Jemez Valley Public Schools
PHYSICS • CONTENT MAP

Quadrant I	Quadrant II	Quadrant III	Quadrant IV
Strand I: Scientific Thinking and Practice **Standard I: Understand the processes of scientific investigations and use inquiry and scientific ways of observing, experimenting, predicting, and validating to think critically.**			
Describe the essential components of an investigation, including appropriate methodologies, proper equipment, and safety precautions. Design and conduct scientific investigations that include: testable hypotheses, controls and variables, results that address hypotheses being investigated, predictions based on results, and error analysis. Use appropriate technologies to collect, analyze, and communicate scientific data (e.g., balances, microscopes). Convey results of investigations using scientific concepts, methodologies, and expressions, including: scientific language and symbols, charts, and other data displays, clear, logical, and concise communication with reasoned arguments Understand how scientific processes produce valid, reliable results, including: consistency of explanations with data and observations, testability of hypotheses, repeatability of experiments and reproducibility of results. Create multiple displays of data to analyze and explain the relationships in scientific investigations. Identify and apply measurement techniques and consider possible effects of measurement errors. Design and conduct scientific investigations that include: methods to collect, analyze, and interpret data, re-evaluation of hypotheses and additional experimentation as necessary. Understand how scientific theories are used to explain and predict natural phenomena (e.g., plate tectonics, ocean currents, structure of atom). Use scientific reasoning and valid logic to recognize: faulty logic, cause and effect, the difference between observation and unsubstantiated inferences and conclusions and potential bias. Understand how new data and	Convey results of investigations using scientific concepts, methodologies, and expressions, including: mathematical expressions and processes (e.g., mean, median, slope, proportionality). Use appropriate technologies to collect, analyze, and communicate scientific data (e.g., computers, calculators). Use mathematical models to describe, explain, and predict natural phenomena.	Use technologies to quantify relationships in scientific hypotheses (e.g., calculators, computer spreadsheets and databases, graphing software, simulations, modeling). Understand how scientific processes produce valid, reliable results, including: openness to peer review, full disclosure and examination of assumptions.	Critically analyze an accepted explanation by reviewing current scientific knowledge. Examine investigations of current interest in science (e.g., superconductivity, molecular machines, age of the universe). Examine 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.

observations can result in new scientific knowledge. Use mathematics to express and establish scientific relationships (e.g., scientific notation, vectors, dimensional analysis).			
Quadrant I	**Quadrant II**	**Quadrant III**	**Quadrant IV**
Strand II: Content of Science **Standard I: (Physical Science) Understand the structure and properties of matter, the characteristics of energy, and the interactions between matter and energy.**			
Understand that electromagnetic waves carry energy that can be transferred when they interact with matter. Describe the characteristics of electromagnetic waves (e.g., visible light, radio, microwave, X-ray, ultraviolet, gamma) and other waves (e.g., sound, seismic waves, water waves), including:; (a) origin and potential hazards of various forms of electromagnetic radiation, and (b) energy of electromagnetic waves carried in discrete energy packets (photons) whose energy is inversely proportional to wavelength. Describe wave propagation using amplitude, wavelength, frequency, and speed. Explain how the interactions of waves can result in interference, reflection, and refraction. Describe how waves are used for practical purposes (e.g., seismic data, acoustic effects, Doppler effect). Describe relative motion using frames of reference.	Understand the relationship between force and pressure, and how the pressure of a volume of gas depends on the temperature and the amount of gas. Represent the magnitude and direction of forces by vector diagrams. Apply Newtonâ€™s Laws to describe and analyze the behavior of moving objects, including (a) displacement, velocity, and acceleration of a moving object, (b) Newtonâ€™s Second Law, F = ma (e.g., momentum and its conservation, the motion of an object falling under gravity, the independence of a falling objectâ€™s motion on mass), and (c) circular motion and centripetal force. Know 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., Newtonâ€™s Third Law).	Identify different forms of energy, including kinetic, gravitational (potential), chemical, thermal, nuclear, and electromagnetic. Explain how thermal energy (heat) consists of the random motion and vibrations of atoms and molecules and is measured by temperature. Understand that energy can change from one form to another (e.g., changes in kinetic and potential energy in a gravitational field, heats of reaction, hydroelectric dams) and know that energy is conserved in these changes. Understand how heat can be transferred by conduction, convection, and radiation, and how heat conduction differs in conductors and insulators. Explain how heat flows in terms of the transfer of vibrational motion of atoms and molecules from hotter to colder regions. Understand 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. Understand the concept of equilibrium (i.e., thermal, mechanical, and chemical). Know 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.	Know that some atomic nuclei can change, including (a) spontaneous decay, (b) half-life of isotopes, (c) fission, (d) fusion (e.g., the sun), and (e) alpha, beta, and gamma radiation. Describe how energy flows from the sun through plants to herbivores to carnivores and decomposers. Understand that matter is made of atoms and that atoms are made of subatomic particles. Understand atomic structure, including; (a) most space occupied by electrons, (b) nucleus made of protons and neutrons, (c) isotopes of an element, (d) masses of proton and neutron 2000 times greater than mass of electron, and (e) atom held together by proton-electron electrical forces. Know 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. Explain how electric currents cause magnetism and how changing magnetic fields produce electricity (e.g., electric motors, generators).

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Strand III: Content of Science **Standard II: (Earth and Space Science) Understand the structure of Earth, the solar system, and the universe, the interconnections among them, and the processes and interactions of Earth's systems.**			
Understand the scale and contents of the universe, including: -range of structures from atoms through astronomical objects to the universe -objects in the universe such as planets, stars, galaxies, and nebulae. Describe the internal structure of Earth (e.g., core, mantle, crust) and the structure of Earthâ€™s plates. Understand how knowledge about the universe comes from evidence collected from advanced technology (e.g., telescopes, satellites, images, computer models).		Explain 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. Describe 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.	
Quadrant I	**Quadrant II**	**Quadrant III**	**Quadrant IV**
Strand IV: Science and Society **Standard I: Understand how scientific discoveries, inventions, practices, and knowledge influence, and are influenced by, individuals and societies.**			
Describe 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). Know 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). Understand 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). Describe major historical changes in scientific perspectives (e.g., atomic theory, germs, cosmology, relativity, plate tectonics, evolution) and the experimental observations that triggered them.	Evaluate 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) Analyze the impact of digital technologies on the availability, creation, and dissemination of information.	Understand 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). Understand how advances in technology enable further advances in science (e.g., microscopes and cellular structure; telescopes and understanding of the universe).	Identify how science has produced knowledge that is relevant to individual health and material prosperity. Know how science enables technology but also constrains it, and recognize 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) Know 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).