# Conceptual Physics Scope and Sequence

| Grading Period | Unit Title | Learning Targets |
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| **Throughout the School Year** | | B.(1) Scientific processes. The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:<br>(A) demonstrate safe practices during laboratory and field investigations, including chemical, electrical, and fire safety, and safe handling of live and preserved organisms; and<br>(B) demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.<br>B.(2) Scientific processes. The student uses scientific methods during laboratory and field investigations. The student is expected to:<br>(A) know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section;<br>(B) know that scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;<br>(C) know that scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly-reliable explanations, but they may be subject to change as new areas of science and new technologies are developed;<br>(D) distinguish between scientific hypotheses and scientific theories;<br>(E) plan and implement investigative procedures, including asking questions, formulating testable hypotheses, and selecting, handling, and maintaining appropriate equipment and technology;<br>(F) collect data individually or collaboratively, make measurements with precision and |

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| | accuracy, record values using appropriate units, and calculate statistically relevant quantities to describe data, including mean, median, and range;<br>(G) demonstrate the use of course apparatuses, equipment, techniques, and procedures;<br>(H) organize, analyze, evaluate, build models, make inferences, and predict trends from data;<br>(I) perform calculations using dimensional analysis, significant digits, and scientific notation; and<br>(J) communicate valid conclusions using essential vocabulary and multiple modes of expression such as lab reports, labeled drawings, graphic organizers, journals, summaries, oral reports, and technology-based reports.<br>B.(3) Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:<br>(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;<br>(B) communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;<br>(C) draw inferences based on data related to promotional materials for products and services;<br>(D) evaluate the impact of research and technology on scientific thought, society, and the environment;<br>(E) describe the connection between aquatic science and future careers; and<br>(F) research and describe the history of aquatic science and contributions of scientists. | |
| **First Grading Period** | Un-Accelerated Motion | ○ Identify a scalar quantity.<br>○ Identify a vector quantity.<br>○ Define, describe, and calculate distance, position and displacement.<br>○ Calculate the speed and/or average speed of an object.<br>○ Calculate the velocity of an object.<br>○ Determine the relative speed of an object. |
| | 1D Horizontal Kinematics | ○ Calculate the acceleration of an object.<br>○ Use the kinematic equations to solve problems involving one-dimensional horizontal motion with constant acceleration.<br>○ Create and interpret graphs (position v time, velocity v time, and acceleration v time) to describe the motion of moving object. |

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| | **1D Vertical Kinematics** | ○ Use the kinematic equations to solve problems involving objects in free-fall with constant acceleration.<br>○ Create and interpret graphs (position v time, velocity v time, and acceleration v time) to describe the motion of moving object. |
| **First Grading Period** | Vectors | ○ Describe a quantity in terms of its magnitude and direction.<br>○ Resolve a vector into its x- and y-components. |
| | 2D Kinematics | ○ Use the kinematic equations to solve problems involving two-dimensional motion with constant (or zero) acceleration.<br>○ Solve projectile motion problems with only an initial horizontal velocity.<br>○ Solve projectile motion problems with a two-dimensional initial velocity.<br>○ Create and interpret graphs (position v time, velocity v time) to describe the motion of moving object. |
| | Newton's Laws | ○ Identify Newton's three laws of motion.<br>○ Solve force problems using kinematics<br>○ Create and interpret graphs (force v acceleration, force v mass, mass v acceleration) to describe the force or acceleration experienced by an object. |
| **Second Grading Period** | 1D Forces | ○ Draw a free body force diagram for an object.<br>○ Write and solve net force equations to find unknown forces, accelerations, and masses for single objects. |
| | 1D Forces with Friction | ○ Perform calculations involving friction for objects moving across a rough surface.<br>○ Determine if a stationary object will move when pushed/pulled across a rough surface. |

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| | 2D Forces | ○ Draw a resolved free body force diagram.<br>○ Perform calculations for objects experiencing a force in two dimensions. |
| **Second Grading Period** | Law of Universal Gravitation & Circular Motion | ○ Use Newton's Law of Universal Gravitation to calculate the force that one mass exerts on another.<br>○ Calculate the period and frequency of an object undergoing circular motion.<br>○ Perform calculations for an object undergoing circular motion. |
| | Conservation of Energy | ○ Identify the types of energy in a system.<br>○ Apply the law of conservation of energy to an isolated system.<br>○ Calculate the kinetic, potential, and elastic energy of a system.<br>○ Calculate the heat lost from a system due to friction. |
| | Work | ○ Write and solve equations to calculate the work, force, or displacement of an object.<br>○ Determine the amount of work required to change the energy of a system. |
| | Power | ○ Calculate power of a physical system using a variety of work and energy equations. |
| | Momentum and Impulse | ○ Calculate the total linear momentum of a system of objects.<br>○ Calculate impulse delivered to an object. |
| | Conservation of Momentum | ○ Apply the principle of conservation of linear momentum to analyze one-dimensional elastic and inelastic collisions.<br>○ Apply the principle of conservation of linear momentum to analyze one-dimensional explosions. |
| **Third Grading Period** | Gas Laws | ○ Use the combined gas law to qualitatively and quantitatively describe the properties of a gas under different conditions. |

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| | Fluids | ○ Define fluid.<br>○ Apply the relationship between pressure, force, and area for a fluid.<br>○ Apply the relationship between density, mass, and volume for a fluid.<br>○ Qualitatively explain Bernoulli's Principle and its ramifications. |
| | Heat/Temperature | Define and apply the following terms:<br>a. Heat<br>b. Thermal Equilibrium<br>c. Temperature<br>d. Internal Energy<br>e. Thermal Expansion/Contraction<br>f. Conduction<br>g. Convection<br>h. Radiation |
| | Heating Curves | ○ Use a heating curve to determine the equation for calculating the heat lost/gained by an object.<br>○ Describe warming/cooling processes as it relates to phase changes |
| **Third Grading Period** | Calorimetry | ○ Define specific heat and calculate heat lost/gained.<br>○ Calculate changes in heat due to mechanical work.<br>○ Calculate the heat transfer between objects. |
| | Intro to Thermodynamics | ○ Define and apply the following terms:<br>a. Thermodynamics<br>b. System<br>c. Zeroth law of thermodynamics<br>d. Work<br>○ Calculate the work done on/by a system |

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| **Third Grading Period** | First Law of Thermodynamics | ○ Define and apply the following terms:<br>a. First Law of Thermodynamics<br>b. Internal Energy<br>c. Thermodynamic Process<br>○ Calculate changes in internal energy of a system. |
| | Second Law of Thermodynamics | ○ Define and apply the following terms:<br>a. Second Law of Thermodynamics<br>b. Heat Engine<br>c. Entropy<br>○ Identify and describe different types of heat engines |
| | Efficiency | ○ Define and apply the following terms:<br>a. Efficiency<br>b. Absolute Zero<br>c. Ideal (Carnot) Efficiency<br>d. Actual Efficiency<br>○ Calculate the efficiency of a heat engine. |
| | Intro to Electrostatics | ○ Define and apply the following terms in relation to static charges:<br>a. Nucleus<br>b. Proton<br>c. Neutron<br>d. Electron<br>e. Conductor<br>f. Insulator<br>g. Friction<br>h. Conduction<br>i. Induction<br>j. Conservation of Charge<br>○ |
| | Electric Force | ○ Define Electric Force<br>○ Describe attraction and repulsion between different charges.<br>○ Apply Coulomb's Law to calculate the magnitude of the electric force between charges. |

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| **Fourth Grading Period** | Circuit Basics | ○ Identify components within a circuit.<br>○ Calculate how much charge flows in a given amount of time.<br>○ Perform calculations using Ohm's Law.<br>○ Identify or describe the difference between a series and a parallel circuit. |
| | Series Circuits | ○ Calculate the voltage and current for any resistor in a series circuit.<br>○ Calculate total resistance of a series circuit. |
| | Parallel Circuits | ○ Calculate the voltage and current for any resistor in a parallel circuit.<br>○ Calculate total resistance of a parallel circuit. |
| | Combination Circuits | ○ Identify a combination circuit.<br>○ Calculate the voltage and current for any resistor in a combination circuit.<br>○ Calculate total resistance of a combination circuit.<br>○ Use equivalent circuits to analyze a combination circuit. |
| | Power | ○ Calculate the power output of a resistor.<br>○ Rank resistors in terms of brightness.<br>○ Describe how the brightness of a circuit will change when resistors are added in series or parallel. |
| | Intro to Magnetism | ○ Define and apply the following terms:<br>a. Magnetism<br>b. Ferromagnetic<br>c. Domain Theory of Magnetism<br>d. Magnetic Poles |

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| **Fourth Grading Period** | Magnetic Fields | ○ Define a magnetic field<br>○ Calculate the strength of a magnetic field<br>○ Draw the magnetic field around Earth, bar magnets, or point charges<br>○ Using the right-hand rules, determine the direction of a magnetic field surrounding a wire. |
| | Magnetic Force | ○ Calculate the magnitude of the magnetic force acting on a charged particle moving through a magnetic field.<br>○ Calculate the magnitude of the force on a current carrying wire in a magnetic field.<br>○ Using the right hand rule, determine the direction of the magnetic force, field, or velocity of a charged particle |
| | Electromagnetism Concepts | ○ Define and apply the following terms in relation to electromagnetism<br>a. Lenz's Law<br>b. Solenoid<br>c. Motor<br>d. Generator<br>e. Transformer<br>○ Calculate the output voltage or current for a given power transformer. |
| | Intro to Waves | ○ Define and apply the following terms in relation to waves<br>a. Parts of a wave<br>b. Ways to classify waves<br>c. Wave Behaviors<br>d. Period<br>e. Frequency<br>○ Perform calculations using the wave equation |
| | Sound Waves | ○ Define and apply the different properties of sound waves<br>a. Resonance<br>b. Beat Frequency<br>c. Interference<br>d. Forced Vibration<br>e. Doppler Effect<br>f. Sonic Boom |

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| | | ○ Identify the limits of Human Hearing<br>○ Know the speed of sound and what variables affect it<br>○ Describe the effect of frequency and amplitude of a sound wave as it relates to pitch and loudness<br>○ Identify parts of a standing wave<br>a. |
| **Fourth Grading Period** | Electromagnetic Waves | ○ Define and apply the following terms in relation to electromagnetic waves<br>a. Electromagnetic Spectrum<br>b. Frequency<br>c. Wavelength<br>d. Energy<br>○ Organize the electromagnetic spectrum by frequency, wavelength or energy.<br>○ Use the wave equation to calculate the frequency and wavelength of a light wave. |
| | Intro to Light | ○ Sketch the direction of reflected and refracted rays.<br>○ Identify conditions under which total internal reflection will occur. |
| | Ray Diagrams | ○ Draw ray diagrams for<br>a. Plane mirrors<br>b. Convex lenses<br>○ Use a ray diagram to predict characteristics of the image formed.<br>○ Calculate the magnification of the image for lenses. |
| | Nuclear Physics | ○ Define and apply the following terms<br>a. Alpha decay<br>b. + Beta decay<br>c. – Beta decay<br>d. Gamma decay<br>e. Nuclear Fission<br>f. Nuclear Fusion |

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| | | g. Critical Mass<br>h. Chain Reaction<br>○ Use conservation of mass and charge to complete nuclear decay reactions.<br>○ Describe the Strong and Weak Nuclear Forces. |
| **Fourth Grading Period** | Modern Physics | ○ Identify the following scientists and identify their experiment<br>a. JJ Thomson<br>b. Ernst Rutherford<br>c. Neils Bohr<br>d. Bohr Model<br>e. Plum Pudding Model<br>f. Gold Foil Experiment<br>g. Cathode Ray Tube Experiment<br>h. Absorption Spectrum<br>i. Emission Spectrum<br>j. Photoelectric Effect<br>○ Explain the emission spectra produced by various atoms<br>○ Describe the photoelectric effect and the dual nature of light<br>○ Describe qualitatively how the number of photoelectrons and their maximum kinetic energy depend on the wavelength and intensity of the light striking the photosensitive surface. |