *Environmental Science: Toward a Sustainable Future* by Richard Wright, et.al., (Prentice Hall, 2002)

**Supplemental Resources**

- *Environment 03/04* by John Allen (Annual Editions, McGraw Hill, 2003)
- *Taking Sides: Clashing Views on Controversial Environmental Issues* by Theodore Goldfarb (McGraw Hill, 2001)

Other suggested textbooks, instructional materials, articles, and other teaching resources are available on the AP Central web site at [www.apcentral.collegeboard.com](http://www.apcentral.collegeboard.com).

**SUGGESTED TITLES/AUTHORS WEB SITES:**

Suggested Web sites, and other teaching resources are available on the AP Central web site at [www.apcentral.collegeboard.com](http://www.apcentral.collegeboard.com)

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 investigation 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 10-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	<ol style="list-style-type: none"> <li>1. Describes the essential components of an investigation, including appropriate methodologies, proper equipment, and safety precautions (NM – I.I.I.1).</li> <li>2. Designs and conducts scientific investigations that include (NM – I.I.I.2):               <ul style="list-style-type: none"> <li>• testable hypotheses,</li> <li>• controls and variables,</li> <li>• methods to collect, analyze, and interpret data,</li> <li>• results that address hypotheses being investigated,</li> <li>• predictions based on results,</li> <li>• re-evaluation of hypotheses and additional experimentation as necessary, and</li> <li>• error analysis.</li> </ul> </li> <li>3. Uses appropriate technologies to collect, analyze, and communicate scientific data (e.g., computers, calculators, balances, microscopes) (NM – I.I.I.3).</li> </ol>	<p><b>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.</b></p> <p>1-16. Laboratory Activity: Foul Water The student completes a lab on purifying “foul” water. He/She investigates the process of filtration in a system of his/her own design and examines the water both pre and post treatment for the following:</p> <ul style="list-style-type: none"> <li>• color,</li> <li>• clarity,</li> <li>• odor,</li> <li>• presence of oil,</li> <li>• presence of solids, and</li> <li>• volume.</li> </ul> <p>In a class discussion the class analyzes the materials and design of the filtration system.</p> <ul style="list-style-type: none"> <li>✓ correct order of steps in lab</li> <li>✓ record of observations</li> <li>✓ analysis of findings</li> <li>✓ adherence to safety procedures</li> </ul> <p>3-16. The student observes Drosophila over several generations studying the effect of population growth, records and analyzes data from this experiment, and applies principles learned to other populations.</p> <ul style="list-style-type: none"> <li>✓ The ability to do the following:           <ul style="list-style-type: none"> <li>• graph and interpret data,</li> </ul> </li> </ul>

GRADE 10-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	<p>4. Conveys results of investigations using scientific concepts, methodologies, and expressions, including (NM – I.I.I.4):</p> <ul style="list-style-type: none"> <li>• scientific language and symbols,</li> <li>• diagrams, charts, and other data displays,</li> <li>• mathematical expressions and processes (e.g., mean, median, slope, proportionality),</li> <li>• clear, logical, and concise communication, and</li> <li>• reasoned arguments.</li> </ul> <p>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).</p> <p>6. Understands how scientific processes produce valid, reliable results, including (NM – I.I.II.1):</p> <ul style="list-style-type: none"> <li>• consistency of explanations with data and observations,</li> <li>• openness to peer review,</li> <li>• full disclosure and examination of assumptions,</li> <li>• testability of hypotheses, and</li> <li>• repeatability of experiments and reproducibility of results.</li> </ul> <p>7. Uses scientific reasoning and valid logic to recognize (NM – I.I.II.2):</p> <ul style="list-style-type: none"> <li>• faulty logic,</li> <li>• cause and effect,</li> <li>• the difference between observation and unsubstantiated inferences and conclusions, and</li> <li>• potential bias.</li> </ul> <p>8. Understands how new data and observations can result in new scientific knowledge (NM – I.I.II.3).</p> <p>9. Critically analyzes an accepted explanation by reviewing current scientific knowledge (NM - I.I.II.4).</p> <p>10. Examines investigations of current interest in science (e.g., superconductivity, molecular machines, age of the universe) (NM – I.I.II.5).</p>	<ul style="list-style-type: none"> <li>• calculate doubling time,</li> <li>• observe the effects of rapid unchecked population growth,</li> <li>• define carrying capacity, and</li> <li>• interpret population growth models.</li> </ul> <p style="text-align: center;">OR</p> <p>In a lab environment the student studies the response of brine shrimp exposed to different environment factors and examines the environmental influences on population distribution.</p> <ul style="list-style-type: none"> <li>✓ The ability to do the following: <ul style="list-style-type: none"> <li>• isolate abiotic environmental variables,</li> <li>• measure effects of environmental variables on the distribution of a population,</li> <li>• compare test results to a control,</li> <li>• identify environmental variables that are significant, and</li> <li>• describe the habitat preference for the brine shrimp.</li> </ul> </li> </ul>

<b>GRADE 10-12</b>	<b>PERFORMANCE STANDARDS</b>	<b>ILLUSTRATIONS</b>
	<ol style="list-style-type: none"> <li data-bbox="275 164 1142 310">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).</li> <li data-bbox="275 345 1142 402">12. Creates multiple displays of data to analyze and explain the relationships in scientific investigations (NM – I.I.III.1).</li> <li data-bbox="275 438 1142 495">13. Uses mathematical models to describe, explain, and predict natural phenomena (NM – I.I.III.2).</li> <li data-bbox="275 531 1142 618">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).</li> <li data-bbox="275 654 1142 711">15. Identifies and applies measurement techniques and consider possible effects of measurement errors (NM – I.I.III.4).</li> <li data-bbox="275 747 1142 803">16. Uses mathematics to express and establish scientific relationships (e.g., scientific notation, vectors, dimensional analysis) (NM – I.I.III.5).</li> </ol>	

**STRAND II: THE CONTENT OF SCIENCE-LIFE****CONTENT STANDARD:** The student understands the properties, structures, and processes of living things, 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 10-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	<p>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).</p> <p>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).</p>	<p>1, 5. Laboratory Activity: Benthic Lab The student examines benthic macroinvertebrates found in the Rio Grande and in the irrigation ditches. Benthic macroinvertebrates are involved in mineralization, recycling of organic material and are important links in the food chain. When the student completes this lab, he/she has a better understanding of the ecosystem.</p> <ul style="list-style-type: none"> <li>✓ The ability to do the following: <ul style="list-style-type: none"> <li>• collect and identify benthic macroinvertebrates from both the Rio Grande and the irrigation ditches over a period of time,</li> <li>• assess species diversity, and</li> <li>• complete a labor report with the following: <ul style="list-style-type: none"> <li>~ analysis of the health of the river and ditches</li> <li>~ comparison between the two ecosystems and the health of both.</li> </ul> </li> </ul> </li> </ul> <p>2, 6, 7. Laboratory Activity: Transect Sampling The student selects an area for transect sampling (e.g., measurement and counting of all individuals within the transect along with identification of any predator prey relationship). The student uses a strip census or line transect involving walking a line established through an area and recording individuals observed from that line. He/She records data and gives a population index.</p> <p>The student analyzes the data:</p> <ul style="list-style-type: none"> <li>• numbers of individuals observed per unit distance traveled,</li> <li>• numbers caught per trap per unit of time (pit traps),</li> <li>• road kills, and</li> <li>• bird counts.</li> </ul>

GRADE 10-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	<p>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.1.3).</p> <p>4. Critically analyzes how humans modify and change ecosystems (e.g., harvesting, pollution, population growth, technology) (NM – II.II.1.4).</p> <p>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.1.5).</p> <p>6. Describes how energy flows from the sun through plants to herbivores to carnivores and decomposers (NM – II.II.1.6).</p> <p>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.1.7).</p>	<p>Based on the findings, the student constructs a food web based for the transect data. He/She uses linear density index, relative density, and frequency of species to make calculations.</p> <ul style="list-style-type: none"> <li>✓ record of observations</li> <li>✓ correct analysis of data</li> <li>✓ accurate mathematical calculations</li> <li>✓ understanding of transect sampling</li> </ul> <p>3. Ecological Footprint: The student goes to an ecological footprint web site (e.g., <a href="http://www.earthday.net/footprint/info.asp">http://www.earthday.net/footprint/info.asp</a> or <a href="http://www.lead.org/leadnet/footprint/intro.html">http://www.lead.org/leadnet/footprint/intro.html</a>) to take a survey to measure how much of the planet Earth’s productive surface he/she individually requires to provide for his/her food, clothing, housing, transportation and so forth. After taking the survey, the student compares his/her use to the average person and discusses the question What can you do to help reuse your ecological footprint?</p> <ul style="list-style-type: none"> <li>✓ completion of survey and print out of results</li> <li>✓ understanding of ecological impact</li> <li>✓ participation in discussion</li> </ul> <p>4. Acid Rain Experiment: Using litmus paper, the student tests some common solutions (i.e., lemon juice, ammonia, baking soda and cola). About the experiment:</p> <ol style="list-style-type: none"> <li>a) Did the ph level of the cola surprise you? What about the ammonia?</li> <li>b) Can you name other acidic solutions? What about base of alkali solutions?</li> <li>c) What happens if you mix an acid and a base together? What does the litmus paper look like?</li> </ol> <p>Questions linking to the environment:</p> <ol style="list-style-type: none"> <li>a) How does the acid get in the rain?</li> <li>b) Have you seen examples of acid rain damage in your area?</li> <li>c) What other parts of the world have been affected by it? Are any other governments dealing with the problem?</li> <li>d) Analyze the possible causes of acid rain and determine its effect on living organisms now and in the future.</li> <li>e) Estimate the impact that acid rain has on the environment.</li> <li>f) Predict what the future will be like if man’s harmful activities continue to increase.</li> <li>g) Evaluate current solutions and propose new solutions. <ul style="list-style-type: none"> <li>✓ explanation of the role of each solution</li> </ul> </li> </ol>

GRADE 10-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	<p>8. Understands and explains the hierarchical classification scheme (i.e., domain, kingdom, phylum, class, order, family, genus, species), including (NM – II.II.1.8):</p> <ul style="list-style-type: none"> <li>• classification of an organism into a category,</li> <li>• similarity inferred from molecular structure (DNA) closely matching classification based on anatomical similarities, and</li> <li>• similarities of organisms reflecting evolutionary relationships.</li> </ul> <p>9. Understands variation within and among species, including (NM – II.II.1.9):</p> <ul style="list-style-type: none"> <li>• mutations and genetic drift, and</li> <li>• factors affecting the survival of an organism natural selection.</li> </ul> <p>10. Knows how DNA carries all genetic information in the units of heredity called genes, including (NM – II.II.1.1):</p> <ul style="list-style-type: none"> <li>• the structure of DNA (e.g., subunits A, G, C, T),</li> <li>• information-preserving replication of DNA, and</li> <li>• alteration of genes by inserting, deleting, or substituting parts of DNA.</li> </ul> <p>11. Uses appropriate vocabulary to describe inheritable traits (i.e., genotype, phenotype) 9NM – II.II.1.2).</p> <p>12. Explains the concepts of segregation, independent assortment, and dominant/recessive alleles (NM – II.II.1.3).</p> <p>13. Identifies traits that can and cannot be inherited (NM – II.II.1.4).</p>	<ul style="list-style-type: none"> <li>✓ accurate observations</li> <li>✓ recorded data</li> <li>✓ understanding of the scientific concept</li> <li>✓ information management skills</li> </ul> <p>8. The student team uses seashells to practice the hierarchical system of classification. He/She investigates a variety of seashells dividing into two groups using any once observable characteristics. The activity is repeated until each shell has its own group. The student draws a diagram on how each seashell was sorted and creates a key. He/She shares the key with other students. The student then uses “key to common shells” to identify the seashells he/she has sorted.</p> <p>For the complete lesson see  <a href="http://www.njmssc.org/Education/Lesson%20Plans/Classification_and_Identification.html">http://www.njmssc.org/Education/Lesson%20Plans/Classification_and_Identification.html</a></p> <ul style="list-style-type: none"> <li>✓ understanding of hierarchical system of classification</li> <li>✓ accurate drawing and labeling</li> </ul> <p>9-15. Genetics of Organisms: In this lab the student uses living organisms to do genetic crosses. The student learns how to collect and manipulate the organisms, collect data from F<sub>1</sub> and F<sub>2</sub> generations, and analyze the results from a monohybrid, dihybrid, or sex-linked cross. The procedures that follow apply to fruit flies (or other procedures using other organisms).</p> <ul style="list-style-type: none"> <li>✓ The ability to do the following: <ul style="list-style-type: none"> <li>• investigate the independent assortment of two genes and determine whether the two genes are autosomal or sex-linked using a multigeneration experiment, and</li> <li>• analyze the data from the genetic crosses using chi-square analysis techniques.</li> </ul> </li> </ul>

GRADE 10-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	<p>14. Knows how genetic variability results from the recombination and mutation of genes, including (NM – II.II.II.5):</p> <ul style="list-style-type: none"> <li>• sorting and recombination of genes in sexual reproduction result in a change in DNA that is passed on to offspring, and</li> <li>• radiation or chemical substances can cause mutations in cells, resulting in a permanent change in DNA.</li> </ul> <p>15. Understands the principles of sexual and asexual reproduction, including meiosis and mitosis (NM – II.II.II.6).</p> <p>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).</p>	<p>15, 16. Mitosis And Meiosis: In this lab the student investigates the processes of mitosis and meiosis:</p> <p>(a) The student uses prepared slides of onion root tips to study plant mitosis and to calculate the relative duration of the phases of mitosis in the meristem of root tissue. Prepared slides of the whitefish blastula may be used to study mitosis in animal cells and to compare animal mitosis with plant mitosis.</p> <p>(b) The student simulates the states of meiosis by using chromosome models. He/She studies the crossing over and recombination that occurs during meiosis. The student observes the arrangements of ascospores in the asci from a cross between wild type <i>Sordaria Fimicola</i> and mutants for tan spore coat color in this fungus. The student uses these arrangements to estimate the percentage of crossing over that occurs between the centromere and the gene that controls the tan spore color.</p> <p>✓ The ability to do the following:</p> <ul style="list-style-type: none"> <li>• recognize the stages of mitosis in a plant or animal cell,</li> <li>• calculate the relative duration of the cell cycle stages,</li> <li>• describe how independent assortment and crossing over can generate genetic variation among the products of meiosis,</li> <li>• use chromosome models to demonstrate the activity of chromosomes during meiosis and mitosis,</li> <li>• relate chromosome activity to Mendel's Laws of segregation and independent assortment,</li> <li>• demonstrate the role of meiosis in the formation of gametes or spores in a controlled experiment using an organism of student choice,</li> <li>• calculate the map distance of a particular gene from a chromosome's centromere or between two genes using an organism of student choice,</li> <li>• compare and contrast the results of meiosis and mitosis in plant cells, and</li> <li>• contrast the result of meiosis and mitosis in animal cells.</li> </ul>

GRADE 10-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	<p>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).</p> <p>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).</p> <p>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).</p> <p>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).</p> <p>21. Explains how natural selection favors individuals who are better able to survive, reproduce, and leave offspring (NM – II.II.II.12).</p> <p>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).</p> <p>23. Knows that cells are made of proteins composed of combinations of amino acids (NM – II.II.III.1).</p> <p>24. Knows that specialized structures inside cells in most organisms carry out different functions, including (NM – II.II.III.2):</p> <ul style="list-style-type: none"> <li>• parts of a cell and their functions (e.g., nucleus, chromosomes, plasma, and mitochondria),</li> <li>• storage of genetic material in DNA,</li> <li>• similarities and differences between plant and animal cells, and</li> <li>• prokaryotic and eukaryotic cells.</li> </ul>	<p>17-19. The student completes research on Aleksandr Ivanovich Oparin, Stanley Miller or Harold Urey along with the early fossil recorded to develop an understanding of the beginning of life on earth and presents the findings in a research paper.</p> <p>Requirements:</p> <ul style="list-style-type: none"> <li>• Research Question</li> <li>• Research Thesis</li> <li>• Finding and Evaluating Sources</li> <li>• Taking Notes <ul style="list-style-type: none"> <li>○ Working with quotations</li> <li>○ Writing summaries and paraphrasing</li> </ul> </li> <li>• Building a Draft</li> <li>• Documenting Sources</li> <li>• Works Cited Page <ul style="list-style-type: none"> <li>✓ introduction (i.e. thesis)</li> <li>✓ consistent structure and flow</li> <li>✓ accurate information</li> <li>✓ clarity of writing</li> <li>✓ conclusion (e.g. synthesis of ideas connecting back to thesis)</li> <li>✓ citation of sources</li> <li>✓ bibliography (e.g., MLA or APA)</li> </ul> </li> </ul> <p>24, 26, 29. Transpiration: In the lab the student:</p> <ol style="list-style-type: none"> <li>(a) applies what he/she learned about water potential from Lab One: Diffusion and Osmosis to the movement of water within the plant,</li> <li>(b) measures transpiration under different lab conditions, and</li> <li>(c) studies the organization of the plant stem and leaf as it relates to these processes by observing sections of tissue. <ul style="list-style-type: none"> <li>✓ The ability to do the following: <ul style="list-style-type: none"> <li>• test the effects of environmental variable on rates of transpiration using a controlled experiment, and</li> <li>• make thin sections of stem, identify xylem and phloem cells and relate the function of these vascular tissues to the structures of their cells.</li> </ul> </li> </ul> </li> </ol>

GRADE 10-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	<p>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).</p> <p>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).</p> <p>27. Explains how cells differentiate and specialize during the growth of an organism, including (NM – II.II.III.5):</p> <ul style="list-style-type: none"> <li>• differentiation, regulated through the selected expression of different genes, and</li> <li>• specialized cells, response to stimuli (e.g., nerve cells, sense organs).</li> </ul> <p>28. Knows that DNA directs protein building (e.g., role of RNA) (NM – II.II.III.6).</p> <p>29. Describes how most cell functions involve chemical reactions, including (NM – II.II.III.7):</p> <ul style="list-style-type: none"> <li>• promotion or inhibition of biochemical reactions by enzymes,</li> <li>• processes of respiration (e.g., energy production, ATP), and</li> <li>• communication from cell to cell by secretion of a variety of chemicals (e.g., hormones).</li> </ul>	<p>25, 26, 29. Enzyme Catalysis: the student observes the conversion of hydrogen peroxide (<math>H_2O_2</math>) to water and oxygen gas by the enzyme catalase, measures the amount of oxygen generated and calculates the rate of the enzyme-catalyzed reaction.</p> <ul style="list-style-type: none"> <li>✓ The ability to do the following: <ul style="list-style-type: none"> <li>• measure the effects of changes in temperature, pH, enzyme concentration and substrate concentration on reaction rates of an enzyme-catalyzed reaction in a controlled experiment, and</li> <li>• explain how environmental factors affect the rate of enzyme-catalyzed reactions.</li> </ul> </li> </ul> <p>27. The student examines research done on frog embryos exposed to toxins and their development. He/She compares exposed embryos to those that developed in a more natural environment (e.g., the control group).</p> <ul style="list-style-type: none"> <li>✓ identification of toxins that caused mutations</li> <li>✓ understanding of the types of mutations investigated along with a review of protein building</li> <li>✓ statistical measurements that are graphed</li> <li>✓ analysis of data</li> </ul>

**STRAND III: 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.

<b>GRADE 10-12</b>	<b>PERFORMANCE STANDARDS</b>	<b>ILLUSTRATIONS</b>
	<ol style="list-style-type: none"> <li>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).</li>   <li>2. Understands the changes in Earth's past and the investigative methods used to determine geologic time, including (NM – II.III.II.4): <ul style="list-style-type: none"> <li>• rock sequences, relative dating, fossil correlation, and radiometric dating, and</li> <li>• geologic time scales, historic changes in life forms, and the evidence for absolute ages (e.g., radiometric methods, tree rings, paleomagnetism).</li> </ul> </li>   <li>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).</li> </ol>	<ol style="list-style-type: none"> <li>1. The student uses computer models and researches current earthquake activity using the United States Geological Survey website. The student does the following: <ul style="list-style-type: none"> <li>• describes the theory of plate tectonics and its relationship to the earthquake and volcanic activity,</li> <li>• interprets seismograms (S and P waves) as used to locate earthquake epicenters,</li> <li>• identifies the general effects of volcanic eruptions and the relationship to weather patterns, and</li> <li>• relates plate tectonics to changing rates of evolution and the diversity of organisms. <ul style="list-style-type: none"> <li>✓ completion of tasks</li> <li>✓ understanding the concept and theory of plate tectonics</li> </ul> </li> </ul> </li>   <li>2. The student conducts a general search of the eras on the geologic timetable and looks for individual events that occurred during each era. He/She determines if these events were placed in time by relative or absolute dating or both, providing justification for each. The student organizes these events into a geologic timetable of his/her own. <ul style="list-style-type: none"> <li>✓ correct information on geologic eras</li> <li>✓ appropriate design and correct information of geologic timetable</li> <li>✓ citation of sources</li> </ul> </li>   <li>3, 5. Dissolved Oxygen and Aquatic Primary Productivity: The student completes two labs: <ol style="list-style-type: none"> <li>(a) The student measures and analyzes the dissolved oxygen (DO) concentration in water samples at varying temperatures.</li> <li>(b) The student measures and analyzes the primary productivity of natural waters or lab cultures using screens to simulate the attenuation (decrease) of light with increasing depth.</li> </ol> </li> </ol>

GRADE 10-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	<p>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):</p> <ul style="list-style-type: none"> <li>• patterns in weather systems related to the transfer of energy,</li> <li>• differences between climate and weather,</li> <li>• global climate, global warming, and the greenhouse effect, and</li> <li>• El Niño, La Niña, and other climatic trends.</li> </ul> <p>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).</p> <p>6. Explains how layers of the atmosphere (e.g., ozone, ionosphere) change naturally and artificially (NM – II.III.II.11).</p> <p>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).</p>	<ul style="list-style-type: none"> <li>✓ The ability to do the following: <ul style="list-style-type: none"> <li>• measure primary productivity based on changes in dissolved oxygen in a controlled experiment, and</li> <li>• investigate the effects of changing light intensity on primary productivity in a controlled experiment.</li> </ul> </li> </ul> <p>4. The student investigates the greenhouse effect by completing a literature review and constructing a working model that simulates the effect.</p> <ul style="list-style-type: none"> <li>✓ The ability to do the following: <ul style="list-style-type: none"> <li>• construct a model that demonstrates the greenhouse effect, <ul style="list-style-type: none"> <li>• explain the greenhouse effect and identify the major greenhouse gases and their sources,</li> <li>• explain the relationship between greenhouse gases and global warming,</li> <li>• analyze the environmental impact of global warming, and</li> <li>• describe how greenhouse gas emissions may be reduced.</li> </ul> </li> </ul> </li> </ul> <p>5. The student completes a lab on soil formation. He/She investigates the process of weathering and the resulting soil formation.</p> <ul style="list-style-type: none"> <li>✓ The ability to do the following: <ul style="list-style-type: none"> <li>• describe the effects of mechanical and chemical weather in several rock samples,</li> <li>• measure the rate of weathering in several rock samples,</li> <li>• relate the physical and chemical processes involved in weathering to soil formation, and</li> <li>• identify examples of weathering in the student’s environment.</li> </ul> </li> </ul> <p>6,7. The student predicts how water will move through gravel, sand, and clay and then tests his/her hypothesis by placing gravel, sand, and clay in the three soda bottles or plastic cups. The material should fill the containers to a depth of about 8 cm. The student looks closely at each container using a hand-held magnifying glass. To demonstrate how groundwater moves through underground rock formations, the student pours about 120 - 240 ml of water into each container and discusses the results. Which container emptied the fastest? Which emptied the slowest? How would different materials influence water in movement of natural systems?</p> <ul style="list-style-type: none"> <li>✓ participation in and use of scientific investigation</li> <li>✓ correct response to questions</li> </ul>

**STRAND IV: SCIENCE AND SOCIETY****CONTENT STANDARD:** The student understands how scientific discoveries, inventions, practices, and knowledge influence and are influenced by individuals and societies.**BENCHMARK:** The student examines and analyzes how scientific discoveries and their applications affect the world and explain how societies influence scientific investigations and applications.

GRADE 10-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	<ol style="list-style-type: none"> <li>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.1.1).</li> <li>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.1.2).</li> <li>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.1.3).</li> <li>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.1.4).</li> <li>5. Understands that applications of genetics can meet human needs and can create new problems (e.g., agriculture, medicine, cloning) (NM – III.I.1.5).</li> <li>6. Analyzes the impact of digital technologies on the availability, creation, and dissemination of information (NM – III.I.1.6).</li> </ol>	<p>1, 2, 6, The student refers to materials either provided by the teacher, found in the library or on the Internet of images taken by the Hubble space telescope of stars in different stages of development. The student joins a team to do research on a star’s life. Each team focuses on one aspect of the stellar evolution of a particular star (e.g., protostar, middle normal star, dying stage, end state). The team reports its findings, including a visual, through a poster, sharing a photographic or printed sources, PowerPoint presentation, or some other format. After each team’s report the team members lead a whole-class discussion on what could be inferred about earlier and later star development based on the information about the stellar evolution the team has researched. After all the presentations are completed, the students as a group respond to the question: Explain how Einstein’s famous equation, <math>E=mc^2</math> relates to the sun’s energy production. Describe what you think would happen if all the sun’s mass were instantly converted to energy.</p> <ul style="list-style-type: none"> <li>✓ well-researched report</li> <li>✓ information clearly and logically organized</li> <li>✓ presentation interesting and lively</li> <li>✓ well-organized discussion</li> </ul> <p>2-4, 6, 8, 10, 14, 10. The student researches a particular technological item or scientific discovery and either orally or in written format presents the origin of that item, changes based on technology or discovery, and the pros and cons of the development.</p> <ul style="list-style-type: none"> <li>✓ thorough research</li> <li>✓ all required components</li> <li>✓ accuracy</li> <li>✓ analysis and organization</li> <li>✓ effective presentation</li> </ul>

GRADE 10-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	<p>7. Describes how human activities have affected ozone in the upper atmosphere and how it affects health and the environment (NM – III.I.7).</p> <p>8. Describes uses of radioactivity (e.g., nuclear power, nuclear medicine, radiometric dating) (NM – III.I.8).</p> <p>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.9).</p> <p>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.10).</p> <p>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.11).</p>	<p>3, 5, 8. The Effects of Radiation on Growth (Topic 17 and Topic 18) The student researches irradiated food on the Internet and presents his/her findings to the class. The student joins a team and develops a question to research. The group presents the information by using clear notes/diagrams and answering student questions. The student takes notes on other presentations.</p> <p>Resources:</p> <ul style="list-style-type: none"> <li>www.ConsumerReports.org</li> <li>www.graystarinc.com/genesis.html</li> <li>www.cdc.gov/ncidod/dbmd/diseaseinfo/foodirradiation.htm</li> <li>www.epa.gov/rpdweb00/rpage/sources/foodsafety.htm</li> <li>www.epa.gov/radiation/surces/foodirrad.htm</li> </ul> <ul style="list-style-type: none"> <li>✓ use of research practices (e.g., note taking, outlining, work citations, bibliography)</li> <li>✓ writing conventions and speaking conventions</li> <li>✓ notes from other groups</li> <li>✓ essential question and answer</li> </ul> <p>7. The student participates in a brainstorming session on what student activities have affected the ozone and how each activity affects the health and environment. The student chooses one activity and suggests ways he/she and the immediate members of the class can reduce the use of the activity. The student presents the suggestion on a poster or PowerPoint presentation.</p> <ul style="list-style-type: none"> <li>✓ accurate information on human causes of ozone depletion</li> <li>✓ appropriate suggestions to lessen effects</li> <li>✓ accurate poster design or PowerPoint presentation</li> </ul> <p>9-15, 17-18. The student listens to a guest speaker (e.g., someone from the Sandia Labs, PNM) talk about local environmental issues (e.g., What are the issues associated with processing and/or storing nuclear waste? What are the considerations of alternate energy sources?). 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.</p> <ul style="list-style-type: none"> <li>✓ understanding of an issue</li> <li>✓ viability of plan</li> <li>✓ specific problem solving</li> </ul>

<b>GRADE 10-12</b>	<b>PERFORMANCE STANDARDS</b>	<b>ILLUSTRATIONS</b>
	<p>12. Explains how societies can change ecosystems and how these changes can be reversible or irreversible (NM – III.I.I.12).</p> <p>13. Describes how environmental, economic, and political interests impact resource management and use in New Mexico (NM – III.I.I.13).</p> <p>14. Identifies how science has produced knowledge that is relevant to individual health and material prosperity (NM – III.I.I.15).</p> <p>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).</p> <p>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).</p> <p>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).</p> <p>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).</p>	<p>17. See Strand IV, Illustration Set 1, 3-8.</p>

**STRAND V: LITERACY****CONTENT STANDARD:** The student communicates environmental science 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 10-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	<ol style="list-style-type: none"> <li>1. Develops and demonstrates proficiency with the following strategies to approach reading for information across content areas (APS – LA I.1):               <ul style="list-style-type: none"> <li>• scans reading selection to determine whether a text contains relevant information,</li> <li>• uses the headings and subheadings of the material to make predictions and to validate comprehension of text,</li> <li>• reads and rereads to decode meaning, and</li> <li>• reviews and summarizes essential elements of text for overview.</li> </ul> </li> <li>2. Identifies and uses roots, prefixes, and suffixes to determine meaning of words (APS – LA I.4).</li> <li>3. Uses textual evidence to develop and support an interpretation of a scientific process or concept (APS – LA II.2).</li> <li>4. Develops increased competence in using the writing process to create a final product (APS – LA III.1).</li> <li>5. Develops increased competence in using elements of effective writing (APS – LA III.2).</li> <li>6. Supports an informed opinion (APS – LA III.6):               <ul style="list-style-type: none"> <li>• uses appropriate language, reasoning, and organizational structure for the audience and purpose,</li> <li>• provides relevant and convincing reasons, uses various types of evidence, and</li> <li>• demonstrates an awareness of possible questions, concerns, or counterarguments.</li> </ul> </li> <li>7. Responds to a variety of written, electronic, and other media (APS – LA III.7).</li> <li>8. Develops increased competence with speaking and language conventions (APS – LA IV.3)</li> </ol>	<ol style="list-style-type: none"> <li>1, 3-8. The student selects and reviews a series of current science articles from an appropriate science journal or teacher-approved website and follows the steps outlined below.               <p>Step 1:</p> <ul style="list-style-type: none"> <li>• Identify the author and locate any biographical information that provides insight into who he/she is.</li> <li>• What perspective does the author bring to the book (e.g., university professor, expert in the field, classroom educator)?</li> </ul> <p>Step 2: Read the article and take notes.</p> <p>Step 3: Write a summary including why the article is interesting or important</p> <p>Step 4: Present findings to the group.</p> <ul style="list-style-type: none"> <li>✓ completion of the steps</li> <li>✓ proper use of referencing author’s thoughts</li> <li>✓ use of bibliographic format for each article</li> </ul> <p>(Based on <i>Questioning The Author: An Approach For Enhancing Student Engagement With Text</i> by I. Beck, et.al., International Reading Association, Newark, DE)</p> </li> <li>2. The student maintains a glossary of important vocabulary including correct spelling of word, etymology, and definition.               <ul style="list-style-type: none"> <li>✓ completion of tasks</li> </ul> </li> </ol>