PHYSICS - GRADE 12

COMMON CORE STATE STANDARDS AND VIRGINIA SOL ADDITIONS

Church Hill Preparatory Academy

CONTENT AREA: SCIENCE - PHYSICS

Students build on basic physical science principles by exploring, in-depth, the nature and characteristics of energy and its dynamic interaction with matter. Key areas covered by the standards include force and motion, energy transformations, wave phenomena and the electromagnetic spectrum, electricity, fields, and non-Newtonian physics. The standards stress the practical application of physics in other areas of science, technology, engineering and mathematics. The effects of physics on our world are investigated through the study of critical, contemporary global topics.

The Physics standards continue to focus on student growth in understanding the nature of science. This scientific view defines the idea that explanations of nature are developed and tested using observation, experimentation, models, evidence, and systematic processes. The nature of science includes the concepts that scientific explanations are based on logical thinking; are subject to rules of evidence; are consistent with observational, inferential, and experimental evidence; are open to rational critique; and are subject to refinement and change with the addition of new scientific evidence. The nature of science includes the concept that science can provide explanations about nature and can predict potential consequences of actions, but cannot be used to answer all questions.

Physics - Anchor Standards

PH. 1 The student will plan and conduct investigations using experimental design and product design processes.

PH.2 The student will investigate and understand how to analyze and interpret data. Key

PH.3 The student will investigate and demonstrate an understanding of the nature of science, scientific reasoning, and logic. Key concepts include

PH.4 The student will investigate and understand how applications of physics affect the world.

PH.5 The student will investigate and understand the interrelationships among mass, distance, force, and time through mathematical and experimental processes.

PH.6 The student will investigate and understand that quantities including mass, energy, momentum, and charge are conserved.

PH.7 The student will investigate and understand that energy can be transferred and transformed to provide usable work.

PH.8 The student will investigate and understand wave phenomenon.

PH.9 The student will investigate and understand that different frequencies and wavelengths in the electromagnetic spectrum are phenomena ranging from radio waves through visible light to gamma radiation Key concepts include:

PH.10 the student will investigate and learn to use the field concept to describe the effects of gravitational, electric, and magnetic forces. Key concepts include:

PH.11 The student will investigate and understand how to diagram, construct, and analyze basic electrical circuits and explain the function of basic circuit components. Key concepts include:

PH.12 The student will investigate and understand that extremely large and extremely small quantities are not necessarily described by the same laws as those studied in Newtonian physics. Key concepts include:

PH. 1 The student will plan and conduct investigations using experimental design and product design processes. Key concepts include:

PH.1a the components of a system are defined;

PH.1b appropriate instruments are selected and used to measure and record position , time, mass, force, volume, temperature, motion, fields, and electric current and potential, using appropriate technology. Determine accuracy of measurement by comparing the experimental averages and the theoretical value. Determine precision of measurement using range or standard deviation.

PH.1c information is recorded and presented in an organized format. Use tables, graphs, and spreadsheets to interpret, organize, and clarify experimental observations, possible explanations, and models for phenomena being observed.

PH.1d The limitations of the experimental apparatus and design are recognized. Follow safe practices in all laboratory procedures.

PH.1e the limitations of measured quantities are recognized through the appropriate use

of significant figures or error ranges. Complete all measurements with a statement about its uncertainty.

PH.1f models and simulations are used to visualize and explain physical phenomena, to make predictions from hypotheses; and to interpret data;

PH.1g appropriate technology, including computers, graphing calculators, and probe ware, is used for gathering and analyzing data and communicating results. Draw conclusions and provide reasoning using supporting data.

PH.2 The student will investigate and understand how to analyze and interpret data.

PH.2a Understand mathematics as a tool to model and describe phenomena. Physical phenomena or events can often be described in mathematical terms as an equation or inequality. A description of a physical problem is translated into a mathematical statement in order to find a solution. The student will recognize linear and nonlinear relationships from graphed data.

PH.2b Graphing and dimensional analysis are used to reveal relationships and other important features of data. Predictions are made from trends based on data. Relationships between physical quantities are determined using the shape of a curve passing through experimentally obtained data. Where appropriate the student will draw a straight line through a set of data points and determine the slope and/or area under the curve. The shape of the curve fit to experimentally obtained data is used to determine the relationship of the plotted quantities. The area under the curve is used to determine related physical quantities.

PH.2c The slope of a linear relationship is calculated and includes appropriate units. Use dimensional analysis to verify appropriate units. Understand that not all experimental data follow a linear relationship.

PH.2d interpolated, extrapolated, and analyzed trends are used to make predictions; and

PH.2e Use trigonometry to combine quantities which cannot be added arithmetically. In situations with vector quantities, combine vectors into resultants utilizing trigonometrical or graphical methods. Also, resolve vectors into components.

PH.3 The student will investigate and demonstrate an understanding of the nature of science, scientific reasoning, and logic including the following concepts: 1) the natural world is understandable; 2) science is based on evidence - both observational and experimental; 3) science is a blend of logic and innovation; 4) scientific ideas are durable yet subject to change as new data are collected; 5) science is a complex social endeavor; 6) scientists try to remain objective and engage in peer review to help avoid bias.

PH.3a Conduct an analysis of scientific sources to develop and refine research hypotheses. Learn that experimentation may support a hypothesis, falsify it, or lead to new discoveries. The hypothesis may be modified.

PH.3b analysis of how science explains and predicts relationships;

PH.3c evaluation of evidence for scientific theories;

PH.3d examination of how new discoveries result in modification of existing theories or establishment of new paradigms. Identify examples of a paradigm shift (e.g., quantum mechanics). Identify examples of a paradigm shift (e.g., quantum mechanics).

PH.3e construction and defense of a scientific viewpoint.

PH.4 The student will investigate and understand how applications of physics affect the world.

PH.4a Develop an awareness of real-world applications of physics and the impact of the discipline on advancements in communications, medicine, engineering, transportations, commerce, exploration, and technology.

PH.4b Use journals, books, the Internet, and other sources to explore the roles and contributions of science and technology.

PH.5 The student will investigate and understand the interrelationships among mass, distance, force, and time through mathematical and experimental processes.

PH.5a Explore the concepts of motion, velocity, force, and acceleration.

PH.5b Newton's 3 laws of motion as the basis for understanding the mechanical universe. Solve problems involving force, mass, and acceleration.

PH.5c Linear motion. Construct linear motion graphs to analyze displacement (d) vs. time (t); velocity (v) vs. time (t); acceleration (a) vs. time (t)

PH.5d Solve problems involving displacement, velocity, acceleration, and time in one and two dimensions (only constant acceleration). Study position, displacement, velocity, and acceleration as vector qualities.

PH.5e Resolve vector diagrams involving displacement and velocity into their components along perpendicular axes.

PH.5f Projectile motion. Draw vector diagrams of a projectile's motion. Find range, trajectory, height of the projectile, and time of flight (uniform gravitational field, no air resistance.)

PH.5g Distinguish between centripetal and centrifugal force.

PH.5h Solve problems related to free-falling objects, including 2-D motion.

PH.5i Gravitation. Solve problems using Newton's Law of Universal Gravitation and planetary motion.

PH.5j Solve problems involving multiple forces, using free body diagrams.

PH.5k Uniform circular motion. Describe the forces involved in circular motion.

PH.5l Discover the forces of work, power, and energy.

PH.6 The student will investigate and understand that quantities including mass, energy, momentum, and charge are conserved.

PH.6a Kinetic and potential energy. How energy can be converted from potential energy to kinetic energy and vice versa.

PH.6b Elastic and inelastic collisions

PH.6c Mass energy equivalence

PH.6d Linear momentum as the product of mass and velocity, is conserved in a closed system.

PH.7 The student will investigate and understand that energy can be transferred and transformed to provide usable work.

PH.7a Illustrate that energy can be transformed from one form to another using examples from everyday life and technology. Study the transfer and storage of energy among systems including mechanical, thermal, gravitational, electromagnetic, chemical, and nuclear systems.

PH7.b Calculate efficiency of systems by identifying the useful energy in a process.

PH.7c Qualitatively identify the various energy transformations in simple demonstrations.

PH.8 The student will investigate and understand wave phenomenon.

PH.8a Wave characteristics. Explore mechanical waves, transverse waves (light), longitudinal waves (sound), the pendulum and harmonic motion, Doppler effect, and reflection.

PH.8b Light and sound in terms of wave models. Identify and differentiate between examples of transverse and longitudinal waves using simulations and or models. Wave frequency and pitch of a note and volume of sound. Wave frequency and color and intensity of light. Polarization of light waves.

PH.8c Fundamental wave processes. Solve problems involving frequency, period, wavelength, and velocity. Distinguish between superimposed waves that are in-phase and those that are out-of-phase. Graphically illustrate reflection and refraction and constructive and destructive interference. Understand diffraction.

PH8.d Identify a standing wave using a string.

PH.9 The student will investigate and understand that different frequencies and wavelengths in the electromagnetic spectrum are phenomena ranging from radio waves through visible light to gamma radiation.

PH.9a The properties, behaviors, and relative size of radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, and gamma rays.

PH.9b Wave/particle dual nature of light

PH.9c Describe the Doppler Effect.

PH.9d current applications based on the respective wavelengths. Long wavelength-low frequency portion of the electromagnetic spectrum and communication (e.g. radio, TV, cellular phone). Medium wavelengths (infrared) and heating and remote control.

PH.10 the student will investigate and learn to use the field concept to describe the effects of gravitational, electric, and magnetic forces.

PH.10a Study the inverse square laws (Newton's law of universal gravitation and Coulomb's law). Describe the electrostatic attractive and repulsive forces between objects relative to their forces and distance between them (Coulomb's Law). Describe the attraction of particles (Newton's Law of Universal Gravitation).

PH10.b Describe the effect of a uniform magnetic field on a moving electrical charge.

PH.10c Technological applications.

PH.11 The student will investigate and understand how to diagram, construct, and analyze basic electrical circuits and explain the function of basic circuit components.

PH.11a Comprehend the concepts of current and voltage.

PH.11a Ohm's law

PH.11b Recognize series, parallel, and combined circuits and apply Ohms law.

PH.11c Electrical power. Calculate the dissipate power of a circuit element, Recognize that DC power is supplied by batteries and that AC power is supplied by electrical wall sockets.

PH.11d Alternating (AC) and direct (DC) currents.

PH.12 The student will investigate and understand that extremely large and extremely small quantities are not necessarily described by the same laws as those studied in Newtonian physics. Key concepts include:

PH.12a wave/particle duality;

PH.12b wave properties of matter

PH.12c matter/energy equivalence;

PH.12d quantum mechanics and uncertainty and the Heisenberg uncertainty principle.

PH.12e Relativity. The theory of relativity and the motion of objects traveling near or approaching the speed of light.

PH.12f nuclear physics, fission and fusion. Describe the structure of the atomic nucleus, including quarks.

PH.12g Describe the Big Bang theory timeline and particle physics.

PH.12g solid state physics;

PH.12h nanotechnology. Provide examples of technology used to explore the nanoscale.

PH.12i superconductivity; and

PH.12j radioactivity, natural radioactivity, gamma rays, and radioactive decay.

PH.12k Examples of technologies used to explore the nanoscale.