

MONTH	CONTENT	NYS STANDARD/KEY IDEA/PERFORMANCE INDICATOR 5.1 a-e	LAB THEMES/SKILLS
<h1 style="writing-mode: vertical-rl; transform: rotate(180deg);">September</h1>	<p><u>Unit 1 – Units and Scientific Notation</u></p> <ul style="list-style-type: none"> ❖ SI System of Units ❖ Unit Conversion ❖ Scientific Notation ❖ Significant Figures ❖ Graphical Analysis <p><u>Unit 2 – Kinematics</u></p> <ul style="list-style-type: none"> ❖ Scalar vs. vector ❖ Displacement/distance ❖ Velocity/speed ❖ Acceleration <p><u>Unit 3 – Uniform Accelerated Motion</u></p> <ul style="list-style-type: none"> ❖ Three equations of motion ❖ Rectilinear motion ❖ Freely falling bodies 	<p>___5.1a Measured quantities can be classified as either vector or scalar.</p> <p>___5.1b A vector may be resolved into perpendicular components.*</p> <p>___5.1c The resultant of two or more vectors, acting at any angle, is determined by vector addition.</p> <p>___5.1d An object in linear motion may travel with a constant velocity* or with acceleration*. <i>(Note: Testing of acceleration will be limited to cases in which acceleration is constant.)</i></p> <p>___5.1e An object in free fall accelerates due to the force of gravity.* Friction and other forces cause the actual motion of a falling object to deviate from its theoretical motion. <i>(Note: Initial velocities of objects in free fall may be in any direction.)</i></p>	<p>LAB THEMES:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Math Toolkit <input type="checkbox"/> Linear Measurement <input type="checkbox"/> Velocity <input type="checkbox"/> Acceleration <p>SKILLS:</p> <ul style="list-style-type: none"> ⌘ Understand the approximate values of 1 kg and 1 m ⌘ Convert using metric units ⌘ Determine the resultant of two or more vectors graphically ⌘ Distinguish between distance and displacement ⌘ Compare and contrast the two cases of equilibrium (static and dynamic) ⌘ Determine the slopes and areas of graphs ⌘ Graphical analysis of displacement vs time, velocity vs time and acceleration vs time graphs. <p><u>Pertinent Reference Table Equations</u></p> $\bar{v} = \frac{d}{t} \quad a = \frac{\Delta v}{t}$ $v_f = v_i + at$ $d = v_i t + \frac{1}{2} at^2$ $v_f^2 = v_i^2 + 2ad$

MONTH	CONTENT	NYS STANDARD/KEY IDEA/PERFORMANCE INDICATOR 5.1b-u	LAB THEMES/SKILLS
<h1 style="writing-mode: vertical-rl; transform: rotate(180deg);">October</h1>	<p><u>Unit 4 – Two-dimensional motion</u></p> <ul style="list-style-type: none"> ❖ Trajectories ❖ Vector Components <p><u>Unit 5 – Static Forces</u></p> <ul style="list-style-type: none"> ❖ Newton’s First Law ❖ Equilibrium ❖ Gravitational forces ❖ Frictional forces ❖ Spring force 	<p>___5.1f The path of a projectile is the result of the simultaneous effect of the horizontal and vertical components of its motion; these components act independently.</p> <p>___5.1g A projectile’s time of flight is dependent upon the vertical component of its motion.</p> <p>___5.1h The horizontal displacement of a projectile is dependent upon the horizontal component of its motion and its time of flight.</p> <p>___5.1i According to Newton’s First Law, the inertia of an object is directly proportional to its mass. An object remains at rest or moves with constant velocity, unless acted upon by an unbalanced force.</p> <p>___5.1j When the net force on a system is zero, the system is in equilibrium.</p> <p>___5.1l Weight is the gravitational force with which a planet attracts a mass*. The mass of an object is independent of the gravitational field in which it is located.</p> <p>___5.1m The elongation or compression of a spring depends upon the nature of the spring (its spring constant) and the magnitude of the applied force.*</p> <p>___5.1o Kinetic friction* is a force that opposes motion.</p> <p>___5.1s Field strength* and direction are determined using a suitable test particle. (Notes: 1)Calculations are limited to electrostatic and gravitational fields. 2)The gravitational field near the surface of Earth and the electrical field between two oppositely charged parallel plates are treated as uniform.)</p> <p>___5.1t Gravitational forces are only attractive, whereas electrical and magnetic forces can be attractive or repulsive.</p> <p>___5.1u The inverse square law applies to electrical* and gravitational* fields produced by point sources.</p>	<p>LAB THEMES:</p> <p><input type="checkbox"/>Free Fall <input type="checkbox"/>Projectile Motion <input type="checkbox"/>Target Practice <input type="checkbox"/>Vectors</p> <p>SKILLS:</p> <ul style="list-style-type: none"> ⌘ Theoretical path of a projectile (with and without air resistance) ⌘ Calculate the position and velocity of a projectile at any point using the horizontal and vertical components of the motion ⌘ Review the trigonometry of right triangles ⌘ Resultant of two or more vectors (graphically) ⌘ Resolve a single vector into component ⌘ Identify the forces acting on an object ⌘ Inertia is directly related to mass ⌘ Find the force of gravity between two masses ⌘ Graphically and analytically represent the inverse square nature of gravitational force ⌘ Contrast kinetic and static friction ⌘ Graphically represent Hooke’s Law and spring constant ⌘ <u>Analyze vector diagrams of mechanical systems in equilibrium</u> <p>Pertinent Reference Table Equations</p> $g = \frac{F_g}{m}$ $F_f = \mu F_N$ $F_g = \frac{Gm_1m_2}{r^2}$ $F_s = kx$ $A_x = A \cos \theta$ $A_y = A \sin \theta$

MONTH	CONTENT	NYS STANDARD/KEY IDEA/PERFORMANCE INDICATOR 5.1 k,n,p,q,r	LAB THEMES/SKILLS
<h1 style="writing-mode: vertical-rl; transform: rotate(180deg);">November</h1>	<p><u>Unit 6 – Dynamic Forces</u></p> <ul style="list-style-type: none"> ❖ Newton’s Second Law ❖ Newton’s Third Law ❖ Free Body Diagrams ❖ Uniform Circular Motion <p><u>Unit 7 – Momentum and Impulse</u></p> <ul style="list-style-type: none"> ❖ Momentum ❖ Impulse ❖ Conservation of momentum 	<p>___5.1k According to Newton’s Second Law, an unbalanced force causes a mass to accelerate*.</p> <p>___5.1n Centripetal force* is the net force which produces centripetal acceleration.* In uniform circular motion, the centripetal force is perpendicular to the tangential velocity.</p> <p>___5.1p The impulse* imparted to an object causes a change in its momentum*.</p> <p>___5.1q According to Newton’s Third Law, forces occur in action/reaction pairs. When one object exerts a force on a second, the second exerts a force on the first that is equal in magnitude and opposite in direction.</p> <p>___5.1r Momentum is conserved in a closed system.* <i>(Note: Testing will be limited to momentum in one dimension.)</i></p>	<p>LAB THEMES:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Coefficient of Friction <input type="checkbox"/> Hooke’s Law <input type="checkbox"/> Centripetal Force <input type="checkbox"/> Conservation of Momentum <p>SKILLS:</p> <ul style="list-style-type: none"> ⌘ Analyze vector diagrams of nonequilibrium mechanical systems and find the net force ⌘ Contrast horizontal motion with motion on an inclined plane ⌘ Identify the directions of centripetal force, centripetal acceleration and velocity vectors for objects in circular motion ⌘ Identify reaction forces ⌘ Analyze the motions of objects before and after collisions <p style="text-align: center;"><u>Pertinent Reference Table Equations</u></p> $a = \frac{F_{net}}{m}$ $F_c = ma_c \quad a_c = \frac{v^2}{r}$ $p = mv$ $J = Ft = \Delta p$ $P_{before} = P_{after}$

MONTH	CONTENT	NYS STANDARD/KEY IDEA/PERFORMANCE INDICATOR 4.1 a-i	LAB THEMES/SKILLS
<h1 style="writing-mode: vertical-rl; transform: rotate(180deg);">December</h1>	<p><u>Unit 8 – Work, Energy and Power</u></p> <ul style="list-style-type: none"> ❖ Work and Power ❖ Kinetic Energy ❖ Gravitational Potential Energy ❖ Elastic Potential Energy ❖ Work-Energy Theorem <p><u>Unit 9 - Conservation of Energy</u></p> <ul style="list-style-type: none"> ❖ Conservation of Energy 	<p>___4.1a All energy transfers are governed by the law of conservation of energy.*</p> <p>___4.1b Energy may be converted among mechanical, electromagnetic, nuclear, and thermal forms.</p> <p>___4.1c Potential energy is the energy an object possesses by virtue of its position or condition. Types of potential energy include gravitational* and elastic*.</p> <p>___4.1d Kinetic energy* is the energy an object possesses by virtue of its motion.</p> <p>___4.1e In an ideal mechanical system, the sum of the macroscopic kinetic and potential energies (mechanical energy) is constant.*</p> <p>___4.1f In a nonideal mechanical system, as mechanical energy decreases there is a corresponding increase in other energies such as internal energy.*</p> <p>___4.1g When work* is done on or by a system, there is a change in the total energy* of the system.</p> <p>___4.1h Work done against friction results in an increase in the internal energy of the system.</p> <p>___4.1i Power* is the time-rate at which work is done or energy is expended.</p>	<p>LAB THEMES:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Power <input type="checkbox"/> Energy Stored in a Spring <input type="checkbox"/> Period of a Pendulum <input type="checkbox"/> Conservation <p>SKILLS:</p> <ul style="list-style-type: none"> ⌘ Factors affecting the period of a pendulum ⌘ Contrast the work done and power developed while moving up stairs ⌘ Graphically represent kinetic and potential energies ⌘ Calculate the work done against friction in a variety of situations ⌘ Identify the types of mechanical energy at any point in an object’s motion ⌘ Identify the location of maximum speed, displacement, energies for a pendulum. <p style="text-align: center;"><u>Pertinent Reference Table Equations</u></p> $W = Fd = E_T$ $P = \frac{W}{t} = \frac{Fd}{t} = F\bar{v}$ $KE = \frac{1}{2}mv^2 \quad \Delta PE = mg\Delta h$ $PE_s = \frac{1}{2}kx^2$ $E_T = PE + KE + Q$

MONTH	CONTENT	NYS STANDARD/KEY IDEA/PERFORMANCE INDICATOR 4.1j, 5.1s-u	LAB THEMES/SKILLS
<h1 style="writing-mode: vertical-rl; transform: rotate(180deg);">January</h1>	<p><u>Unit 10 – Electrostatics</u></p> <ul style="list-style-type: none"> ❖ Atomic structure ❖ Conservation of Charge ❖ Elementary charge ❖ Electric fields ❖ Potential difference 	<p>___4.1j Energy may be stored in electric* or magnetic fields. This energy may be transferred through conductors or space and may be converted to other forms of energy.</p> <p>___5.1s Field strength* and direction are determined using a suitable test particle. <i>(Notes: 1)Calculations are limited to electrostatic and gravitational fields. 2)The gravitational field near the surface of Earth and the electrical field between two oppositely charged parallel plates are treated as uniform.)</i></p> <p>___5.1t Gravitational forces are only attractive, whereas electrical and magnetic forces can be attractive or repulsive.</p> <p>___5.1u The inverse square law applies to electrical* and gravitational* fields produced by point sources.</p>	<p>LAB THEMES: <input type="checkbox"/>Electrostatics</p> <p>SKILLS:</p> <ul style="list-style-type: none"> ⌘ Knowledge of basic atomic structure ⌘ Behavior of charges and interactions between charged and uncharged objects ⌘ Conservation of charge and symmetry of such to predict conduction ⌘ Graphically and analytically represent the inverse square nature of electrostatic force ⌘ Draw electric field lines around charged objects and between parallel plates using a positive test charge <p style="text-align: center;"><u>Pertinent Reference Table Equations</u></p> $F_e = \frac{kq_1q_2}{r^2}$ $E = \frac{F_e}{q}$ $V = \frac{W}{q}$

MONTH	CONTENT	NYS STANDARD/KEY IDEA/PERFORMANCE INDICATOR 4.1 n,o	LAB THEMES/SKILLS
<h1>February</h1>	<p><u>Unit 11 – Current and Electricity</u></p> <ul style="list-style-type: none"> ❖ Electric Current ❖ Resistance of a Conductor ❖ Ohm’s Law ❖ Electric Power and Energy 	<p>___4.1n A circuit is a closed path in which a current* can exist. (<i>Note: Use conventional current.</i>)</p> <p>___4.1o Circuit components may be connected in series* or in parallel*. Schematic diagrams are used to represent circuits and circuit elements.</p>	<p>LAB THEMES:</p> <ul style="list-style-type: none"> ☐ Using Multimeters ☐ Ohm’s Law <p>SKILLS:</p> <ul style="list-style-type: none"> ⌘ Use ammeters and voltmeters to determine the resistance on a circuit ⌘ Compare and contrast the resistance of conductors of various lengths, materials and cross-sectional areas ⌘ Calculate power and energy expenditures for a variety of devices <p style="text-align: center;"><u>Pertinent Reference Table Equations</u></p> $I = \frac{q}{t}$ $R = \frac{V}{I}$ $R = \frac{\rho L}{A}$ $P = VI = I^2R = \frac{V^2}{R}$ $W = Pt = VIt = I^2Rt = \frac{V^2t}{R}$

MONTH	CONTENT	NYS STANDARD/KEY IDEA/PERFORMANCE INDICATOR 4.1 j 5.1 t,u	LAB THEMES/SKILLS
<h1 style="writing-mode: vertical-rl; transform: rotate(180deg);">March</h1>	<p><u>Unit 12 – Circuits</u></p> <ul style="list-style-type: none"> ❖ Series Circuits ❖ Parallel Circuits <p><u>Unit 13 – Magnetism</u></p> <ul style="list-style-type: none"> ❖ Magnetic Fields ❖ Electromagnetism ❖ Generators/Motors 	<p>___4.1j Energy may be stored in electric* or magnetic fields. This energy may be transferred through conductors or space and may be converted to other forms of energy.</p> <p>___5.1t Gravitational forces are only attractive, whereas electrical and magnetic forces can be attractive or repulsive.</p> <p>___5.1u The inverse square law applies to electrical* and gravitational* fields produced by point sources.</p>	<p>LAB THEMES:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Series and Parallel Circuits <input type="checkbox"/> Magnetic Field Lines Around a Permanent Magnet <input type="checkbox"/> Magnetic Induction <p>SKILLS:</p> <ul style="list-style-type: none"> ⌘ Build simple and parallel circuits and be able to predict the behavior of light bulbs in such circuits ⌘ Draw a schematic diagram from a given list of components ⌘ Identify the appropriate location for ammeters and voltmeters in a circuit ⌘ Solve circuit diagrams using the series and parallel equations ⌘ Map the magnetic field of a permanent magnet, distinguishing between N and S poles ⌘ Recognize and describe conversions among different forms of energy in devices such as motors, generators, photocells or batteries <p style="text-align: center;"><u>Series Circuits</u></p> $I = I_1 = I_2 = I_3 = \dots$ $V = V_1 + V_2 + V_3 + \dots$ $R_{eq} = R_1 + R_2 + R_3 + \dots$ <p style="text-align: center;"><u>Parallel Circuits</u></p> $I = I_1 + I_2 + I_3 + \dots$ $V = V_1 = V_2 = V_3 = \dots$ $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$

MONTH	CONTENT	NYS STANDARD/KEY IDEA/PERFORMANCE INDICATOR 4.3a-k	LAB THEMES/SKILLS
<h1 style="font-size: 48px; margin: 0;">April</h1>	<p><u>Unit 14-Wave Characteristics</u></p> <ul style="list-style-type: none"> ❖ Mechanical/ ❖ Electromagnetic Waves ❖ Transverse/ Longitudinal Waves ❖ Period ❖ Wavelength ❖ Amplitude ❖ Speed ❖ Phase ❖ Sound and Light 	<p>___4.3a An oscillating system produces waves. The nature of the system determines the type of wave produced.</p> <p>___4.3b Waves carry energy and information without transferring mass. This energy may be carried by pulses or periodic waves.</p> <p>___4.3c The model of a wave incorporates the characteristics of amplitude, wavelength,* frequency*, period*, wave speed*, and phase.</p> <p>___4.3d Mechanical waves require a material medium through which to travel.</p> <p>___4.3e Waves are categorized by the direction in which particles in a medium vibrate about an equilibrium position relative to the direction of propagation of the wave, such as transverse and longitudinal waves.</p> <p>___4.3g Electromagnetic radiation exhibits wave characteristics. Electromagnetic waves can propagate through a vacuum.</p> <p>___4.3k All frequencies of electromagnetic radiation travel at the same speed in a vacuum.*</p>	<p>LAB THEMES:</p> <p>❑ Speed of Sound Lab</p> <p>SKILLS:</p> <ul style="list-style-type: none"> ⌘ Draw waves with various characteristics ⌘ Determine the net motion of particles in a wave ⌘ Describe the difference between mechanical and electromagnetic waves ⌘ Differentiate between transverse and longitudinal waves ⌘ Compare the characteristics between two transverse waves for frequency, period, amplitude, wavelength and speed and how these characteristics manifest themselves in light and sound waves ⌘ Determine the type of electromagnetic wave from its frequency or wavelength ⌘ Compare the frequencies of color of visible light <p style="text-align: center;"><u>Pertinent Reference Table Equations</u></p> $T = \frac{1}{f} \quad v = f\lambda$

MONTH	CONTENT	NYS STANDARD/KEY IDEA/PERFORMANCE INDICATOR 4.3f-n	LAB THEMES/SKILLS
<h1 style="font-size: 4em; margin: 0;">May</h1>	<p><u>Unit 15 - Wave Behaviors</u></p> <ul style="list-style-type: none"> ❖ Reflection ❖ Refraction ❖ Dispersion ❖ Diffraction ❖ Doppler Effect ❖ Interference ❖ Standing Waves ❖ Resonance 	<p>___4.3f Resonance occurs when energy is transferred to a system at its natural frequency.</p> <p>___4.3h When a wave strikes a boundary between two media, reflection*, transmission, and absorption occur. A transmitted wave may be refracted.</p> <p>___4.3i When a wave moves from one medium into another, the wave may refract due to a change in speed. The angle of refraction (measured with respect to the normal) depends on the angle of incidence and the properties of the media (indices of refraction).*</p> <p>___4.3j The absolute index of refraction is inversely proportional to the speed of a wave.*</p> <p>___4.3l Diffraction occurs when waves pass by obstacles or through openings. The wavelength of the incident wave and the size of the obstacle or opening affect how the wave spreads out.</p> <p>___4.3m When waves of a similar nature meet, the resulting interference may be explained using the principle of superposition. Standing waves are a special case of interference.</p> <p>___4.3n When a wave source and an observer are in relative motion, the observed frequency of the waves traveling between them is shifted (Doppler effect).</p>	<p>LAB THEMES:</p> <p><input type="checkbox"/> Reflection of Light <input type="checkbox"/> Refraction of Light <input type="checkbox"/> Energy Levels of Hydrogen</p> <p>SKILLS:</p> <ul style="list-style-type: none"> ⌘ Observe, sketch and interpret the behavior of a wave as it reflects from a boundary ⌘ Draw a ray diagram for a given reflection and identify angles of incidence and reflection. Identify distance to object and to image ⌘ Observe, sketch and interpret the behavior of a wave as it refracts at a boundary ⌘ Draw a ray diagram for a given refraction and identify angles of incidence and refraction. ⌘ Describe the relationship of a wavelength to that of the size of the opening or obstacle causing diffraction ⌘ Describe the relationship between source, observer with respect to frequency, wavelength and speed (Doppler effect) ⌘ Predict the superposition of two waves interfering constructively and destructively ⌘ Determine amplitude, phase, nodes and antinodes of a standing wave ⌘ Relate the importance of standing waves in producing resonance <p>Pertinent Reference Table Equations</p> $n_1 \sin \theta_1 = n_2 \sin \theta_2$ $\theta_i = \theta_r$ $\frac{n_2}{n_1} = \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2}$ $n = \frac{c}{v}$

MONTH	CONTENT	NYS STANDARD/KEY IDEA/PERFORMANCE INDICATOR 5.3a-i	LAB THEMES/SKILLS
<h1>June</h1>	<p><u>Unit 16 - Modern Physics</u></p> <ul style="list-style-type: none"> ❖ Quantum Physics ❖ Models of the Atom ❖ Hydrogen/Mercury ❖ Energy Level 	<p>___5.3a States of matter and energy are restricted to discrete values (quantized).</p> <p>___5.3b Charge is quantized on two levels. On the atomic level, charge is restricted to multiples of the elementary charge (charge on the electron or proton). On the subnuclear level, charge appears as fractional values of the elementary charge (quarks).</p> <p>___5.3c On the atomic level, energy is emitted or absorbed in discrete packets called photons.*</p> <p>___5.3d The energy of a photon is proportional to its frequency.*</p> <p>___5.3e On the atomic level, energy and matter exhibit the characteristics of both waves and particles.</p> <p>___5.3f Among other things, mass-energy and charge are conserved at all levels (from subnuclear to cosmic).</p> <p>___5.3g The Standard Model of Particle Physics has evolved from previous attempts to explain the nature of the atom and states that:</p> <ul style="list-style-type: none"> • atomic particles are composed of subnuclear particles • the nucleus is a conglomeration of quarks which manifest themselves as protons and neutrons • each elementary particle has a corresponding antiparticle <p>___5.3h Behaviors and characteristics of matter, from the microscopic to the cosmic levels, are manifestations of its atomic structure. The macroscopic characteristics of matter, such as electrical and optical properties, are the result of microscopic interactions.</p> <p>___5.3i The total of the fundamental interactions is responsible for the appearance and behavior of the objects in the universe.</p> <p>___5.3j The fundamental source of all energy in the universe is the conversion of mass into energy.*</p>	<p>LAB THEMES:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Half-Life Lab <input type="checkbox"/> Spectral Analysis Lab <p>SKILLS:</p> <ul style="list-style-type: none"> ⌘ Interpret energy-level diagrams (reference tables) ⌘ Correlate spectral lines with energy-level diagram ⌘ Quantitatively determine energy of a photon frequency and wavelength ⌘ Classification of Matter (reference tables) ⌘ Particles of the standard model (reference tables) ⌘ Quantitatively convert energy to mass and vice versa <p style="text-align: center;"><u>Pertinent Reference Table Equations</u></p> $E_{\text{photon}} = E_i - E_f$ $E = hf$ $E = mc^2$