Curriculum & Pacing Guide

Physics

Martinsville City Public Schools

Revised Summer 2011 by Teresa Davis

Martinsville City Public Schools *Curriculum* & *Pacing* Guide

Content: *Physics* **Grade Level: *9-12***

Martinsville City Public Schools' Instructional Plan of Action

The Curriculum Guides represent **Martinsville City Public Schools' Curriculum**, which is based on the ***Standards of Learning for Virginia Public School*** and the **State Curriculum Framework**. In order for curriculum to be effective, it must be composed of three important components: written curriculum, taught curriculum, and assessed curriculum. Each of these components must be aligned to ensure learning at its highest level. The Curriculum Guides are a starting point in this process.

The Written Curriculum: The written curriculum consists of the **Curriculum Guide** used in conjunction with the **State Curriculum Frameworks**. The Curriculum Guide provides information on which standards are taught during a given grading period, the essential vocabulary for direct instruction in that standard, the understandings students should gain from instruction in the standard, and the expected student outcomes for this standard. The next step in this process is to study the Curriculum Framework for the identified standard. The Curriculum Framework provides instructional details for how instruction on this standard should look in the classroom.

The Taught Curriculum: The Curriculum Framework helps the teacher "unpack" the written curriculum for aligned "taught curriculum." It does this by providing the definitions to use in direct vocabulary instruction, content details, and details on instructional strategies to use. The instructional strategy details include explanations of specific instructional methodologies and names instructional tools such as manipulatives and graphic organizers. Using the definitions, methodologies, content details, and instructional tools provided by the Curriculum Framework will ensure alignment in between the written, taught curriculum, and assessed curriculum.

The Assessed Curriculum: Formative assessment is an integral and ongoing part of the instruction process and occurs on a formal and informal basis at many levels. Teachers use informal assessment throughout the learning to check for student understanding formal common assessments to assess student mastery and plan interventions. Another level of formal assessment is the division benchmark assessment, which has as its primary purpose to help the adults know how to adjust instruction for student success. The final level of assessment is the ***Virginia Standards of Learning Tests***, which are based on the ***Standards of Learning for Virginia Public Schools*** and the **Curriculum Frameworks**. Martinsville City Public Schools provides many tools to assist our teachers and administrators in assessment and disaggregation of assessment data. Teachers have access to tools such as **Tests for Higher Standards**, **ExamView** at grades two through twelve, **PALS** phonological awareness and literacy screening for preK through third grade, **STAR** reading assessment at grades two through twelve, and **Algebra Readiness Diagnostic Tests** for grades five through twelve. Also, teachers have access to **Reports Online Systems** for analyzing data from classroom assessments and benchmark assessments. All of this is an integral part of Martinsville's commitment to "**Learning for all; Whatever it takes**."

Content: *Physics* **Grade Level: *9-12***

Pacing / Time Frame	Unit 1 Nature of Science	Essential Vocabulary	Technology Resources	Print Resources	Instructional notes
Unit 1: Nature of Science **6 Weeks**	PH.1 The student will plan and conduct investigations using experimental design and product design processes. Key concepts include a) the components of a system are defined; b) instruments are selected and used to extend observations and measurements; c) information is recorded and presented in an organized format; d) the limitations of the experimental apparatus and design are recognized; e) the limitations of measured quantities are recognized through the appropriate use of significant figures or error ranges; f) models and simulations are used to visualize and explain phenomena, to make predictions from hypotheses, and to interpret data; and g) appropriate technology, including computers, graphing calculators, and probeware, is used for gathering and analyzing data and communicating results. **In order to meet this standard, it is expected that students will** • measure and record position, time, mass, force, volume, temperature, motion, fields, and electric current and potential, using appropriate technology.	System Components Observation Measurement Investigation Experimental Design Instrument Extend Format Limitation Quality Significant Figure Error Simulation Visualize Phenomena Predict Hypothesis Intrepret	**Laying the Foundation** www.layingthefoundation.org Middle School Physics - Changing Motion Physics: -Carts and Ramps -Constant Velocity	**Glencoe Lab Manual** 1-1 Bubble Up 2-1 Measuring Length 2-2 Measuring Temperature **Modern Physics Labortatory Experiments** 2a Units of Measure 2b Making and Recording Measurements **Hands-On Physics Activities** 1.1.1 Dimensions	Use LTF activities for laboratory activities Middle School Physics activities are found on LTF site and are good for Applied Physics High School Physics activities are found on LTF site and are better for advanced physics.

Content: *Physics* **Grade Level: *9-12***

Pacing / Time Frame	Unit 1 Nature of Science	Essential Vocabulary	Technology Resources	Print Resources	Instructional notes
Unit 1: Nature of Science **6 Weeks**	• determine accuracy of measurement by comparing the experimental averages and the theoretical value. • determine precision of measurement using range or standard deviation. • follow safe practices in all laboratory procedures. • use simulations to model physical phenomena. • draw conclusions and provide reasoning using supporting data. PH.2 The student will investigate and understand how to analyze and interpret data. Key concepts include a) a description of a physical problem is translated into a mathematical statement in order to find a solution; b) relationships between physical quantities are determined using the shape of a curve passing through experimentally obtained data; c) the slope of a linear relationship is calculated and includes appropriate units; d) interpolated, extrapolated, and analyzed trends are used to make predictions; and e) situations with vector quantities are analyzed utilizing trigonometric or graphical methods. **In order to meet this standard, it is expected that students will** • recognize linear and nonlinear relationships from graphed data. • where appropriate, draw a straight line through a set of experimental data points and determine the slope and/or area under the curve.	Data Position Mass Force Volume Temperature Motion Field Current Potential Accuracy Theoretical Precision Standard Deviation Procedure Solution Determine Curve Obtain Slope Linear Interpolated Extrapolated Analyze	**Laying the Foundation** www.layingthefoundation.org Middle School Physics: -The Hiker Lab -Position vs Time Graphs -Velocity vs Time Graphs -Vector Scavenger Hunt -Barbee Bungee Jumping Physics: -Graphing Motion -Graph Match -Kinematics Vector Exercises -Map of Texas	**Holt Laboratory Experiments** Discovery Lab 1-Circumference Diameter Ratio of a Circle	Use LTF activities for laboratory activities Middle School Physics activities are found on LTF site and are good for Applied Physics High School Physics activities are found on LTF site and are better for advanced physics.

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Pacing / Time Frame	Unit 1 Nature of Science	Essential Vocabulary	Technology Resources	Print Resources	Instructional notes
Unit 1: Nature of Science **6 Weeks**	• use dimensional analysis to verify appropriate units. • combine vectors into resultants utilizing trigonometric or graphical methods. • resolve vectors into components utilizing trigonometric or graphical methods. PH.3 The student will investigate and demonstrate an understanding of the nature of science, scientific reasoning, and logic. Key concepts include a) analysis of scientific sources to develop and refine research hypotheses; b) analysis of how science explains and predicts relationships; c) evaluation of evidence for scientific theories; d) examination of how new discoveries result in modification of existing theories or establishment of new paradigms; and construction and defense of a scientific viewpoint. **In order to meet this standard, it is expected that students will** • identify and explain the interaction between human nature and the scientific process. • identify examples of a paradigm shift (e.g., quantum mechanics).	Trigonometry Nonlinear Area Verify Vector Resultants Components Refine Paradigm Evaluate Modification	**See page 3**	**See page 3**	**See page 3**

Unit 1: Nature of Science **6 Weeks** ***End Unit One***	**Nature of Science cont.** PH.4 The student will investigate and understand how applications of physics affect the world. Key concepts include a) examples from the real world; and b) exploration of the roles and contributions of science and technology. **In order to meet this standard, it is expected that students will** • be aware of real-world applications of physics, and the importance of physics in the advancement of various fields, such as medicine, engineering, technology, etc.	**See page 4**	**See page 3**	**See page 3**	**See page 3**

Content: *Physics* **Grade Level: *9-12***

Pacing / Time Frame	Unit 2 Mechanics	Essential Vocabulary	Technology Resources	Print Resources	Instructional notes
Unit 2: Mechanics **6 Weeks**	PH.5 The student will investigate and understand the interrelationships among mass, distance, force, and time through mathematical and experimental processes. Key concepts include a) linear motion; b) uniform circular motion; c) projectile motion; d) Newton's laws of motion; e) gravitation; f) planetary motion; and g) work, power, and energy. **In order to meet this standard, it is expected that students will** • qualitatively explain motion in terms of Newton's Laws. • solve problems involving force (F), mass (m), and acceleration (a). • construct and analyze displacement (d) vs. time (t), velocity (v) vs. time (t), and acceleration (a) vs. time (t) graphs. • solve problems involving displacement, velocity, acceleration, and time in one and two dimensions (only constant acceleration). • resolve vector diagrams involving displacement and velocity into their components along perpendicular axes. • 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). • distinguish between centripetal and centrifugal force.	Mass Distance Force Time Linear Motion Uniform Circular Projectile Newton Gravitation Planetary Work Power Energy Displacement Graph Acceleration Velocity Dimension Vector Diagram Perpendicular Range Trajectory	**Laying the Foundation** www.layingthefoundation.org Middle School Physics: -Hiker Lab -Position vs Time Graphs -Velocity vs Time Graphs -Solving Problems Involving Vectors -Changing Motion -Centripetal Force -Running the Stairs Physics: -Acceleration on a Ramp -Cart Ramps -The Atwood Machine	**Holt Laboratory Experiments** Discovery Lab 2: Motion Lab 4: Discovering Newton's Laws Lab 5: Exploring Work and Energy Lab 5 Invention Lab: Bungee Jumping Energy Lab 7: Circular Motion	Use LTF activities for laboratory activities Middle School Physics activities are found on LTF site and are good for Applied Physics High School Physics activities are found on LTF site and are better for advanced physics.

Content: *Physics* **Grade Level: *9-12***

Pacing / Time Frame	Unit 2 Mechanics *cont.*	Essential Vocabulary	Technology Resources	Print Resources	Instructional notes
Unit 2: Mechanics **6 Weeks** ***End Unit Two***	• solve problems related to free-falling objects, including 2-D motion. • solve problems using Newton's Law of Universal Gravitation. • solve problems involving multiple forces, using free-body diagrams. • solve problems involving mechanical work, power, and energy. • describe the forces involved in circular motion.	**Range** **Height** **Distinguish** **Centripetal** **Centrifugal** **Free-Falling Object** **Free-Body** **Mechanical**	**Laying the Foundation** www.layingthefoundation.org Physics: -The Dart Gun -Sizzle and Slice - Newton's Second Law -Relationships -Projectile Motion -Rollercoaster -Vector Analysis	**Glencoe Lab Manual** 5-1 Accelerated Motion 7-1 Projectile Motion 7-2 Range of a Projectile **Hands-On Physics Activities** 2.2.2 Newton's First Law 2.3.1 Acceleration Due to Gravity 2.3.6 Projectile and Target 3.1.3 Newton's 2nd Law 3.1.4 Newton's 3rd Law 3.1.5 Centripetal	**See page 6**

Content: *Physics* **Grade Level: *9-12***

Pacing / Time Frame	Unit 3 Energy, Work and Mechanics	Essential Vocabulary	Technology Resources	Print Resources	Instructional notes
Unit 3: Energy, Work and Mechanics **4 Weeks** ***End Unit Three***	PH.6 The student will investigate and understand that quantities including mass, energy, momentum, and charge are conserved. Key concepts include a) kinetic and potential energy; b) elastic and inelastic collisions; and c) mass/energy equivalence. **In order to meet this standard, it is expected that students will** • provide and explain examples of how energy can be converted from potential energy to kinetic energy and the reverse. • provide and explain examples showing linear momentum is the product of mass and velocity, and 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. Key concepts include a) transfer and storage of energy among systems including mechanical, thermal, gravitational, electromagnetic, chemical, and nuclear systems; and b) efficiency of systems. **In order to meet this standard, it is expected that students will** • illustrate that energy can be transformed from one form to another, using examples from everyday life and technology. • calculate efficiency by identifying the useful energy in a process. • qualitatively identify the various energy transformations in simple demonstrations.	Kinetic Potential Energy Momentum Quantity Charge Conserved Elastic Inelastic Collision Mass Converted Linear Closed System Transferred Transformed Storage Thermal Gravitational Electromagnetic Chemical Nuclear Efficiency Qualitative Various	**Laying the Foundation** www.layingthefoundation.org Physics: -Coefficient of Friction - Electrical Equivalent of Heat -Rollercoaster! -Running the Stairs	**Holt Laboratory Experiments** Discovery Lab 10: Temperature and Internal Energy Invention Lab 10: Thermal Conduction **Hands-On Physics Activities** 5.2.1 Magnetic Potential Energy 5.2.2 Kinetic Energy 5.2.3 Conversion of Potential and Kinetic Energy 5.2.4 Conservation of Energy	

Content: *Physics* **Grade Level: *9-12***

Pacing / Time Frame	Unit 4 Waves	Essential Vocabulary	Technology Resources	Print Resources	Instructional notes
Unit 4: Waves **4 Weeks**	PH.8 The student will investigate and understand wave phenomena. Key concepts include a) wave characteristics; b) fundamental wave processes; and c) light and sound in terms of wave models. **In order to meet this standard, it is expected that students will** • identify examples of and differentiate between transverse and longitudinal waves, using simulations and/or models. • illustrate period, wavelength, and amplitude on a graphic representation of a wave. • 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 of a wave when it encounters a change in medium or a boundary. • graphically illustrate constructive and destructive interference. • identify a standing wave, using a string.	Wave Characteristic Fundamental Sound Light Differentiate Transverse Longitudinal Simulation Period Wavelength Amplitude Graphic Frequency Velocity Distinguish Superimposed In-phase Out-of-phase Illustrate Reflection Refraction Medium Encounter Boundary Dual	**Laying the Foundation** www.layingthefoundation.org Physics: - Bright Line Spectra -Ripple Tank -The Science of Light and Color -Speed of Sound - Speed of Sound II - Waves in a Spring - Waves in a String Middle School Physics: -Standing Waves -Sound	**Holt Laboratory Experiments** Discovery Lab 12: Pendulums and Spring Waves Lab 13: Resonance and the Nature of Sound Invention Lab 13: Building a Musical Instrument Lab 15: Refraction and Lenses	

Content: *Physics* **Grade Level: *9-12***

Pacing / Time Frame	Unit 4 Waves	Essential Vocabulary	Technology Resources	Print Resources	Instructional notes
Unit 4: Waves **4 Weeks** ***End Unit 4***	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 a) the properties, behaviors, and relative size of radio waves, microwaves, infrared, visible light, ultraviolet, X-rays, and gamma rays; b) wave/particle dual nature of light; and c) current applications based on the respective wavelengths. **In order to meet this standard, it is expected that students will** • describe the change in observed frequency of waves due to the motion of a source or a receiver (the Doppler effect). • identify common uses for radio waves, microwaves, X-rays and gamma rays.	Spectrum Visible Gamma Radiation Observed Reciver Source Radio Microwave X-ray	**Laying the Foundation** www.layingthefoundation.org	**Hands-On Physics Activities** 6.1.1 Wave Characteristics 6.1.2 Transverse & Longitudinal Waves 6.1.3 Superposition 6.1.4 Standing Waves 6.2.1 Sound Is Caused by Vibration 6.2.3 Sound Is a Form of Energy 6.4.2 Doppler Effect 6.4.3 Determining the Wavelength of Sound	

Content: *Physics* **Grade Level: *9-12***

Pacing / Time Frame	Unit 5 Electricity and Magnetism	Essential Vocabulary	Technology Resources	Print Resources	Instructional notes
Unit 5: Electricity and Magnetism **6 weeks**	PH.10 The student will investigate and understand how to use the field concept to describe the effects of gravitational, electric, and magnetic forces. Key concepts include a) inverse square laws (Newton's law of universal gravitation and Coulomb's law); and b) technological applications. **In order to meet this standard, it is expected that students will** • describe the attractive or 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). • describe the effect of a uniform magnetic field on a moving electrical charge. PH.11 The student will investigate and understand how to diagram, construct, and analyze basic electrical circuits and explain the function of various circuit components. Key concepts include a) Ohm's law; b) series, parallel, and combined circuits; c) electrical power; and d) alternating and direct currents. **In order to meet this standard, it is expected that students will** • recognize a series and a parallel circuit. • apply Ohm's law to a series and a parallel circuit.	Gravitational Electric Magnetic Inverse Square Law Coulomb's Law Application Attractive Repulsive Relative Distance Particles Electrical Charge Ohm's Law Circuit Function Component Diagram Series Parallel Power Alternating Current Direct Current	**Laying the Foundation** www.layingthefoundation.org Middle School Physics: -Introduction to Electric Circuits -Electric Circuits -Circuits -Circuits Worksheet I -Circuits Worksheet II Physics: -Paths of Resistance -RC Circuit	**Holt Laboratory Experiments** Discovery Lab17: Charges and Electrostatics Lab 20: Exploring Circuit Elements Investigation Lab 20: Designing a Dimmer Switch Lab 21: Magnetism Lab 22: Electricity and Magnetism	

Content: *Physics* **Grade Level: *9-12***

Pacing / Time Frame	Unit 5 Electricity and Magnetism	Essential Vocabulary	Technology Resources	Print Resources	Instructional notes
Unit 5: Electricity and Magnetism **6 weeks** ***End Unit Five***	• assemble simple circuits composed of batteries and resistors in series and in parallel. • solve simple circuits using Ohm's law. • calculate the dissipated power of a circuit element. • recognize that DC power is supplied by batteries and that AC power is supplied by electrical wall sockets.	DC Power AC Power Dissipated Simple Circuit Battery Resistor Socket	**Laying the Foundation** www.layingthefoundation.org	**Glencoe Lab Manual** 24-1 The Nature of Magnetism **Hands-On Physics Activities** 8.2.1 Electric Current 8.2.4 Cells in Series and Parallel 8.2.5 Ohm's Law 8.2.7 Series and Parallel Circuits 8.3.4 Magnetic Fields 8.4.1 Electromagnetic Fields	

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Pacing / Time Frame	Unit 6 Modern Physics	Essential Vocabulary	Technology Resources	Print Resources	Instructional notes
Unit 6: Modern Physics **5 Weeks**	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 may include a) wave/particle duality; b) wave properties of matter; c) matter/energy equivalence; d) quantum mechanics and uncertainty; e) relativity; f) nuclear physics; g) solid state physics; h) nanotechnology; i) superconductivity; and j) radioactivity. In order to meet this standard, it is expected that students will • explain that the motion of objects traveling near or approaching the speed of light does not follow Newtonian mechanics but must be treated within the theory of relativity. • describe the relationship between the Big Bang theory timeline and particle physics. • describe the structure of the atomic nucleus, including quarks. • provide examples of technologies used to explore the nanoscale.	Extremely Quantity Newtonian Duality Properties Matter Quantum Mechanics Uncertainty Relativity Nuclear Physics Solid State Physics Nanotechnology Superconductivity Radioactivity Theory Speed Big Bang Theory Quarks Atomic Nucleus	**Laying the Foundation** www.layingthefoundation.org Physics: -Blackbody Radiation -Bubble Chamber -Conservation Laws -Half Life and Nuclear Decay Reactions -Nuclear Physics -Seeing the Unseen -Vector Analysis and the Physics of Blood Spatter		