APS DISTRICT HIGH SCHOOL SCIENCE CURRICULUM FRAMEWORK

Course Title: Medical Physics CEC **Course Number:** SEE BELOW

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

Prerequisites: None

Length of Course: One Year **Credit/PRI Area:** 1.0 or 1.5 per Sem/Science **Grade Level(s):** 10 - 12

COURSE AND ADS NUMBERS:

Medical Physics CEC (1.0 credit per semester) 452C2 17424144
Medical Physics CEC (1.5 credits per semester) 452C3 17424144

Important Notes:

A course that provides one credit per semester allows the student additional opportunities for in-depth study and application of the course content through internships. The time spent in the classroom is more than your traditional time block of fifty minutes.

Session III meets Tuesday and Thursday and every other Friday.

Pre-Med meets the standards for column C science standards.

COURSE DESCRIPTION: This laboratory course* is designed as an advanced lab science course to prepare college-bound students for a career in medicine. The student leaves the course with a strong background in cardiology, anatomy, histology, biochemistry, physiology, and experimental design and presentation. The student diagnoses, treats, and understands disease processes using case studies of real patients throughout the entire year. A field trip to the UNM medical school cadaver lab culminates a lab unit on the internal organs. Reading, writing, speaking, and research straregies are integrated throughout the course.

* 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 align with the State of New Mexico Science Standards (NM), the State of New Mexico Mathematics Standards (NM – MA), the State of New Mexico Health Education Standards (NM – H), the State of New Mexico Career Readiness Standards (NM – CR), 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 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:
- *Merck Manual of Diagnosis and Therapy* – Beers, mark and Berkow, Robert – Merck Research Laboratories – 1999
- *Grays Anatomy* – Clemente, Carmine – Lea Febiger, Publisher
- *Medical Physiology* – Guyton, Arthur C., M. D. – W. B. Saunders Company – 1991
- *Human Anatomy & Physiology* – Marieb, Elaine – Addison Wesley – 1999
- *Laboratory Exercises in Astronomy* – Macmillan – 1976
- *Earth Science – Geology, the Environment, and the Universe* – Glencoe – 2002
- *Teaching Resources*
- Microscopes
- Dissecting kits
- Computers and computer software

SUGGESTED TITLES/AUTHORS WEB SITES:
- www.merck.com
- www.gratefulmed.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 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 10-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	1. Describes the essential components of an investigation, including appropriate methodologies, proper equipment, and safety precautions (NM - I.I.I.1). 2. Designs and conducts scientific investigations that include (NM - I.I.I.2): • testable hypotheses, • controls and variables, • methods to collect, analyze, and interpret data, • results that address hypotheses being investigated, • predictions based on results, • re-evaluation of hypotheses and additional experimentation as necessary, and • error analysis. 3. Uses appropriate technologies to collect, analyze, and communicate scientific data (e.g., computers, calculators, balances, microscopes) (NM - I.I.I.3). 4. Conveys results of investigations using scientific concepts, methodologies, and expressions, including (NM - I.I.I.4): • scientific language and symbols, • diagrams, charts, and other data displays, • mathematical expressions and processes (e.g., mean, median, slope, proportionality), • clear, logical, and concise communication, and	**NOTE: Illustrations include suggested activities for attaining each performance standard. A check for (√) refers to a key feature to look for while assessing student performance.** 1 – 19. As an introduction to experimentation, the student observes a demonstration of blood pressure readings to understand the scientific method process. In the experiment, five different blood pressure readings are taken of males and females. As practice the student records the readings and analyzes the results. The student then designs his/her own experiment related to blood pressure (e.g., raising or lowering the blood pressure after exercise). He/She writes a hypothesis, conducts the experiment, collects the data, does a statistical analysis of the data, and records the data graphically using a spreadsheet format (e.g., Excel), and states his/her conclusion. Using the information, the student writes a research paper presenting the results with support for the hypothesis. √ thorough research √ all required components √ support for argument √ effective writing elements √ use of technology √ graphs/charts √ analysis See the illustration in Strand VI (Health).

	• reasoned arguments. 5. Understands how scientific theories are used to explain and predict natural phenomena (e.g., plate tectonics, ocean currents, structure of atom) (NM - I.I.I.5). 6. Understands how scientific processes produce valid, reliable results, including (NM - I.I.II.1): • consistency of explanations with data and observations, • openness to peer review, • full disclosure and examination of assumptions, • testability of hypotheses, and • repeatability of experiments and reproducibility of results. 7. Uses scientific reasoning and valid logic to recognize (NM - I.I.II.2): • faulty logic, • cause and effect, • the difference between observation and unsubstantiated inferences and conclusions, and • potential bias. 8. Understands how new data and observations can result in new scientific knowledge (NM - I.I.II.3). 9. Critically analyzes an accepted explanation by reviewing current scientific knowledge (NM - I.I.II.4). 10. Examines investigations of current interest in science (e.g., superconductivity, molecular machines, age of the universe) (NM - I.I.II.5). 11. Examines the scientific processes and logic used in investigations of past events (e.g., using data from crime scenes, fossils), investigations that can be planned in advance but are only done once (e.g., expensive or time-consuming experiments such as medical clinical trials), and investigations of phenomena that can be repeated easily and frequently (NM - I.I.II.6). 12. Creates multiple displays of data to analyze and explain the relationships in scientific investigations (NM - I.I.III.1). 13. Uses mathematical models to describe, explain, and predict natural phenomena (NM - I.I.III.2).	

	14. Uses technologies to quantify relationships in scientific hypotheses (e.g., calculators, computer spreadsheets and databases, graphing software, simulations, modeling) (NM - I.I.III.3). 15. Identifies and applies measurement techniques and considers possible effects of measurement errors (NM - I.I.III.4). 16. Uses mathematics to express and establish scientific relationships (e.g., scientific notation, vectors, dimensional analysis) (NM - I.I.III.5). 17. Knows the characteristics of a well-designed and well-conducted experiment (NM - MA IIIA.3): • differentiate between an experiment and an observational study and • recognize sources of bias in poorly designed experiments. 18. Understands the concept of probability as relative frequency (NM – MA IIID.2). 19. Uses simulations to compute the expected value and probabilities of random variables in simple cases (NM – MA IIID.3).	

STRAND II: THE CONTENT OF SCIENCE-PHYSICAL SCIENCE
CONTENT STANDARD: The student understands the structure and properties of matter, the characteristics of energy, and the interactions between matter and energy.

BENCHMARKS: A. The student understands the transformation and transmission of energy and how energy and matter interact.
B. The student understands the motion of objects and waves, and the forces that cause them.

GRADE 10 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS

GRADE 10 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	1. Understands how heat can be transferred by conduction, convection, and radiation and how heat conduction differs in conductors and insulators (NM - II.I.II.4). 2. Understands that the ability of energy to do something useful (work) tends to decrease (and never increases) as energy is converted from one form to another (NM - II.I.II.6).	1, 2, 4. Through text readings, lectures, and labs, the student grasps the theoretical concepts of a variety of topics (e.g., conduction, convection). Early in the year as a means for the students to get to know each other and to learn to interact with each other as lab partners, the students do a variety of tests (e.g., heat/cold, blind spot, map the tongue) on one another. In the heat/cold test, the student has a grid stamped on his/her arm and a grid stamped on paper. The student takes a probe, sticks it in hot water, and touches it on a corner of the grid of his/her partner. The student records the heat receptor with a "+" if felt and with a "-" if not felt. The same test is repeated using ice. When all of the test have been done, the student has a "map of the body" that shows the blind spots, nerve endings, etc. √ individual participation √ cooperation √ completion of all tests √ accurate recordings √ analysis √ understanding of the theoretical concepts
	3. Understands that electromagnetic waves carry energy that can be transferred when they interact with matter (NM - II.I.II.7).	3, 5, 9. The student uses an electromagnetic flow meter device to show that ions cause an electrical current. The student measures the magnet force using the flow meter. He/She does this on his/her lab partner, records the results, and explains how the ions in blood can cause an electromagnetic field. √ connections √ understanding of forces and energy √ clear explanations
	4. Understands the concept of equilibrium (i.e., thermal, mechanical, and chemical) (NM - II.I.II.11). 5. Knows that there are four fundamental forces in nature: gravitation, electromagnetism, weak nuclear force, and strong nuclear force (NM - II.I.III.1). 6. Knows that every object exerts gravitational force on every other object and how this force depends on the masses of the objects and the distance between them (NM - II.I.III.2).	4, 6, 10, 11. The student performs simple experiments using class 1, 2, and 3 levers (e.g., put pressure on the arm to demonstrate contraction of muscles). From here the student advances to a cat dissection to study the muscles to understand optimum length of muscles and to see that the length produces different forces against gravity. In a class discussion the student talks about the muscles, how they tie in with gravity and gives specific examples to illustrate that concept (e.g., pushing against a force, putting pressure on the floor). He/She draws vector diagrams of the forces on a joint. √ understanding the relationship between force and gravity √ involvement in all experiments √ skilled dissection

GRADE 10 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
		√ active participation in discussion √ specific examples √ visual aids
	7. Knows that materials containing equal amounts of positive and negative charges are electrically neutral, but that a small excess or deficit of negative charges produces significant electrical forces (NM - II.I.III.3).	4, 7, 14 -16. The student learns during the cardiology unit about waves through looking at an EKG. The diagram produced in an EKG allows the student to measure the charges, the amplitude, wavelength, and frequency of the waves. The results come out on graph paper where each box represents a time frame that is different for each person. The student determines the heart beats, the amplitude (e.g., height of wave), and faults. The EKG can tell the student what is wrong with the heart allowing the student to examine causes. √ individual participation √ ability to perform the required measurements √ accuracy (e.g., readings, measurements) √ analysis Extension: The student dissects a sheep's heart to study the heart valves.
	8. Understands the relationship between force and pressure and how the pressure of a volume of gas depends on the temperature and the amount of gas (NM - II.I.III.4). 9. Explains how electric currents cause magnetism and how changing magnetic fields produce electricity (e.g., electric motors, generators) (NM - II.I.III.5). 10. Represents the magnitude and direction of forces by vector diagrams (NM - II.I.III.6). 11. Knows that when one object exerts a force on a second object, the second object exerts a force of equal magnitude and in the opposite direction on the first object (i.e., Newton's Third Law) (NM - II.I.III.7).	8. The student continues to use the cat dissection activity to look at the diaphragm and lungs. Through the examination the student explains how the lungs inflate. The temperature inside the lungs is 98.6° and 72° outside. The student describes what needs to happen between the two to get to 98.6°. He/She is able to explain, in either oral or written format, that all this happens in the nasal cavity, and that is why it is harder to breathe in cold weather and why that hurts the lungs. √ engagement in the dissection activity √ connections √ effective communication
	12. Applies Newton's Laws to describe and analyze the behavior of moving objects, including (NM - II.I.III.8): • displacement, velocity, and acceleration of a moving object, • Newton's Second Law, $F = ma$ (e.g., momentum and its conservation, the motion of an object falling under gravity, the independence of a falling object's motion on mass), and • circular motion and centripetal force.	12, 13. By this time the student has studied the muscular skeletal system. With this prior knowledge and work done in the cardiology unit, the student designs a motion (e.g., dance, throwing a ball) showing the starting point to the ending point. The design includes all the muscles used, which contracted, how force acts on that joint, the action of the muscles, and the direction that the muscle produces on the skeletal system. √ all the required components

GRADE 10 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	13. Describes relative motion using frames of reference (NM - II.I.III.9). 14. Describes wave propagation using amplitude, wavelength, frequency, and speed (NM - II.I.III.10). 15. Explains how the interactions of waves can result in interference, reflection, and refraction (NM - II.I.III.11). 16. Describes how waves are used for practical purposes (e.g., seismic data, acoustic effects, Doppler effect) (NM - II.I.III.12). 17. Understands atomic structure, including (NM – II.I.I.6): • most space occupied by electrons, • nucleus made of protons and neutrons, • isotopes of an element, • masses of proton and neutron 2000 times greater than mass of electron, and • atom held together by proton-electron electrical forces. 18. Explains how electrons determine the properties of substances by (NM – II.I.I.7): • interactions between atoms through transferring or sharing valence electrons, • ionic and covalent bonds, and • the ability of carbon to form a diverse array of organic structures. 19. Makes predictions about elements using the periodic table (e.g., number of valence electrons, metallic character, reactivity, conductivity, type of bond between elements) (NM – II.I.I.8).	√ completion of design √ effective design √ accuracy The student looks at a variety of examples to understand relative motion and frame of reference (e.g., throwing a ball at 60 mph; if a car moves 20 mph towards you the force is 60 + 20, and 60 – 20 if going away from you). √ Comprehension 17 – 19. See the illustration in this strand, #4, 7, 14-16 that deals with EKG. Using a given reading, the student explains why the ion is positively charged. OR The student builds an atomic model to demonstrate different types of bonds. √ clear communication √ model design √ accuracy √ connections/relationships

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.

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

GRADE 10 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	1. Understands the scale and contents of the universe, including (NM - II.III.I.1): • range of structures from atoms through astronomical objects to the universe, • objects in the universe such as planets, stars, galaxies, and nebulae.	1. The student builds to scale (e.g., the student creates his/her own scale) a model of the universe using common materials (e.g., paper towels) and a confined space (e.g., classroom). (Hint: Each student uses a different scale so that not all of the models look the same.) √ realistic proportionate model √ individual participation √ required structural materials
	2. Predicts changes in the positions and appearances of objects in the sky (e.g., moon, sun) based on knowledge of current positions and patterns of movements (e.g., lunar cycles, seasons) (NM - II.III.I.2).	2. The class visits the on-site planetarium. While there each student predicts changes in the positions and appearances of the objects in the sky. The student responds to questions and (e.g., What are the sun's locations on ecliptic throughout the seasons?)to get him/her into the critical-thinking mode. √ reasoning
	3. Understands how knowledge about the universe comes from evidence collected from advanced technology (e.g., telescopes, satellites, images, computer models) (NM - II.III.I.3). 4. Describes the key observations that led to the acceptance of the Big Bang theory and that the age of the universe is over 10 billion years (NM - II.III.I.4).	3, 4. The student does the laboratory exercise, # 38 p. 255, from *Laboratory Exercises in Astronomy* to gain an understanding of red-shift. A basic tenet is that when waves are moving away they expand and get larger. Red-shift are light rays and the color red because they are longer than other colors. √ completion of lab activity √ comprehension
	5. Explains how objects in the universe emit different electromagnetic radiation and how this information is used (NM - II.III.I.5).	5. The student performs the spectral analysis lab. He/She looks at two different stars with given wave lengths and uses a chart to determine what the star is made of (e.g., 397nm is hydrogen). After obtaining the different readings and comparing his/her responses with other students' readings in the class, he/she writes an explanation of his/her findings and conjectures as to what elements are present in stars and what the most common elements are.

GRADE 10 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
		√ accurate readings √ comparisons √ analysis √ effective communication
	6. Examines the role that New Mexico research facilities play in current space exploration (e.g., Very Large Array, Goddard Space Center) (NM - II.III.I.7).	6. The student, working in a group that represents a New Mexico space research facility, creates a timeline that represents contributions to space made by that center. √ individual participation √ teamwork/collaboration √ accurate representation of timeline √ thoroughness
	7. Explains plate tectonic theory and understand the evidence that supports it (NM - II.III.II.5).	7, 9, 10. The student learns that plate tectonics is the geological theory that states that pieces of Earth's lithosphere are in constant, slow motion, driven by convection currents in the mantle. This theory explains the formation, movement, and subduction of Earth's plates. To gain an understanding of the main idea of this theory, the student labels several figures by indicating the type of plate boundary it shows. Based on the figures, he/she responds to several questions. From this introductory exercise the student advances to a hands-on activity where he/she builds a model to help understand the process of sea-floor spreading and to answer the essential question, "How does sea-floor spreading add material to the ocean floor?" Using a set of instructions (See *Teaching Resources – pp. 32 – 37)* and required materials (i.e.., scissors, metric ruler, two sheets of unlined paper, colored marker), the student completes the activity. Upon completion of the activity, the student answers in writing several questions posed by the activity (e.g., Explain how differences in density and temperature provide some of the force needed to move the strips in your model.) √ individual participation √ completion of all activities √ reasonable response to essential question √ effective communication
	8. Describes how stars are powered by nuclear fusion, how luminosity and temperature indicate their age, and how stellar processes create heavier and stable elements that are found throughout the universe (NM - II.III.I.6).	8. The student uses the H-R diagram (e.g., plot of the absolute magnitudes of stars against their spectral types) in an exercise that permits him/her to explore the family relations among the stars in the sky. The premise is that the student discovers that there are many different kinds of stars of

GRADE 10 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
		different brightness, surface temperature, and size and that these properties are not immediately apparent to the casual observer. See p. 193 of *Teaching Resources* for complete details.). After completion of the exercise, the student writes a summary of what he/she learned. √ completion of exercise √ accurate plotting and curve drawing √ synthesis √ effective communication
	9. Knows that Earth's systems are driven by internal (i.e., radioactive decay and gravitational energy) and external (i.e., the sun) sources of energy (NM - II.III.II.6). 10. Describes convection as the mechanism for moving heat energy from deep within Earth to the surface and discuss how this process results in plate tectonics, including (NM - II.III.II.7): • geological manifestations (e.g., earthquakes, volcanoes, mountain building) that occur at plate boundaries, and • impact of plate motions on societies and the environment (e.g., earthquakes, volcanoes).	9, 10. The student conducts a lab in which he/she observes a model of convection currents in Earth's mantle. At the end of this experiment, the student answers the essential question, "How do convection currents affect earth's plates?" in either oral or written format. The student follows the procedures outlined in the *Teaching Resources, p. 38* and answers the questions at the end of the lab exercise. √ successful completion of the lab exercise √ response to questions √ effective communication

STRAND IV: THE CONTENT OF SCIENCE – LIFE SCIENCE
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 10-12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	1. Critically analyzes how humans modify and change ecosystems (e.g., harvesting, pollution, population growth, technology) (NM – II.II.I.4).	1. The student examines a case study that deals with toxins in the environment that lead to health problems. Following the procedure outlined in the Science and Society Strand, the illustration for performance standard # 12, the student looks at the symptoms, diagnoses the problem and prescribes treatment. √ accurate diagnosis and treatment
	2. Explains how matter and energy flow through biological systems (e.g., organisms, communities, ecosystems), and 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).	2. The student completes a kinesiology (e.g., movememt) experiment. In this experiment the student goes through the muscles, names them, determines where the energy comes from for muscle contraction and makes the connection with exercise (e.g., a person perspires because the body is releasing heat). √ all required components √ accuracy √ connections
	3. Understands and explains the hierarchical classification scheme (i.e., domain, kingdom, phylum, class, order, family, genus, species), including (NM – II.II.I.8): • classification of an organism into a category, • similarity inferred from molecular structure (DNA) closely matching classification based on anatomical similarities, and • similarities of organisms reflecting evolutionary relationships.	3. During the cat dissection the student compares the anatomy of the cat and humans and writes a summary of his/her findings. √ active participation in dissection √ accurate comparisons √ effective writing elements
	4. Knows that an ecosystem is complex and may exhibit fluctuations around a steady state or may evolve over time (NM – II.II.I.1).	4 – 11, 16. The student reads two case studies on genetic disorders (e.g., PKU, cystic fibrosis). He/She reads about the DNA carrying the genetic information. With the information provided, the student gives the family tree going all the way down to the gene itself that is causing the genetic disorder. √ thorough representation of family tree √ accuracy

	5. Knows how DNA carries all genetic information in the units of heredity called genes, including (NM – II.II.II.1): • the structure of DNA (e.g., subunits A, G, C, T), • information-preserving replication of DNA, and • alteration of genes by inserting, deleting, or substituting parts of DNA. 6. Uses appropriate vocabulary to describe inheritable traits (i.e., genotype, phenotype) (NM – II.II.II.2). 7. Explains the concepts of segregation, independent assortment, and dominant/recessive alleles (NM – II.II.II.3). 8. Identifies traits that can and cannot be inherited (NM – II.II.II.4). 9. Knows how genetic variability results from the recombination and mutation of genes, including (NM – II.II.II.5): • sorting and recombination of genes in sexual reproduction result in a change in DNA that is passed on to offspring, and • radiation or chemical substances can cause mutations in cells, resulting in a permanent change in DNA. 10. 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). 11. Knows that DNA directs protein building (e.g., role of RNA) (NM – II.II.III.6). 12. Knows that cells are made of proteins composed of combinations of amino acids (NM – II.II.III.1).	12. The student refers back to the EKG exercise in Strand II. It is given that the starting point of the wave is –90 mv. The student answers the following questions to gain an understanding of where that –90 comes from (e.g., negative charge on amino acids). • What happens to resting membrane potential if intracellular Na+ is increased? • What happens to resting membrane potential if intracellular K+ is increased? • What happens to the flow of Na+ across the membrane during depolarization of a cardiac cell if intracellular Na+ is increased before depolarization ever happened?

		• What happens to the flow of K+ during repolarization of a cardiac cell if extracellular K+ is increased before repolarization ever happened? • What happens to the flow of Na+ across the membrane during depolarization of a cardiac cell if extracellular Na+ is increased before depolarization ever happened? • What happens to the flow of K+ during repolarization of a cardiac cell if intracellular K+ is increased before repolarization ever happened? √ reasonable responses to questions √ effective communication
	13. Knows that specialized structures inside cells in most organisms carry out different functions, including (NM – II.II.III.2): • parts of a cell and their functions (e.g., nucleus, chromosomes, plasma, and mitochondria), • storage of genetic material in DNA, • similarities and differences between plant and animal cells, and • prokaryotic and eukaryotic cells. 14. 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). 15. 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). 16. Knows that DNA directs protein building (e.g., role of RNA) (NM – II.II.III.6). 17. Describes how most cell functions involve chemical reactions, including (NM – II.II.III.7): • promotion or inhibition of biochemical reactions by enzymes • processes of respiration (e.g., energy production, ATP), and communication from cell to cell by secretion of a variety of chemicals (e.g., hormones).	13 - 15, 17. The student dissects the cat's muscles, looks at muscle slides under the microscope, and identifies the organelles and their functions. √ correct identification of organelles and their functions √ skillful use of equipment

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 10 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	1. Knows how science enables technology but also constrains it, and recognizes the difference between real technology and science fiction (e.g., rockets vs. antigravity machines, nuclear reactors vs. perpetual-motion machines, medical X-rays vs. Star-Trek tricorders) (NM - III.I.I.1). 2. Understands how advances in technology enable further advances in science (e.g., microscopes and cellular structure, telescopes and understanding of the universe) (NM - III.I.I.2). 3. Evaluates the influences of technology on society (e.g., communications, petroleum, transportation, nuclear energy, computers, medicine, genetic engineering) including both desired and undesired effects, and including some historical examples (e.g., the wheel, the plow, the printing press, the lightning rod) (NM - III.I.I.3). 4. Understands the scientific foundations of common technologies (e.g., kitchen appliances, radio, television, aircraft, rockets, computers, medical X-rays, selective breeding, fertilizers and pesticides, agricultural equipment) (NM - III.I.I.4). 5. Understands that applications of genetics can meet human needs and can create new problems (e.g., agriculture, medicine, cloning) (NM - III.I.I.5). 6. Analyzes the impact of digital technologies on the availability, creation, and dissemination of information (NM - III.I.I.6).	1 – 5, 9, 11, 16. The student writes a paper on a controversial topic (e.g., cloning) stating the advantages and disadvantages of the current concepts with an emphasis on the latest technological advances. √ support for argument √ both sides of the issue √ technological influences 6. The *Journal of the American Medical Association*(JAMA) and the *New England Journal* of Medicine are the two most prominent journals where medicine is reported and where others can find out what is going on in the medical field. Every nine weeks the student reads three original research articles from these journals and writes a critique and abstract of the articles. √ reading analysis √ task completion √ organization and sharing of information

	7. Describes how human activities have affected ozone in the upper atmosphere and how it affects health and the environment. 8. Describes uses of radioactivity (e.g., nuclear power, nuclear medicine, radiometric dating) (NM - III.I.I.8). 9. Describes how scientific knowledge helps decision makers with local, national, and global challenges (e.g., Waste Isolation Pilot Project [WIPP], mining, drought, population growth, alternative energy, climate change) (NM - III.I.I.9). 10. Describes major historical changes in scientific perspectives (e.g., atomic theory, germs, cosmology, relativity, plate tectonics, evolution) and the experimental observations that triggered them (NM - III.I.I.10). 11. Knows that societal factors can promote or constrain scientific discovery (e.g., government funding, laws and regulations about human cloning and genetically modified organisms, gender and ethnic bias, AIDS research, alternative-energy research) (NM - III.I.I.11).	7, 8, 15. The student works on projects throughout the semester. One such project that is ongoing at all times – five a semester – is the case study. The student assumes the role of a physician where he/she diagnoses the symptoms of a patient, gives a prognosis, and prescribes treatment. The case studies vary in nature. One example may be where an environmental toxin is a cause for medical problems in several individuals. In order for a student to render proper treatment, he/she researches the problem, uses deductive reasoning, and applies problem-solving skills. √ proper diagnosis and treatment √ reasoning and problem solving √ thorough research 10. The student views a video on the history of anesthesia (e.g., 1700 – 1800s) taking the student from the most elementary forms (e.g., whiskey, nitrous oxide, chloroform, morphine) to current forms. The student learns that "the father of anesthesia" experimented on himself until he became addicted. The student takes notes during the viewing noting every drug mentioned, its effect, the outcome, when it was used, for what it was used, how the drug was used, and if the drug is still used. At the end of the video, the student selects one that most impressed him/her and writes a paper stating why he/she chose that particular drug. √ listening skills √ note taking √ personal response √ support for argument √ effective communication 11, 17. The student listens to a guest speaker (e.g., someone from the AIDS Society, technical person) talk about the epidemiology of AIDS (e.g., how it spreads, who gets it). After the lecture on this disease, the student listens to a person who has AIDS and/or a person who is living with it. That individual explains what it is like to live with it and the impact it has had on him/her. The student is free to ask questions. Afterwards, a discussion follows where the student talks about personal responsibilities. √ listening skills √ appropriate behavior (e.g., questions) √ individual participation in discussion √ prevention theories Note: A common thread throughout the course is the examination of diseases that have no cure.

	12. Explains how societies can change ecosystems and how these changes can be reversible or irreversible (NM - III.I.I.12). 13. Describes how environmental, economic, and political interests impact resource management and use in New Mexico (NM - III.I.I.13).	12, 13. Through lectures and text readings the student learns that society in some way has caused certain diseases to thrive (e.g., West Nile virus, hantavirus). The student researches one such disease, preferably one that is predominant in New Mexico (e.g., poverty, diabetes in hispanics) and reports on its health effects in either an oral or written format. √ thorough research √ effective presentation √ clarity in communication √ relevant information
	14. Describes New Mexico's role in nuclear science (e.g., Manhattan Project, WIPP, national laboratories) (NM - III.I.I.14). 15. Identifies how science has produced knowledge that is relevant to individual health and material prosperity (NM - III.I.I.15). 16. Understands that reasonable people may disagree about some issues that are of interest to both science and religion (e.g., the origin of life on Earth, the cause of the Big Bang, the future of Earth) (NM - III.I.I.16). 17. Identifies important questions that science cannot answer (e.g., questions that are beyond today's science, decisions that science can only help to make, questions that are inherently outside of the realm of science) (NM - III.I.I.17).	14. The student participates in a discussion about New Mexico's role in nuclear science. Main ideas to come out of this are Los Alamos role in the creation of the bomb, its role in WWII, and the labs (e.g., Sandia Labs). √ active participation in discussion √ understanding of New Mexico's role in nuclear science development
	18. Understands that scientists have characteristics in common with other individuals (e.g., employment and career needs, curiosity, desire to perform public service, greed, preconceptions and biases, temptation to be unethical, core values including honesty and openness) (NM - III.I.I.18). 19. Knows that science plays a role in many different kinds of careers and activities (e.g., public service, volunteers, public office holders, researchers, teachers, doctors, nurses, technicians, farmers, ranchers) (NM - III.I.I.19).	18, 19. The student takes a field trip to one of the local hospitals, listens to a variety of guest speakers (e.g., physicians lecture series) where different people involved in the medical field (e.g., cardiologist, pediatrician, physical therapist, internist) come in and talk about their fields and topics of interest (e.g., ethics). For each visit made or speaker that comes in, the student takes notes and turns them in with a personal reflection. √ note taking √ personal reflection √ attention to detail √ awareness of medical career opportunities

STRAND VI: HEALTH
CONTENT STANDARD: The student acquires medical terminology and information that enables him/her to make sound health decisions.

BENCHMARK: The student analyzes personal goals, behaviors, values, and other health factors that impact and promote an individual's health throughout life..

GRADE 10 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	1. Describes the interrelationships of mental, emotional, social, and physical health throughout life NM – H 1B). 2. Explains the impact of personal health behaviors on the functioning of body systems (NM – H 1C). 3. Analyzes how the environment influences the health of the community (NM – H 1E). 4. Analyzes situations requiring professional health services (NM – H 2F). 5. Analyzes the role of individual responsibility for enhancing health (NM – H 3A). 6. Examines the short-term and long-term consequences of safe, risky, and harmful behaviors (NM – H 3C). 7. Evaluates strategies to manage stress (NM – H 3G). 8. Analyzes health concerns that require collaborative decision making (NM – H 6B). 9. Implements a plan for attaining a personal health goal (NM – H 6D). 10. Formulates an effective plan for lifelong health (NM – H 6F). 11. Expresses information and opinions about health issues (NM – H 7B).	1 – 11. Throughout Medical Physics the student has multiple opportunities to examine and apply concepts of disease, its symptoms, diagnosis, and treatment on a personal level. Through discussions and a variety of activities, he/she integrates and connects what is learned to himself/herself. As an example in the illustration in Strand I, the student performs the blood pressure experiment and then relates the significance of the work to himself/herself discussing what one can do to lower blood pressure (e.g., manage stress). This may then lead to relating, analyzing, evaluating, and implementing personal health goals and health plans. A current event activity allows for discussion on environmental issues and its health effects and other medical topics. The Science in Society Strand that emphasizes the role of technology opens the door for further discussion or activity engagement on its impact on health. Consequently, the health standards are met through the integration of the content in the other strands. √ understanding of self and personal health √ understanding of health implications that promote positive health behaviors √ individual participation in discussions √ effective communication √ analysis √ connections √ personal reflection See Strand I illustration; Strand II the illustration for performance standards # 4, 7, 14 – 16 (e.g., EKG); Strand IV, the 1st and 2nd illustrations and the illustration for performance standards # 4 – 11, 16; and Strand V, the illustrations for performance standards # 7, 8, 15; #11, 17; and #12, 13.

STRAND VII: CAREER EXPLORATION
CONTENT STANDARD: The student explores the expectations, guidelines, and roles of a medical profession.

BENCHMARK: The student identifies career interests, aptitudes, skills, resources, and behaviors that support personal medical career options.

GRADE 10 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	1. Revises a career plan consistent with career interests, aptitudes, and abilities (NM – CR 1C).	1, 6. Throughout the year the student has explored a variety of medical career opportunities (e.g., research, guest speakers, field trips) and has gained an insight into what the expectations are if a medical career is chosen as his/her profession. Many times the student takes the course because he/she believes upon entry that this might be an option for him/her and is seriously considering a career in medicine. At the end of the course, the student summarizes in writing the impact the course has had on him/her. He/She states how this course has affected his/her post secondary career options and what steps/goals must be accomplished to be successful. √ analysis/perspectives √ identification of goals √ modifications √ effective writing elements
	2. Assesses knowledge and skills within the group, delegates responsibilities, and evaluates team performance as a member of a working team (NM – CR 2B). 3. Demonstrates advanced technology knowledge and skills required for entry into career fields of interest (NM – CR 3D). 4. Demonstrates ability to work cooperatively to accomplish objectives (NM – CR 4B). 5. Investigates, analyzes, and applies safety standards related to the school, community, and workplace (NM – CR 4D). 6. Identifies and utilizes individual interests, aptitudes, and skills within the group to accomplish goals (NM – CR 5A). 7. Demonstrates ability to work with others from diverse backgrounds (NM – CR 5C).	2 – 5, 7, 8. The student as part of a group selects a disease to research, writes a research paper, and makes a presentation (e.g., PowerPoint) to the class on the topic. The group delineates the responsibilities and delegates the work. The student includes links in the presentation if using technology, develops a case study on the disease chosen, and follows a prescribed format (e.g., APA) in writing the paper. After all the presentations, the student group assesses its performance and analyzes the strengths and growth areas of the team project. √ teamwork/collaboration √ completion of delegated work √ thorough research √ relevant information √ leadership development √ all required components √ technological skills √ effective writing elements √ quality presentation

GRADE 10 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	8. Demonstrates leadership within a group through effective communication ability to motivate team members and effective delegation of responsibility (NM – CR 5D).	√ analysis/insights

STRAND VIII: LITERACY
CONTENT STANDARD: The student communicates medical 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
	1. Develops and demonstrates proficiency with the following strategies to approach reading for information across content areas: (APS – LA I.1): • scans reading selection to determine whether a text contains relevant information, • uses the headings and subheadings of the material to make predictions and to validate comprehension of text, • reads and rereads to decode meaning, and • reviews and summarizes essential elements of text for overview. 2. Identifies and uses roots, prefixes, and suffixes to determine meaning of words (APS – LA I.4). 3. Uses textual evidence to develop and support an interpretation of a scientific process or concept (APS – LA II.2). 4. Develops increased competence in using the writing process to create a final product (APS – LA III.1). 5. Develops increased competence in using elements of effective writing (APS – LA III.2). 6. Supports an informed opinion: (APS – LA III.6): • uses appropriate language, reasoning, and organizational structure for the audience and purpose, • provides relevant and convincing reasons, uses various types of evidence, and • demonstrates an awareness of possible questions, concerns, or counterarguments. 7. Responds to a variety of written, electronic, and other media (APS – LA III.7).	1 – 16. The student, working alone or with a partner, researches a disease or syndrome of his/her choice and prepares a presentation (e.g., PowerPoint) for the class. The content includes the etiology of the disease or syndrome; all the signs and symptoms of the disease or syndrome; the biochemistry, microbiology, histology, and cellular processes of the disease or syndrome; normal prognosis of the disease; lab tests used to diagnose the disease or syndrome, including how the tests were performed, the normal values and the values observed in the case; and treatment of the patient, including how and why the treatment is given and the effectiveness of the treatment. The research is presented in a three-page paper that covers all the required content section. The paper must be double spaced, in New Times Roman font, 12-point font, normal margins, and include a bibliography that is in proper format (e.g., MLA). The presentation must be at least 20 minutes long and include at least 20 different slides which are used as a catalyst for the content and not the sum of the project. In addition, the student submits five multiple-choice questions electronically which are included on the instructor's final exam. √ all required components √ proper format √ use of technology √ teamwork/collaboration √ thoroughness of research √ synthesis and analysis of research √ support for argument √ effective writing elements and conventions √ documentation of resources √ quality presentation Although the above illustration is representative of a culminating project that meets all of the indicated performance standards, multiple opportunities are provided throughout the course for the student to demonstrate literacy skills and are evident in every strand.

GRADE 10 - 12	PERFORMANCE STANDARDS	ILLUSTRATIONS
	8. Develops increased competence with speaking and language conventions (APS – LA IV.3). 9. Listens to and analyzes a presentation or discussion (APS – LA V.1). 10. Conducts research and collects data from in-depth field studies (APS – LA VI.1). 11. Obtains and sends information electronically to support advanced research (APS – LA VI.2). 12. Uses a variety of technology (APS – LA VI.5). 13. Recognizes and continues to use the elements of formal citations to document sources (APS – LA VI.6). 14. Accesses appropriate style manuals as research guides (APS – LA VI.7). 15. Synthesizes information from multiple research studies to draw conclusions and inferences that go beyond those found in any of the individual studies (APS – LA VI.9). 16. Synthesizes and organizes information from a variety of sources to inform and persuade an audience (APS – LA VI.9).	10 – 16. See the 2nd illustration in Strand VII (Career Exploration).