

**LITCHFIELD PUBLIC SCHOOLS**  
**Core Curriculum Scope and Sequence**  
**Physics Honors /12<sup>th</sup> grade**

	<b>CT Frameworks/ Standards</b>	<b>Content and Skill Objectives</b> Students will be able to:	<b>Assessments</b>	<b>Resources</b>
<b>Name of Unit</b> <b>Weeks</b>  <b>Newtonian Mechanics</b>  <b>16 weeks</b>	<p>Newton's laws predict the motion of most objects.</p> <p>When forces are balanced, no acceleration occurs; thus an object continues to move at a constant speed or stays at rest.</p> <p>The law <math>F = ma</math> is used to solve motion problems that involve constant forces.</p> <p>When one object exerts a force on a second object, the second object always exerts a force of equal magnitude and in the opposite direction.</p> <p>Applying a force to an object perpendicular to the direction of its motion causes the object to change direction.</p>	<p>Describe the motion of one object by measuring its position, direction and speed relative to another object.</p> <p>Describe the relationship between position, velocity and acceleration of the motion of a single particle in a straight line.</p> <p>Create and interpret a graphical analysis of motion in one dimension.</p> <p>Understand that changes in the speed and direction of an object are due to forces, which have magnitude and direction.</p> <p>Demonstrate an understanding of the relationship between force and acceleration and apply that understanding to problem solving.</p> <p>Name the four basic forces of nature.</p> <p>Students will name Newton's three laws of motion and display an understanding of their applications.</p> <p>Demonstrate an understanding of</p>	<p>RTP Lab 1 Introduction to Motion</p> <p>RTP Lab 2 Changing Motion</p> <p>RTP Lab 3 Force and Motion</p> <p>Inquiry Lab: Force Table</p> <p>Inquiry Lab: Projectile Motion</p>	

	<p>Circular motion requires the application of a constant force directed toward the center of the circle.</p>	<p>Vector Addition both graphically and analytically.</p> <p>Recognize the independence of perpendicular vector quantities.</p> <p>State the requirements for equilibrium.</p> <p>Resolve vectors into parallel and perpendicular components to solve inclined plane problems.</p> <p>Find the height and range of a projectile launched at an arbitrary angle if initial velocity and angle are given.</p> <p>Demonstrate an understanding of Periodic Motion, including Circular Motion and Simple Harmonic Motion.</p> <p>Understand that every object exerts a gravitational force on every other object.</p> <p>List Kepler's Laws of Planetary Motion and calculate periods and velocities of orbiting objects.</p> <p>Understand that gravitational force is proportional to both masses and the inverse square of the distance between the objects.</p> <p>Understand the conditions for translational and rotational equilibrium.</p>	<p>PwC Lab: Pendulum Periods</p> <p>Lab: Rotational Motion</p>	
--	---	--	--	--

<p><b>Energy and Momentum</b></p> <p><b>4 weeks</b></p>	<p>The laws of conservation of energy and momentum provide a way to predict and describe the movement of objects.</p> <p>Kinetic energy can be calculated by using the formula <math>E = (1/2)mv^2</math>.</p> <p>Changes in gravitational potential energy near Earth can be calculated by using the formula (change in potential energy) = mgh.</p> <p>Momentum is calculated as the product mv.</p> <p>Momentum is a separately conserved quantity different from energy.</p> <p>An unbalanced force on an object produces a change in its momentum.</p> <p>The principles of conservation of momentum</p>	<p>Solve problems balancing translational and rotational forces.</p> <p>Define momentum and impulse and use the momentum-impulse theorem to calculate changes in momentum.</p> <p>State the Law of Conservation of Momentum and use it in solving collision problems.</p> <p>Identify energy transformations that occur in various systems (e.g., biological, mechanical, geological) and recognize that heat is a by-product of all energy transformations.</p> <p>Classify various forms of energy as either kinetic or potential.</p> <p>Understand the relationship between work done and energy transferred.</p> <p>Students will understand the concept of mechanical advantage and use it correctly in solving problems involving simple machines.</p> <p>State the law of conservation of energy and use the law to solve problems.</p>	<p>Inquiry Lab: Momentum and Collisions</p>	
---	---	---	---	--

<p><b>Name of Unit</b> <b>Waves and Optics</b></p> <p><b>5 Weeks</b></p>	<p>and energy can be used to solve problems involving elastic and inelastic collisions.</p> <p>Waves have characteristic properties that do not depend on the type of wave.</p> <p>Waves carry energy from one place to another.</p> <p>Transverse and longitudinal waves exist in mechanical media, such as springs and ropes, and in the Earth as seismic waves.</p> <p>Wavelength, frequency and wave speed are related.</p> <p>Sound is a longitudinal wave whose speed depends on the properties of the medium in which it propagates.</p> <p>Radio waves, light and X-rays are different wavelength bands in the spectrum of electromagnetic waves, the speed of which in a vacuum is approximately <math>3 \times 10^8</math> m/s, and less when passing through other media.</p>	<p>Demonstrate the nature of different types of waves, how they are produced and how they transfer energy.</p> <p>Identify evidence that waves (e.g. light, sound, radiant) can transfer energy between two points.</p> <p>Demonstrate an understanding of Wave Properties in terms of Frequency, Wavelength, and Velocity</p> <p>Demonstrate knowledge of the nature of sound waves and the properties sound waves share with other waves.</p> <p>Solve problems relating the frequency, wavelength, and velocity of sound.</p> <p>Define the Doppler shift and identify some applications.</p> <p>State the Law of Reflection.</p> <p>Define refraction.</p> <p>State Snell's Law and be able to solve refraction problems.</p>	<p>Lab: Waves on a Snakey</p> <p>PwC Lab: Sound Waves and Beats</p>	
--	--	---	---	--

	<p>Waves have characteristic behaviors, such as interference, diffraction, refraction and polarization.</p> <p>Beats and the Doppler Effect result from the characteristic behavior of waves.</p>	<p>Relate index of refraction to speed of light in a medium.</p> <p>Analyze images in concave and convex mirrors using ray diagrams.</p> <p>Use the mirror equation to analyze images in concave and convex mirrors.</p> <p>Analyze images in concave and convex lenses using ray diagrams.</p> <p>Use the mirror equation to analyze images in concave and convex lenses.</p>		
<p><b>Name of Unit</b></p> <p><b>Fluid Mechanics, Heat, Kinetic Theory, and Thermodynamics</b></p> <p><b>5 Weeks</b></p>	<p>Energy cannot be created or destroyed although, in many processes, energy is transferred to the environment as heat.</p> <p>Heat flow and work are two forms of energy transfer between systems.</p> <p>The work done by a heat engine that is working in a cycle is the difference between the heat flow into the engine at high temperature and the heat flow out at a lower temperature.</p> <p>The internal energy of an</p>	<p>Describe the air as a mixture of gases including water vapor, and other liquid and solid particles.</p> <p>Recognize that air exerts pressure and expands and contracts in relation to temperature.</p> <p>Students will apply Pascal's, Archimedes' and Bernoulli's principles.</p>	<p>Lab: Boyle's Law</p>	

	<p>object includes the energy of random motion of the object's atoms and molecules. The greater the temperature of the object, the greater the energy of motion of the atoms and molecules that make up the object.</p> <p>Most processes tend to decrease the order of a system over time, so that energy levels eventually are distributed more uniformly.</p>			
<p><b>Name of Unit</b></p> <p><b>Weeks</b></p> <p><b>Electricity and Magnetism</b></p> <p><b>6 weeks</b></p>	<p>Electric and magnetic phenomena are related and have many practical applications.</p> <p>The voltage or current in simple direct current (DC) electric circuits constructed from batteries, wires, resistors and capacitors can be predicted using Ohm's law.</p> <p>Any resistive element in a DC circuit dissipates energy, which heats the resistor.</p> <p>The power in any resistive circuit element can be calculated by using the formula <math>Power = I^2R</math>.</p> <p>Charged particles are sources</p>	<p>Recognize that electric currents and magnets can exert a force on each other.</p> <p>State the difference between conductors and insulators.</p> <p>State Coulomb's Law and how the forces depend on charges and their separation.</p> <p>Understand the vector nature of the electrical force and use Coulomb's Law to solve problems.</p> <p>Define an electric field and explain how to measure it.</p> <p>Solve problems relating field, force and charge.</p>	<p>RTP Lab 1 Batteries, bulbs and current</p> <p>RTP Lab 2 DC Circuits</p> <p>RTP Lab 3 Voltage and Ohm's Law</p> <p>RTP Lab 4 Kirchkoff's Rules</p> <p>RTP Lab 5 Intro to RC Circuits</p> <p>PwC Exp 28 The Magnetic Field in a Coil</p> <p>PwC Exp 29 The Magnetic Field in a Slinky</p>	

	<p>of electric fields and are subject to the forces of the electric fields from other charges.</p> <p>Magnetic materials and electric currents (moving electric charges) are sources of magnetic fields and are subject to forces arising from the magnetic fields of other sources.</p> <p>Changing magnetic fields produce electric fields, thereby inducing currents in nearby conductors.</p> <p>Plasmas, the fourth state of matter, contain ions, or free electrons or both and conduct electricity.</p>	<p>Define the electric potential difference in terms of work done moving a unit test charge.</p> <p>Define capacitance, describe the principle of the capacitor, and solve capacitor problems.</p> <p>Understand that a complete circuit is necessary in order for current to flow.</p> <p>Draw circuits and recognize they are closed loops.</p> <p>Define resistance and solve problems involving current, potential difference and power.</p> <p>Describe Ohm's Law and use it to solve problems involving current, resistance and potential difference.</p> <p>Describe series and parallel connections and state their important characteristics.</p> <p>Calculate current, voltage drops and equivalent resistance in both series and parallel circuits.</p> <p>Calculate the equivalent resistance in combined circuits.</p> <p>Describe magnetic fields around permanent magnets and between like</p>		
--	--	---	--	--

		<p>and unlike poles.</p> <p>Describe the field around a current-carrying wire.</p> <p>Define magnetic induction and explain the direction of the force on a current-carrying wire in a magnetic field.</p> <p>List the factors that determine the magnitude of the force on a moving charge in a magnetic field and solve problems using this force.</p> <p>Understand that changing magnetic field produces an electric current.</p> <p>Define EMF and calculate EMF of wires moving in a magnetic field.</p>		
<p><b>Name of Unit</b> <b>Modern Physics</b>  <b>4 weeks</b></p>		<p>Explain how the chemical and physical properties of substances are related to their atomic and molecular structures.</p> <p>Apply atomic theory to the understanding of all matter.</p> <p>Define the photoelectric effect and explain it in terms of quantum theory.</p> <p>Define the Compton effect and explain in terms of the momentum and energy of the photon.</p>	<p>Virtual lab: Photoelectric effect</p> <p>Lab: Half-life of pennies</p> <p>Research project: Standard Model</p> <p>CERN website investigation</p> <p>The Elegant Universe video and related items from Brian Greene, PBS website</p> <p>Stephen Hawkings Universe video and PBS website</p>	

		<p>Recognize the dual nature of both waves and particles and the impact of the Heisenberg uncertainty principle.</p> <p>Describe the Rutherford model of the atom.</p> <p>List Bohr's assumptions, define energy levels and solve problems using the Bohr model of the atom.</p> <p>Describe the quantum model of the atom.</p> <p>Define atomic number, mass number, isotopes, and half-life.</p> <p>Describe the three modes of radioactive decay and write equations for each form.</p> <p>Calculate the amount of material and its activity remaining after a given number of half-lives.</p> <p>Balance nuclear equations showing the results of nuclear reactions.</p> <p>Describe the two families of fundamental particles and describe the quark nature of the proton and neutron.</p> <p>Define binding energy and calculate mass defect.</p>		
--	--	---	--	--

		<p>Relate the energy released in a nuclear reaction to the binding energy.</p> <p>Define nuclear fission and a chain reaction and describe the operation of nuclear reactors.</p> <p>Describe the fusion process and the formation of helium in the sun.</p> <p>Describe two approaches to controlled nuclear fusion.</p> <p>Status of the Standard Model Investigate the latest research in particle physics at CERN and other particle research websites (Fermilab, Stanford, etc.) so they can:</p> <ol style="list-style-type: none"> <li>a) Relate their particle research to current research.</li> <li>b) Compare predictions of direction of particle physics research to current information.</li> </ol> <p>String Theory Understand the basis of string theory as an alternate model of the structure of matter. Compare and contrast the string theory model to previously studied models of matter.</p> <p>Astrophysics and Cosmology View the work of Stephen Hawkings in the context of the study of cosmology and the universe.</p>		
--	--	--	--	--

		<p>Compare and contrast models of expansion and contraction of the universe.</p>		
--	--	--	--	--

--	--	--	--	--

	<b>CT Frameworks/ Standards</b>	<b>Content and Skill Objectives</b> Students will be able to:	<b>Assessments</b>	<b>Resources</b>
--	---------------------------------	--	--------------------	------------------

--	--	--	--	--
