ALAMO HEIGHTS INDEPENDENT SCHOOL DISTRICT
ALAMO HEIGHTS HIGH SCHOOL
Physics Scope and Sequence

Course Description:

In this class the student will learn about the physical world in the same way as scientists. The student will discover and learn to describe relationships in nature through lab experiments and explore applications to new situations. Physics is a math-intensive course, using algebra, trigonometry, and graphing skills.

Methods of Instruction:

- Lecture/Demonstration with Socratic Dialogue Interaction
- Laboratory experiments and reports; mostly inquiry-based discovery labs and some problem-solving labs
- Interactive computer simulations and tutorials
- Audio-visuals
- Group projects and reports
- Student-led problem-solving discussions

Scope and Sequence:

A. Scientific Processes			
TEKS/EXPECTATIONS	**READINGS/TOPICS**	**LABS/ACTIVITIES**	**# of Days**
Scientific Processes - **[P1A,B]** Conduct investigations, for at least 40% of instructional time, using safe, environmentally appropriate, and ethical practices. Actively obtaining and analyzing data with physical equipment or experimentation in a simulated environment - **[P2A]** know the definition of science and understand that it has limitations - **[P2B, C, D]** know the definitions of hypothesis and theory and distinguish between the two - **[P2E]** design & implement investigative procedures - **[P2F, G]** demonstrate the use of course apparatus, equipment, techniques, and procedures - **[P2H]** make measurements with accuracy & precision and record data using scientific notation & SI units	Chapters 1 Supplemental Reading: - The Nature of Science - Lab Safety Contract - Acceptable Use of Computers - Graphical Methods and Modeling Data - Logger Pro Tips - Hypotheses vs. Theories - SI Units, Dimensional Analysis - Modeling data with line graphs and linearization - Equation Manipulation and Proportional Reasoning - Reinforced throughout the course	Activity: Scientific Method: The Science Puzzle, *or* the Water Drops on a Penny, *or* Mythbuster Science, *or* Tower Build Activity: Creating Graphs in Logger Pro Lab: Drop-Bounce Graphing Activity: Research/ Evaluate/Critique a Scientific Article, Current Event	9

- **[P2I]** identify and quantify causes & effects of uncertainties in measured data - **[P2J]** organize & evaluate data & make inferences from data, including the use of tables, charts, and graphs - **[P3A, B]** critique scientific explanations by using empirical evidence, logical reasoning, and experimental & observational testing**;** communicate & apply scientific information extracted from current events, news reports, published journal articles - **[P3C]** draw inferences based on data related to promotional materials for products and services; - **[P3F]** express & interpret relationships symbolically in accordance with accepted theories to make predictions and solve problems mathematically, including problems requiring proportional reasoning & graphical vector addition			
B. MOTION			
Motion in 1 Dimension - **[P4A]** generate & interpret graphs & charts describing different types of motion, including the use motion detectors or photogates; - **[P4B]** describe and analyze motion in one dimension using equations with the concepts of distance, displacement, speed, average velocity, instantaneous velocity, and acceleration	Chapter 2 Supplemental Reading: - Motion Maps & Graphs - The Uniformly Accelerated Particle Model - Kinematics Graphs: Position, Velocity, Acceleration - Kinematic Equations with constant - Free Fall	<u>Lab:</u> Position vs. Time for Constant Velocity Vehicles <u>Lab:</u> Graph Matching using Motion Detectors <u>Lab:</u> Position vs. Time for an Marble Rolling Down and Inclined Plane using Photogates <u>Lab:</u> Online Simulation: The Moving Man	18
Motion in 2 Dimensions - **[P4C]** analyze and describe accelerated motion in two dimensions using equations,	Chapters 3 - 5 Supplemental Reading: - Vector Analysis	<u>Lab</u>: Video Analysis of a Projectile	12

including projectile examples - identify and describe motion relative to different frames of reference.	- Vector Algebra - Kinematics in 2-D - Relative Motion - Projectile Motion	Lab: Virtual Vector Lab Lab: Vector Map	
B. FORCES			
The relationship of force and motion - **[P4D]** calculate the effect of forces on objects, including the law of inertia, the relationship between force and acceleration, and the nature of force pairs between objects - **[P4E]** develop and interpret free-body force diagrams - **[P4C]** analyze and describe accelerated motion in two dimensions using equations, including circular examples - **[P5A]** research and describe the historical development of the concepts of gravitational, electromagnetic, weak nuclear, and strong nuclear forces - **[P5B]** describe and calculate how the magnitude of the gravitational force between two objects depends on their masses and the distance between their centers - **[P5C]** describe and calculate how the magnitude of the electrical force between two objects depends on their charges and the distance between them - **[P5D]** identify examples of electric forces in everyday life - **[P5E]** characterize materials as conductors or insulators based on their electrical properties	Chapters 6 - 8 Supplemental Reading/ Viewing: - Force Diagrams - Problem-Solving Strategy - Gravitational & Electrical Fields - Apollo 13 - Free-body Diagrams - Relate kinematics to dynamics - Friction and its relation to the Normal force - Static vs. Kinetic Friction - Inclined Planes - Force Pairs and Interactions - Uniform Circular Motion - Centripetal Force - Newton's Law of Universal Gravitation - Gravitational and Electric Fields - Static Electricity - Coulomb's Law	Lab: Inertia & Interactions Lab: Force Table Lab: Mass vs. Weight Lab: Acceleration vs. Mass Lab: Acceleration vs. Force Lab: Friction vs. the Normal Force Lab: Online Simulation of Newton's Law of Universal Gravitation Lab: Mapping an Electric Field Project: Research Topics in the Astrophysics; Group Presentations	34
C. ENERGY & MOMENTUM			
Energy & Momentum - **[P6A]** investigate & calculate quantities using the	Chapter 9 - 13 Supplemental Reading:	Lab: Spring Force	25

work-energy theorem - **[P6B]** investigate examples of kinetic & potential energy & their transformations - **[P6C]** calculate the mechanical energy of, power generated within, impulse applied to, and momentum of a physical system - **[P6D]** demonstrate and apply the laws of conservation of energy & conservation of momentum **Thermodynamics** - **[P6E]** describe how the macroscopic properties of a thermodynamic system such as temperature, specific heat, and pressure are related to the molecular level of matter, including kinetic or potential energy of atoms - **[P6F]** contrast & give examples of different processes of thermal energy transfer, including conduction, convection, & radiation - **[P6G]** analyze & explain everyday examples that illustrate the laws of thermodynamics, including the law of conservation of energy & the law of entropy	- Energy Storage Mechanisms - Rocket Reading - Work done by a constant force - Area under F-x graphs - Calculate Kinetic Energy - Work-Energy Theorem - Energy Conservation - Potential Energy calculations - Spring forces and energy - Loss of ME to frictional forces - When to use energy, when to use kinematics - Use of both energy and Newton's laws - Power calculations - Kinetic Theory of Gases - Thermal Expansion - Specific Heat - Conduction, Convection, Radiation - Laws of Thermodynamics - Impulse - Force vs. Time Graphs - Conservation of Momentum - Elastic & Inelastic Collisions, Explosions - Rocket Science (extension)	<u>Lab:</u> Potential to Kinetic Energy *or* Barbie Bungee Drop *or* Design a Conservation of Energy Lab <u>Lab Practical:</u> The Catapult Design Challenge <u>Lab:</u> Heat vs. Temperature <u>Lab:</u> Cart Explosion Conservation of Momentum <u>Lab:</u> Elastic and Inelastic Collisions <u>Project</u>: Bottle Rockets with Egg Cargo *or* Egg Drop	
D. WAVES & QUANTUM PHENOMENA			
Waves & Sound - **[P7A]** examine/describe oscillatory motion & wave propagation in various types of media - **[P7B]** investigate/analyze characteristics of waves, including velocity, frequency, amplitude, & wavelength; calculate using the	Chapters 14 – 19; 27, 28 - Pendulum & Spring Oscillators - Transverse & Longitudinal Waves - Wave Properties - Wave Equation Calculations - Reflection, Refraction,	<u>Lab</u>: Pendulum & Spring Oscillators <u>Lab:</u> Wave Properties <u>Activity</u>: Sound & Instruments <u>Lab:</u> Speed of Sound	29

relationship between wave speed, frequency, & wavelength - **[P7D]** investigate behaviors of waves, including reflection, refraction, diffraction, interference, resonance, and the Doppler effect **Electromagnetic Waves** - **[P7C]** compare characteristics & behaviors of transverse waves, including EM waves & the EM spectrum, & characteristics & behaviors of longitudinal waves, including sound waves - **[P7F]** describe the role of wave characteristics and behaviors in medical and industrial applications **Light Optics** - **[P7E]** describe and predict image formation as a consequence of reflection from a plane mirror and refraction through a thin convex lens **Atomic, Nuclear, Quantum** - **[P8A]** describe the photoelectric effect and the dual nature of light - **[P7D]** compare and explain the emission spectra produced by various atoms	Diffraction, Interference, Resonance, Doppler Effect - Properties of Sound - EM Spectrum - Polarization - Redshift/Blueshift - Energy & Atomic Spectra - Plane, Concave, Convex Mirrors - Concave and Convex Lenses - Ray Diagrams - Real & Virtual Images - Total Internal Reflection - Photoelectric Effect	using Resonance (optional) Lab: Electromagnetic Waves Introduction Lab: Reflection & Mirrors Lab: Refraction & Lenses	
E. ELECTRICITY & MAGNETISM			
Electrical Circuits - **[P5F]** design, construct, & calculate in terms of current, voltage, resistance, & power used by electric circuit elements connected in both series & parallel combinations **Electromagnetism** - **[P5G]** investigate and describe the relationship between electric and	Chapters 20 - 26 - Potential Difference - Current - Resistance - Ohm's Law - Watt's Law - Series vs. Parallel Circuits - Magnetic Fields - Magnetic Forces - Relationship between	Lab: Online Simulation of Simple Circuits Lab: Series and Parallel Circuits Lab: Magnetic Fields & EM Induction Lab: Radioactive Decay Practical Lab: Create an electromagnet, a motor,	25

magnetic fields in applications such as generators, motors, and transformers **Modern Physics** - **[P5H]** describe evidence for and effects of the strong & weak nuclear forces in nature - **[P8C]** describe the significance of mass-energy equivalence & apply it in explanations of phenomena such as nuclear stability, fission, & fusion - **[P8D]** give examples of applications of atomic & nuclear phenomena such as radiation therapy, diagnostic imaging, & nuclear power and examples of applications of quantum phenomena such as digital cameras **Extension Research** - **[P3D]** explain the impacts of the scientific contributions of a variety of historical & contemporary scientists on scientific thought & society - **[P3E]** research and describe the connections between physics & future careers	moving charges and magnetism - Electromagnetic Induction - Motors & Generators - Transformers - Radioactive Decay, Nuclear Energy - Strong/Weak Nuclear Forces - Mass-Energy Equivalence - Historical Research - Career Research	or a generator <u>Project:</u> Research a Historical Figure in Physics *or* Research Physics Careers	