South Hadley Public Schools

Subject: Accelerated Physics **School: High School**

Big Idea/Essential Question: Motion and Forces/What gets you going?				
Standard	**Learning Expectations**	**Skills**	**Assessments**	**Content**
1.1 Distinguish between vector quantities (velocity, acceleration, and force) and scalar quantities (speed and mass). 1.2 Illustrate how to represent vectors graphically and be able to add them graphically. 1.3 Distinguish between, and solve problems involving, velocity, speed, and constant acceleration. 1.4 Create and interpret graphs of motion (position vs. time, speed vs. time, velocity vs. time, constant acceleration vs. time). 1.5 Explain the relationship between mass and inertia. 1.6 Interpret and apply Newton's first law of motion. 1.7 Interpret and apply Newton's second law of motion to show how an object's motion will change only when a net force is applied. 1.8 Use a free body force diagram with only co-linear forces to show forces acting on an object, and determine the net force on it. 1.9 Qualitatively distinguish between static and kinetic friction, what they depend on and their effects on the motion of objects. 1.10 Interpret and apply Newton's third law of motion. 1.11 Understand conceptually	LE 2: Define, analyze, and solve complex problems and communicate results. LE 5: Acquire, apply, integrate, analyze, and synthesize knowledge. LE 8: Identify and apply appropriate technologies.	1. Differentiate between scalar and vector quantities. 2. Define displacement, velocity, and acceleration operationally. 3. Relate the direction and magnitude of velocity and acceleration vectors to the motion of objects. 4. Understand the independence of horizontal and vertical components. 5. Resolve vectors into components graphically and trigonometrically. 6. Solve one- and two-dimensional problems graphically and algebraically. 7. Establish a coordinate system for problems involving vector quantities. 8. Recognize the meaning of acceleration due to gravity and its direction with respect to a coordinate system. 9. Define a force and differentiate between contact forces and long-range forces. 10. Explain Newton's laws of motion and recognize their significance in terms of solving problems. 11. Define friction force and distinguish between static and kinetic friction. 12. Solve planetary motion problems using Kepler's and Newton's laws of motion.	1. Written exams 2. Labs – Analyzing motion Force vector addition Motion Acceleration due to gravity Newton's second law Friction Projectile motion Range of a projectile Kepler's laws	Chapters 2, 3, 4, 5 (Physics, Giancoli) 1. Vector vs. scalar quantities 2. Displacement, velocity, and acceleration vectors 3. Graphical procedures 4. Projectile motion 5. Acceleration due to gravity 6. Newton's laws of motion, Kepler's laws, Newton's law of universal gravitation 7. Friction and force vectors

Newton's law of universal gravitation. 1.12 Identify appropriate standard international units of measurement for force, mass, distance, speed, acceleration, and time, and explain how they are measured.				

Big Idea/Essential Question: Conservation of Energy and Momentum/What keeps you going?				
Standard	**Learning Expectations**	**Skills**	**Assessments**	**Content**
2.1 Interpret and provide examples that illustrate the law of conservation of energy. 2.2 Provide examples of how energy can be transformed from kinetic	LE 2: Define, analyze, and solve complex problems and communicate results. LE 5: Acquire, apply, integrate, analyze, and synthesize knowledge. LE 8: Identify and apply appropriate technologies.	1. Solve problems involving mechanical energy conversions. 2. Calculate the momentum and kinetic energy of objects. 3. Use conservation of energy and momentum to solve problems involving elastic and inelastic collisions.	1. Written exams 2. Labs – Conservation of momentum Conservation of energy Work/energy conversion to determine coefficient of friction	Chapters 6, 7 (Physics, Giancoli) 1. Work done by a force 2. Kinetic energy and the work-energy theorem 3. Kinetic energy, gravitational potential energy, and elastic potential energy 4. Conservative forces

to potential and vice versa 2.3 Apply quantitatively the law of conservation of mechanical energy to simple systems. 2.4 Describe the relationship among energy, work, and power both conceptually and quantitatively. 2.5 Interpret the law of conservation of momentum and provide examples that illustrate it. Calculate the momentum of an object. 2.6 Identify appropriate standard international units of measurement for energy, work, power, and momentum.		4. Determine the impulse of an object and recognize that it equals the change in momentum of that object. 5. Describe the relationship between work and energy. 6. Display an ability to calculate work done by a force. 7. Differentiate between force, work, and power, and correctly use in solving problems. 8. Discriminate between kinetic energy, gravitational potential energy, and elastic potential energy. 9. Convert between kinetic, gravitational potential, and elastic potential energies within a system.		5. Law of conservation of energy 6. Power 7. Conservation of momentum 8. Collision and impulse 9. Elastic and inelastic collisions

Big Idea/Essential Question: Heat and Heat Transfer/How hot is hot?				
Standard	**Learning Expectations**	**Skills**	**Assessments**	**Content**
3.1 Relate thermal energy to molecular motion. 3.2 Differentiate between specific heat and heat capacity. 3.3 Explain the relationship among temperature change in a substance for a given amount of heat transferred, the amount (mass) of the substance, and the specific heat of the substance.	LE 2: Define, analyze, and solve complex problems and communicate results. LE 5: Acquire, apply, integrate, analyze, and synthesize knowledge. LE 8: Identify and apply appropriate technologies.	1. Describe the nature of thermal energy. 2. Define temperature and distinguish it from thermal energy. 3. Define specific heat and calculate heat transfer. 4. Define heats of fusion and vaporization. 5. State the first and second laws of thermodynamics. 6. Define entropy.	1. Written exams 2. Labs – Specific heat	Chapters 13, 14, 15 (Physics, Giancoli) 1. Heat vs. temperature 2. Kinetic theory 3. Heat as energy transfer 4. Specific heat 5. Calorimetry 6. First and second laws of thermodynamics

3.4 Recognize that matter exists in four phases, and explain what happens during a phase change.				

Big Idea/Essential Question: Waves/Surfs up?				
Standard	**Learning Expectations**	**Skills**	**Assessments**	**Content**
4.1 Differentiate between wave motion (simple harmonic nonlinear motion) and the motion of objects (nonharmonic). 4.2 Recognize the measurable properties of waves (e.g., velocity, frequency, wavelength) and explain the relationship among them. 4.3 Distinguish between transverse and longitudinal waves. 4.4 Distinguish between mechanical and electromagnetic waves. 4.5 Interpret and be able to apply	LE 2: Define, analyze, and solve complex problems and communicate results. LE 5: Acquire, apply, integrate, analyze, and synthesize knowledge. LE 8: Identify and apply appropriate technologies.	1. Identify how waves transfer energy without transferring matter. 2. Contrast transverse and longitudinal waves. 3. Relate wave speed, wavelength, and frequency. 4. Describe how waves are reflected and refracted at boundaries between media, and explain how waves diffract. 5. Apply the principle of superposition to the phenomenon of interference. 6. Demonstrate knowledge of the nature of sound waves. 7. Relate the physical properties of	1. Written exams 2. Labs – Waves on a string Speed of sound Bending of light Concave and convex mirrors Concave and convex lenses Reflection of light Snell's law	Chapters 11, 12, 23, 24, 25 (Physics, Giancoli) 1. Simple harmonic motion 2. Simple pendulum 3. Behavior of waves; reflection, refraction, interference, and diffraction 4. Standing waves; resonance 5. Constructive and destructive interference 6. Principle of superposition 7. Characteristics of sound 8. Doppler effect 9. Speed of light and index of refraction 10. Snell's law 11. Mirror and lens ray diagrams

the laws of reflection and refraction (qualitatively) to all waves. 4.6 Recognize the effects of polarization, wave interaction, and the Doppler effect. 4.7 Explain, graph, and interpret graphs of constructive and destructive interference of waves. 4.8 Explain the relationship between the speed of a wave (e.g., sound) and the medium it travels through. 4.9 Recognize the characteristics of a standing wave and explain the conditions under which two waves on a string or in a pipe can interfere to produce a standing wave.		sound waves to the way we perceive sound. 8. Define the Doppler shift and identify some of its applications. 9. Describe an understanding of resonance. 10. Describe the electromagnetic spectrum. 11. Explain the laws of reflection and refraction. 12. Define the index of refraction. 13. Explain how concave, convex, and plane mirrors form images. 14. Explain how concave and convex lenses form images. 15. Use lens/mirror equation to solve problems. 16. Draw ray diagrams.		

Big Idea/Essential Question: Electromagnetism/How do you keep from getting zapped?				
Standard	**Learning Expectations**	**Skills**	**Assessments**	**Content**
5.1 Recognize the characteristics of static charge, and explain how a static charge is generated. 5.2 Interpret and apply Coulomb's law. 5.3 Explain the difference in concept between electric forces and electric fields. 5.4 Develop a qualitative and quantitative understanding of current, voltage, resistance, and the connection between them. 5.5 Identify appropriate units of measurement for current, voltage, and resistance, and explain how they are measured. 5.6 Analyze circuits (find the current at any point and the potential difference between any two points in the	LE 2: Define, analyze, and solve complex problems and communicate results. LE 5: Acquire, apply, integrate, analyze, and synthesize knowledge. LE 8: Identify and apply appropriate technologies.	1. Recognize that objects that are charged exert forces, both attractive and repulsive. 2. Demonstrate that charging is the separation, not the creation, of electrical charges. 3. Describe the difference between conductors and insulators. 4. Summarize the relationship between forces and charges. 5. Use Coulomb's law to solve problems relating to electrical force. 6. Develop a model of how charged objects can attract a neutral object. 7. Define and measure an electric field. 8. Solve problems relating to charge, electric fields, and forces. 9. Diagram electric field lines. 10. Define and calculate electric potential difference.	1. Written exams 2. Labs – Investigating static electricity Ohm's law Series, parallel, and combination circuits	Chapters 16, 17, 18, 19 (Physics, Giancoli) 1. Static electricity and electric charge 2. Insulators and conductors 3. Coulomb's law 4. Electric fields and field lines 5. Electric potential and potential difference 6. Capacitance 7. Electric current 8. Ohm's law: resistance and resistors 9. Resistors in series and parallel 10. Kirchoff's rules

circuit) using Kirchoff's and Ohm'.		11. Define an electric current and the ampere. 12. Draw circuits and recognize that they are closed loops. 13. Define resistance and describe Ohm's law. 14. Build and analyze simple circuits. 15. Use a multimeter to measure current, voltage, and resistance.		

Big Idea/Essential Question: Electromagnetic Radiation/Can you see the light?				
Standard	**Learning Expectations**	**Skills**	**Assessments**	**Content**
6.1 Describe the electromagnetic spectrum in terms of wavelength and energy, and be able to identify specific regions such as visible light. 6.2 Explain how the various wavelengths in the electromagnetic spectrum have many useful applications such as radio, television, microwave appliances, and cellular telephones. 6.3 Calculate the frequency and energy of an electromagnetic wave from the wavelength. 6.4 Recognize and explain the ways in which the direction of visible light can be changed.	LE 2: Define, analyze, and solve complex problems and communicate results. LE 5: Acquire, apply, integrate, analyze, and synthesize knowledge. LE 8: Identify and apply appropriate technologies.	1. Recognize that light is the visible portion of an entire range of electromagnetic frequencies. 2. Identify the components of the electromagnetic spectrum. 3. Calculate the frequency or wavelength of electromagnetic radiation. 4. Recognize that light has a finite speed. 5. Calculate the energy of radiation based on the frequency or wavelength. 6. Compare and contrast various regions of the electromagnetic spectrum based on energy. 7. Describe the applications of the various regions of the electromagnetic spectrum.	1. Written exams 2. Labs – Planck's constant Photoelectric effect	Chapters 22 (Physics, Giancoli) 1. Changing electric fields produce magnetic fields 2. Production of electromagnetic waves 3. Velocity, frequency, and wavelength of electromagnetic radiation 4. Electromagnetic spectral regions