COMPONENT	OBJECTIVES	COMPETENCY
I Science Skills and Attitudes, Applications, and Contexts of Physics	1. Use careful observations and exploratory activities to identify variables and to develop problem statements. **(SC.H.1.4.1)** 2. Distinguish among descriptive (laboratory and field observations), comparative (comparing two experiments with one common manipulated variable), and experimental (controlled experiment) investigation designs commonly used in physics. **(SC.H.1.4.1) (SC.H.3.4.1)** 3. Write hypotheses leading to different types of experimental designs for selected problem statements using variables identified as manipulated (independent) and responding (dependent). **(SC.H.1.4.0)** 4. Routinely analyze experiments in terms of: problem statement, hypothesis, manipulated and responding variables, quantification of variables, identification of variables held constant, the number of tests and trials, and the use of an experimental control. **(SC.H.2.4.2)** 5. Based upon an appropriate number of experimental trials and samples, systematically collect and organize data into tables or charts and properly distinguish among the types of qualitative (nominal and ordinal) and quantitative (interval and ratio) data analyzed. **(SC.H.1.4.0)** 6. Interpret experimental data by reordering and/or plotting graphs and then describing the central tendency of the data by the appropriate use of the mean, median, and/or mode and the variation of the data by the appropriate use of the range and/or the frequency distribution. **(SC.H.1.4.0)** 7. Write conclusions that briefly state what was investigated, describe whether or not the hypothesis was supported by the results, include sample results, compare the results with other investigations, provide possible explanations about the results, recommend additional studies, and discuss possible applications. **(SC.H.1.4.3)**	A. Apply science investigation skills to design and carry out appropriate types of experiments and to analyze the data collected to form conclusions on physics topics using established laboratory and safety procedures.

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	8. Analyze conclusions by classifying each sentence as a statement based upon either: an observation, the result of information gathered through the senses; an inference, the explanation or interpretation of observations; a fact, the activities performed during the investigation; or an opinion, inferences not directly supported by observations. **(SC.H.1.4.7)** 9. Identify the parts, functions, proper care, and use of appropriate scientific equipment, balances, and demonstrate accurate metric measurement by reading common laboratory apparatus to the nearest tenth of a unit of measure and describing the uncertainty of these measures. **(SC.H.1.4.0)** 10. Select attire (aprons, eye protection, containment of hair, clothes) to ensure personal protection and practice accepted safety procedures using appropriate science equipment for all science activities. **(SC.H.1.4.0)** 11. Identify appropriate safety procedures for typical laboratory emergencies such as broken glass, chemical spills, chemical splashes on the skin or in the eye, and the prevention of fires. 12. Research, design, complete, and make an appropriate scientific report on the results of a long range experimental investigation on a suitable science topic.	
	1. Describe how discoveries made by physicists can have both beneficial and detrimental affects on the quality of human life. **(SC.G.2.4.6)** 2. Identify how technology and conservation have affected the rate of consumption of our common natural renewable and nonrenewable resources. **(SC.G.2.4.5) (SC.G.2.4.6)** 3. Explore research and career opportunities in physics. **(SC.H.3.4.6)**	B. Apply physics knowledge, principles and skills to clarify and make decisions involving critical social issues.

COMPONENT	OBJECTIVES	COMPETENCY
	4. Identify and describe the scientific contributions of physics researchers from various ethnic and cultural backgrounds and recognize the importance of the continuous development and sharing of scientific information. **(SC.H.1.4.5)** 5. Determine that results are tentative, are subject to different interpretations, and should be replicable by other scientists. **(SC.H.1.4.4) (SC.H.1.4.5) (SC.H.1.4.6) (SC.H.1.4.7)** 6. Use the science process skills to analyze information from public media. 1. Research the development of Newton's conception of the universe and its impact on modern science. 2. Research the development of Einstein's Theory of Relativity and its impact on modern science. 3. Research the development of the concept of radioactivity and its impact on modern science.	C. Demonstrate the historical and social contexts of physics and its relationships with other disciplines by describing an example for one of the following: how a technological device has allowed scientists to further understanding of the natural world; how a physics activity has influenced a political, economic, or cultural event or the reverse situation; or how physics is involved in the emergence of new fields of endeavor in the sciences.

COMPONENT	OBJECTIVES	COMPETENCY
II Kinematics	1. Based upon laboratory experiences, calculate average speed, instantaneous speed, and change in speed, given appropriate distance and time data. **(SC.C.1.4.2)** 2. Represent linear motion by use of displacement/time, velocity/time, and acceleration/time graphs. **(SC.C.1.4.0)** 3. Determine approximate instantaneous speed and/or acceleration from the slope on appropriate graphs. 4. Recognize examples of different frames of reference. 5. Determine the change in position and/or change in velocity from the area under the curve of appropriate graphs. 6. Resolve a velocity vector into its horizontal and vertical components using graphic and trigonometric functions.	A. Experimentally investigate linear motion to determine if the velocity is constant, increasing, or decreasing when the acceleration is zero and when it is constant.
III Dynamics and Forces	1. Define a vector quantity as one which requires both a magnitude and a direction measurement. **(SC.C.2.4.0)** 2. Determine the resultant of two component vectors. **(SC.C.2.4.0)** 3. Resolve a vector diagram into its x and y components. **(SC.C.2.4.0)** 4. Identify velocity acceleration, and displacement as vector quantities. **(SC.C.2.4.2)** 5. Investigate how acceleration varies with the force that causes it and the mass of the object accelerated, generate plots of acceleration versus force and acceleration versus mass, and combine these two relationships into one proportional statement. **(SC.C.1.4.2)**	A. Quantitatively apply Newton's laws to the analysis of balanced and unbalanced forces acting on an object in one and two dimensions.

COMPONENT	OBJECTIVES	COMPETENCY
	6. Solve problems which require the use of Newton's Laws of Motion. **(SC.C.2.4.0)** 7. Quantitatively apply Newton's laws to analysis of velocity-dependent forces such as the resistance of a fluid to a falling object's motion. **(SC.C.2.4.0)** 8. Describe those properties which affect friction. **(SC.C.2.4.0)** 9. Calculate the magnitude, and direction of force, or torque that must be applied to achieve equilibrium in an unbalanced system. **(SC.C.2.4.0)** 10. Calculate the gravitational force between two objects given their mass and the distance between their centers. **(SC.C.2.4.1)** 11. Qualitatively describe a projectile's motion in terms of its vertical and horizontal components of velocity and quantitatively at the initial, midpoint, and the final point of the trajectory. **(SC.C.2.4.0)**	
	1. Investigate the factors effecting the period of an object moving in periodic motion. **(SC.C.2.4.0)** 2. Describe the relationship between the restoring force and the displacement on an object moving in simple harmonic motion. **(SC.C.2.4.0)** 3. Based on experimental data calculate the magnitudes of velocity, force, and acceleration vectors in uniform circular motion. **(SC.C.2.4.0)**	B. Apply Newton's laws to the analysis of objects moving periodically.

COMPONENT	OBJECTIVES	COMPETENCY
	1. Define a vector quantity as one which requires both a magnitude and a direction measurement. **(SC.C.2.4.0)** 2. Determine the resultant of two component vectors. **(SC.C.2.4.0)** 3. Resolve a vector diagram into its x and y components. **(SC.C.2.4.0)** 4. Identify velocity acceleration, and displacement as vector quantities. **(SC.C.2.4.2)** 5. Describe those properties which affect friction. 6. Calculate the magnitude, and direction of force, or torque that must be applied to achieve equilibrium in an unbalanced system. 7. Calculate the gravitational force between two objects given their mass and the distance between their centers. **(SC.C.2.4.1)** 8. Calculate the amount of stress resulting from a given force applied over a given area.	C. Quantitatively apply Newton's laws to the analysis of forces acting on an object in equilibrium.
IV Conservation of Momentum and Mechanical Energy	1. Use Newton's laws to show how they guarantee the conservation of momentum in any two-body collision. **(SC.B.2.4.1)** 2. Quantitatively describe the conservation of momentum in the following types of collisions: (1) One-dimensional, totally inelastic; (2) One-dimensional, elastic; (3) Two-dimensional, inelastic; (4) Two-dimensional, elastic **(SC.B.2.4.1)**	A. Experimentally investigate the conservation of momentum for one-dimensional and two dimensional elastic and inelastic collisions.

COMPONENT	OBJECTIVES	COMPETENCY
	1. Based upon laboratory experience, determine mathematically that in a conservative system the total of the potential energy and kinetic energy remains the same, even when the energy is changed from one to the other. **(SC.B.1.4.1) (SC.B.1.4.2) (SC.B.2.4.1)** 2. Solve motion problems about an object in free fall near the earth's surface, using the relationship between potential and kinetic energy. **(SC.B.1.4.2)** 3. Determine the conversion factor from mechanical energy to thermal energy. **(SC.B.1.4.6)** 4. Solve problems involving work energy relationships. **(SC.B.1.4.6)** 5. Solve problems in which the energy of a conservative system (e.g., frictionless) remains the same, even when an energy transformation has occurred. **(SC.B.1.4.2)** 6. Relate mass to energy conservation in relativistic terms. 7. Describe the length, time, and mass changes that occur at relativistic speed.	B. Experimentally investigate the conservation of mechanical energy and the transition of mechanical energy to thermal energy.
V Energy	1. State the mathematical relationship among heat, phase change, energy, and work. **(SC.B.1.4.6) (SC.B.1.4.7)** 2. Describe at least one phenomenon that is explained by the Second Law of Thermodynamics. **(SC.B.1.4.6) (SC.B.1.4.7)** 3. Explain the effect of enthalpy, temperature, and entropy on free energy. **(SC.B.1.4.3) (SC.B.1.4.6) (SC.B.1.4.7) (SC.B.2.4.1)**	A. Apply the First Law of Thermodynamics, the conservation of energy, and the Second Law of Thermodynamics to explain the operations of heat engines and refrigerators.

COMPONENT	OBJECTIVES	COMPETENCY
	4. Explain steps and proper sequences in the Carnot cycle. **(SC.B.1.4.6) (SC.B.1.4.7)** 5. Apply the Second Law of Thermodynamics to practical situations. **(SC.B.1.4.6) (SC.B.1.4.7)** 6. Calculate the specific heat of a substance. **(SC.B.1.4.2)** 7. Solve problems using Charles' Law and Boyle's Law. **(SC.B.1.4.2)**	
VI Waves	1. Quantitatively state the relationship between the frequency of a wave and the period of a wave. **(SC.A.2.4.6)** 2. Explain the necessity of a supporting medium to transmit mechanical waves. **(SC.A.2.4.6)** 3. Demonstrate and explain the behaviors of transverse and longitudinal waves, as well as calculate wave length, frequency, and period. **(SC.A.2.4.6)** 4. Identify the nodal, and antinodal lines produced by the interference of sound waves and light waves. **(SC.A.2.4.6)**	A. Demonstrate the behaviors of transverse and longitudinal mechanical waves, and make appropriate calculations of wavelength, frequency, and period.
	1. Identify similarities and differences between theories of light propagation. **(SC.A.2.4.6)** 2. Derive and discuss Young's single and double slit diffraction equations.	B. Compare and contrast the two light theories, electromagnetic wave and the photon theory, using wave behaviors and apply these behaviors to the functions of mirrors and lenses.

COMPONENT	OBJECTIVES	COMPETENCY
	3. Recognize patterns resulting from various diffraction gratings. **(SC.A.2.4.6)** 3. Explain the contributions of Roemer, Michaelson, Morley, and Huygens to our understanding of the nature and speed of light. 4. Diagram light rays reflecting off a plane, concave, or convex mirror, showing the focal point and the location and orientation of the images, when given the location and orientation of the object. **(SC.A.2.4.6)** 5. Diagram light rays passing through concave or convex lenses, lenses showing the focal point and the location and orientation of the image, when given the location and orientation of the object. **(SC.A.2.4.6)** 6. Identify, apply, and calculate factors in refraction of light, including indexes of refraction. 7. Discuss the operating principles of a gas laser, including population inversion, superposition, optical cavity, and characteristics of laser light. **(SC.A.2.4.6)**	
	1. Distinguish among production, propagation, reception, detection, and characteristics of sound. **(SC.A.2.4.6)** 2. Use sound to demonstrate such properties of waves as reflection, diffraction, interference, and the Doppler effect. **(SC.A.2.4.6)** 3. Identify wave phenomena of sound (e.g., frequency, loudness, overtones, etc.) in everyday settings.	C. Explain the nature and transmission of sound through different mediums, the effects of interference, and the implications of the Doppler effect in practical situations.

COMPONENT	OBJECTIVES	COMPETENCY
VII Nuclear Energy	1. Give examples of more than three subatomic particles. **(SC.A.2.4.3)** 2. Demonstrate an understanding of measuring various forms of nuclear radiation. **(SC.A.2.4.3) (SC.A.2.4.4) (SC.C.2.4.4)** 3. Give examples of technological uses of radioactive materials. **(SC.A.2.4.3) (SC.B.1.4.5) (SC.E.2.4.6)** 4. Solve problems in radioactive decay using half-life data. 5. State the basis of the quark theory of elementary particle structure. **(SC.A.2.4.3)**	A. Write balanced nuclear equations for the decay of unstable isotopes, then quantitatively apply the concept of half life to the products of these reactions.
	1. Compare fission and fusion in terms of the initial particles, final products, and relative energy released. **(SC.A.2.4.3) (SC.A.2.4.4) (SC.C.2.4.4)** 2. Balance nuclear transmutation equations. **(SC.A.2.4.3)** 3. Describe nuclear energy sources. **(SC.A.2.4.3) (SC.A.2.4.4)** 4. Identify applications of nuclear reactions, including power generations. **(SC.A.2.4.3) (SC.A.2.4.4) (SC.B.1.4.5) (SC.E.2.4.6)** 5. Predict the products of, and balance nuclear equations. 6. Discuss the characteristics of electron capture, pair production/ annihilation, neutron decay, Bremsstrahulund and Compton scattering.	B. Analyze the energy of fission and fusion in terms of mass deficit and discuss the implications of these issues to nuclear waste, energy and medicine.

COMPONENT	OBJECTIVES	COMPETENCY
VIII Electricity	1. Calculate the force between two spherical charges using Coulomb's Law when given the value of their charges and the distance between their centers. **(SC.C.2.4.2)** 2. Describe basic characteristics of static electricity. **(SC.C.2.4.2)** 3. Define and calculate the electric field due to a static point charge.	A. Predict the outcome of the interactions between static point charges using Coulomb's Law
	1. Demonstrate a knowledge of current electricity by diagramming a complete circuit, and identifying all its components. **(SC.C.2.4.2)** 2. Define any motion of electrical charges in terms of electric current. **(SC.C.2.4.2)** 3. Calculate the unknown variable (voltage, current, or resistance) when given the other two. **(SC.C.2.4.2)** 4. Calculate the total resistance of elementary parallel or series circuits containing resistors. **(SC.C.2.4.2)** 5. Calculate the work done in transferring a given charge through a given potential difference. **(SC.C.2.4.2)** 6. Design a specified combination of series and parallel circuits in terms of total resistance, current through the various branches, and voltage at various junctions. 7. Investigate the relationship between the heat developed, the current through, and the resistance of the conductor over a specified time period. **(SC.B.1.4.6) (SC.C.2.4.2)**	B. Design a series/parallel circuit with three or more resistors and one power source and predict the total current through the various branches and the voltage at various junctions. Confirm these predictions using a voltmeter and an ammeter.

COMPONENT	OBJECTIVES	COMPETENCY
	8. Solve for an unknown resistance using a Wheatstone Bridge. 9. Solve a three power source Kirchoff's mesh (loop) problem. 10. Illustrate how capacitors store electric charge. 11. Define inductance.	
IX Magnetism	1. Diagram the field around a magnet. **(SC.C.2.4.3)** 2. Demonstrate the existence of a magnetic field around a moving electric charge. **(SC.C.2.4.3)** 3. Recognize the relationship between alternating and direct current. **(SC.C.2.4.3)** 4. Demonstrate the existence of a magnetic field around a moving charge using the magnetic force on a compass needle. **(SC.C.2.4.3)** 5. Diagram the magnetic field around a permanent magnet, current carrying straight wire, and solenoid. 6. Describe the domain theory of magnetism. **(SC.C.2.4.3)** 7. Describe the theory of electric motors and generators, in terms of the relationship between electricity and magnetism.	A. Experimentally demonstrate the effects of magnetic forces on moving charges and on currents using an ammeters and voltmeter.