South Carolina Physics Standards Correlation

	Physics for Scientists and Engineers	Principles of Physics	Conceptual Physics	Virtual Physics Labs
Standard P-1: The student will demonstrate an understanding of how scientific inquiry and technological design, including mathematical analysis, can be used appropriately to pose questions, seek answers, and develop solutions. **Indicators**				
P-1.1 Apply established rules for significant digits, both in reading scientific instruments and in calculating derived quantities from measurement.	Covered in Factbook: Math tab: Math Review. Applied throughout the book.	Covered in Factbook: Math tab: Math Review. Applied throughout the book.	Covered in Factbook: Math tab: Math Review. Applied throughout the book.	All labs require application of significant digits.
P-1.2 Use appropriate laboratory apparatuses, technology, and techniques safely and accurately when conducting a scientific investigation.				
P-1.3 Use scientific instruments to record measurement data in appropriate metric units that reflect the precision and accuracy of each particular instrument.				All labs have computer simulations of instruments
P-1.4 Design a scientific investigation with appropriate methods of control to test a hypothesis (including independent and dependent variables), and evaluate the designs of sample investigations.				·Firing a cannon ·Helicopters in flight ·Orbiting satellites ·Birds on a wire ·Pressure, volume and temperature ·Electric golf ·Investigating electric fields ·Generators and transformers
P-1.5 Organize and interpret the data from a controlled scientific investigation by using (including calculations in scientific notation, formulas, and dimensional analysis), graphs, tables, models, diagrams, and/or technology.				All labs
P-1.6 Evaluate the results of a controlled scientific investigation in terms of whether they refute or verify the hypothesis.				All labs
P-1.7 Evaluate conclusions based on qualitative and quantitative data (including the impact of parallax, instrument malfunction, or human error) on experimental results.				

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P-1.8 Evaluate a technological design or product on the basis of designated criteria (including cost, time, and materials).				
P-1.9 Communicate and defend a scientific argument or conclusion.				All labs
P-1.10 Use appropriate safety procedures when conducting investigations.				
Standard P-2: The student will demonstrate an understanding of the principles of force and motion and relationships between them. **Indicators**				
P-2.1 Represent vector quantities (including displacement, velocity, acceleration, and force) and use vector addition.	Chapter 3	Chapter 3	Chapter 3	·Firing a cannon ·Juggling objects ·Helicopters in flight ·Navigating race tracks ·Electric golf ·Investigating electric fields ·Generators and transformers
P-2.2 Apply formulas for velocity or speed and acceleration to one and two-dimensional problems.	Chapters 2 & 4	Chapters 2 & 4	Chapters 2 & 4	·Skee-Ball ·Firing a cannon ·Juggling objects
P-2.3 Interpret the velocity or speed and acceleration of one and two-dimensional motion on distance-time, velocity-time or speed-time, and acceleration-time graphs.	2.6 - 2.9, 2.12 - 2.14	2.6 - 2.9, 2.12	2.6 - 2.7, 2.10	
P-2.4 Interpret the resulting motion of objects by applying Newton's three laws of motion: inertia; the relationship among net force, mass, and acceleration (using $F = ma$); and action and reaction forces.	Chapters 5 & 6	Chapters 5 & 6	Chapter 5	·Helicopters in flight
P-2.5 Explain the factors that influence the dynamics of falling objects and projectiles.	2.26, 2.30 - 2.31, 4.8	2.23, 2.27, 4.7	2.18, 4.3	·Firing a cannon ·Juggling objects
P-2.6 Apply formulas for velocity and acceleration to solve problems related to projectile motion.	4.8 - 4.21	4.7 - 4.20	4.3 - 4.13	·Firing a cannon ·Juggling objects
P-2.7 Use a free-body diagram to determine the net force and component forces acting upon an object.	5.14 - 5.17, 5.22 - 5.27, 5.29, 6.1 - 6.13	5.14 - 5.17, 5.22 - 5.27, 5.29, 6.1 - 6.13	5.14 - 5.15, 5.20 - 5.22	·Helicopters in flight
P-2.8 Distinguish between static and kinetic friction and the factors that affect the motion of objects.	5.18 - 5.20	5.18 - 5.20	5.16 - 5.18	

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P-2.9 Explain how torque is affected by the magnitude, direction, and point of application of force.	11.1 - 11.2	11.1 - 11.2	10.1	
P-2.10 Explain the relationships among speed, velocity, acceleration, and force in rotational systems.	Chapters 10 & 11	Chapters 10 & 11	Chapters 9 & 10	·Navigating race tracks
Standard P-3: The student will demonstrate an understanding of the conservation, transfer, and transformation of mechanical energy. **Indicators**				
P-3.1 Apply energy formulas to determine potential and kinetic energy and explain the transformation from one to the other.	Chapter 7	Chapter 7	Chapter 6	·Mission to Mars
P-3.2 Apply the law of conservation of energy to the transfer of mechanical energy through work.	Chapter 7	Chapter 7	Chapter 6	·Mission to Mars
P-3.3 Explain, both conceptually and quantitatively, how energy can transfer from one system to another (including work, power, and efficiency).	Chapter 7	Chapter 7	Chapter 6	
P-3.4 Explain, both conceptually and quantitatively, the factors that influence periodic motion.	Chapter 15	Chapter 15	Chapter 14	·Birds on a wire
P-3.5 Explain the factors involved in producing a change in momentum (including impulse and the law of conservation of momentum in both linear and rotary systems).	Chapter 8, 11.26 - 11.35	Chapter 8, 11.21 - 11.29	Chapter 7, 10.8 - 10.11	
P-3.6 Compare elastic and inelastic collisions in terms of conservation laws.	8.9 - 8.21	8.8 - 8.19	7.7 - 7.13	
Standard P-4: The student will demonstrate an understanding of the properties of electricity and magnetism and the relationships between them. **Indicators**				
P-4.1 Recognize the characteristics of static charge and explain how a static charge is generated.	23.1 - 23.2	23.1 - 23.2	22.1 - 22.2	·Electric golf
P-4.2 Use diagrams to illustrate an electric field (including point charges and electric field lines).	24.4, Chapter 24	24.4, Chapter 24	23.4, Chapter 23	·Investigating electric fields
P-4.3 Summarize current, potential difference, and resistance in terms of electrons.	25.14, 27.1, 27.6, Chapters 25 & 27	25.11, 27.1, 27.3, Chapters 25 & 27	24.6, 25.1, 25.3, Chapters 24 & 25	

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P-4.4 Compare how current, voltage, and resistance are measured in a series and in a parallel electric circuit and identify the appropriate units of measurement.	Chapter 29	Chapter 29	Chapter 27	
P-4.5 Analyze the relationships among voltage, resistance, and current in a complex circuit by using Ohm's law to calculate voltage, resistance, and current at each resistor, any branch, and the overall circuit.	Chapters 27 & 29	Chapters 27 & 29	Chapters 25 & 27	
P-4.6 Differentiate between alternating current (AC) and direct current (DC) in electrical circuits.	29.1, 33.0, 33.11, Chapters 29 & 33	29.1, 33.0, 33.5, Chapters 29 & 33	27.1, 29.12	·Building a radio tuner
P-4.7 Carry out calculations for electric power and electric energy for circuits.	27.13 - 27.18, 28.9, 29.3	27.8 - 27.13, 28.7, 29.3	25.7 - 25.11, 26.4, 27.3	
P-4.8 Summarize the function of electrical safety components (including fuses, surge protectors, and breakers).				
P-4.9 Explain the effects of magnetic forces on the production of electrical currents and on current carrying wires and moving charges.	Chapters 30, 31, & 32	Chapters 30, 31, & 32	Chapters 28 & 29	·Generators and transformers
P-4.10 Distinguish between the function of motors and generators on the basis of the use of electricity and magnetism by each.	30.27, 32.17 - 32.20	30.26, 32.14 - 32.17	28.19, 29.12	·Generators and transformers
P-4.11 Predict the cost of operating an electrical device by determining the amount of electrical power and electrical energy in the circuit.	27.14 - 27.15	27.9 - 27.10	25.8 - 25.9	
Standard P-5: The student will demonstrate an understanding of the properties and behaviors of mechanical and electromagnetic waves. **Indicators**				
P-5.1 Analyze the relationships among the properties of waves (including energy, frequency, amplitude, wavelength, period, phase, and speed).	Chapters 15 & 16	Chapters 15 & 16	Chapters 14 & 15	·Birds on a wire
P-5.2 Compare the properties of electromagnetic and mechanical waves.	35.2	34.2	30.2	
P-5.3 Analyze wave behaviors (including reflection, refraction, diffraction, and constructive and destructive interference).	Chapters 36, 37, 39 & 40	Chapters 35, 36 & 37	Chapters 31, 32 & 33	·Helicopters versus submarines
P-5.4 Distinguish the different properties of waves across the range of the electromagnetic spectrum.	35.1	34.1	30.1	

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P-5.5 Illustrate the interaction of light waves with optical lenses and mirrors by using Snell's law and ray diagrams.	Chapters 36, 37 & 38	Chapters 35, 36 & 37	Chapters 31, 32 & 33	
P-5.6 Summarize the operation of lasers and compare them to incandescent light.	42.21 - 42.27	41.20 - 41.25	36.17 - 36.21	
***Two* of physics standards 6 through 10 must be taught in addition to standards 1 through 5.**				
Standard P-6: The student will demonstrate an understanding of the properties and behaviors of sound. **Indicators**				
P-6.1 Summarize the production of sound and its speed and transmission through various media.	17.1, 17.4 - 17.7	17.1, 17.4 - 17.6	16.1	·Playing Beethoven's Fifth Symphony
P-6.2 Explain how frequency and intensity affect the parts of the sonic spectrum.	17.1 - 17.3, 17.10	17.1 - 17.3, 17.8	16.1 - 16.4	·Playing Beethoven's Fifth Symphony
P-6.3 Explain pitch, loudness, and tonal quality in terms of wave characteristics that determine what is heard.	17.1 - 17.3, 17.10 - 17.11	17.1 - 17.3, 17.8 - 17.9	16.1 - 16.5	·Playing Beethoven's Fifth Symphony
P-6.4 Compare intensity and loudness.	17.10	17.8	16.4	
P-6.5 Apply formulas to determine the relative intensity of sound.	17.10 - 17.11	17.8 - 17.9	16.4 - 16.5	
P-6.6 Apply formulas in order to solve for resonant wavelengths in problems involving open and closed tubes.	18.10	18.10		
P-6.7 Explain the relationship among frequency, fundamental tones, and harmonics in producing music.	18.7	18.7	17.4	·Playing Beethoven's Fifth Symphony
P-6.8 Explain how musical instruments produce resonance and standing waves.	18.2 - 18.12	18.2 - 18.12	17.2 - 17.6	·Playing Beethoven's Fifth Symphony
P-6.9 Explain how the variables of length, width, tension, and density affect the resonant frequency, harmonics, and pitch of a vibrating string.	16.8, 18.7	16.8, 18.7	15.8, 17.4	·Playing Beethoven's Fifth Symphony
Standard P-7: The student will demonstrate an understanding of the properties and behaviors of light and optics. **Indicators**				
P-7.1 Explain the particulate nature of light as evidenced in the photoelectric effect.	42.6 - 42.8	41.6 - 41.8	36.5 - 36.7	

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P-7.2 Use the inverse square law to determine the change in intensity of light with distance.	35.13	34.10		
P-7.3 Illustrate the polarization of light.	35.21 - 35.27	34.17 - 34.23	30.8 - 30.10	
P-7.4 Summarize the operation of fiber optics in terms of total internal reflection.	37.12 - 37.13	36.11 - 36.12	32.8	
P-7.5 Summarize image formation in microscopes and telescopes (including reflecting and refracting).	38.24 - 38.26	37.22 - 37.24	33.14	
P-7.6 Summarize the production of continuous, emission, or absorption spectra.	42.2 - 42.12	41.2 - 41.11	36.2 - 36.9	
P-7.7 Compare color by transmission to color by reflection.	35.20, 36.1	34.16, 35.1	30.7, 31.1	
P-7.8 Compare color mixing in pigments to color mixing in light.				
P-7.9 Illustrate the diffraction and interference of light.	Chapters 39 & 40	Chapters 38 & 39	Chapter 34	
P-7.10 Identify the parts of the eye and explain their function in image formation.	38.14 - 38.16, 38.18	37.13 - 37.16	33.9 - 33.12	
Standard P-8: The student will demonstrate an understanding of nuclear physics and modern physics. **Indicators**				
P-8.1 Compare the strong and weak nuclear forces in terms of their roles in radioactivity.				
P-8.2 Compare the nuclear binding energy to the energy released during a nuclear reaction, given the atomic masses of the constituent particles.	44.9 - 44.14	43.9 - 43.14	38.9 - 38.14	
P-8.3 Predict the resulting isotope of a given alpha, beta, or gamma emission.	44.15 - 44.17	43.15 - 43.17	38.15 - 38.16	
P-8.4 Apply appropriate procedures to balance nuclear equations (including fusion, fission, alpha decay, beta decay, and electron capture).	44.9 - 44.17	43.9 - 43.17	38.9 - 38.16	
P-8.5 Interpret a representative nuclear decay series.	44.17, 44.19, 44.26	43.17, 43.19, 43.26	38.16 38.23	
P-8.6 Explain the relationship between mass and energy that is represented in the equation $E = mc^2$ according to Einstein's special theory of relativity.	41.23 - 41.24, 44.9	40.16 - 40.17, 43.9	35.12, 38.9	

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P-8.7 Compare the value of time, length, and momentum in the reference frame of an object moving at relativistic velocity to those values measured in the reference frame of an observer by applying Einstein's special theory of relativity.	Chapter 41	Chapter 40	Chapter 35	·Jump into Einstein's shoes
Standard P-9: The student will demonstrate an understanding of the principles of fluid mechanics. **Indicators**				
P-9.1 Predict the behavior of fluids (including changing forces) in pneumatic and hydraulic systems.	14.15	14.15	13.11	
P-9.2 Apply appropriate procedures to solve problems involving pressure, force, volume, and area.	12.14, 14.3 - 14.8	12.13, 14.3 - 14.8	11.8, 13.3 - 13.6	
P-9.3 Explain the factors that affect buoyancy.	14.9 - 14.14	14.9 - 14.14	13.7 - 13.10	
P-9.4 Explain how the rate of flow of a fluid is affected by the size of the pipe, friction, and the viscosity of the fluid.	14.16 - 14.18, 14.25	14.16 - 14.18, 14.24	13.12 - 13.13	
P-9.5 Explain how depth and fluid density affect pressure.	14.2 - 14.6	14.2 - 14.6	13.2 - 13.5	
P-9.6 Apply fluid formulas to solve problems involving work and power.				
P-9.7 Exemplify the relationship between velocity and pressure by using Bernoulli's principle.	14.20 - 14.23	14.20 - 14.22	13.14 - 13.15	
Standard P-10: The student will demonstrate an understanding of the principles of thermodynamics. **Indicators**				
P-10.1 Summarize the first and second laws of thermodynamics.	21.1, 22.2	21.1, 22.2	20.1, 21.2	
P-10.2 Explain the relationship among internal energy, heat, and work.	21.1	21.1	20.1	
P-10.3 Exemplify the concept of entropy.	22.5 - 22.8	22.5 - 22.8	21.4 - 21.5	
P-10.4 Explain thermal expansion in solids, liquids, and gases in terms of kinetic theory and the unique behavior of water.	19.10 - 19.15	19.8 - 19.13	18.7 - 18.11	
P-10.5 Differentiate heat and temperature in terms of molecular motion.	19.7, 20.10	19.5, 20.10	18.5, 19.9	·Pressure, volume and temperature
P-10.6 Summarize the concepts involved in phase change.	19.21	19.18	18.14	

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P-10.7 Apply the concepts of heat capacity, specific heat, and heat exchange to solve calorimetry problems.	19.16 - 19.18, 19.20	19.14 - 19.15, 19.17	18.12 - 18.13	
P-10.8 Summarize the functioning of heat transfer mechanisms (including engines and refrigeration systems).	Chapters 21 & 22	Chapters 21 & 22	Chapters 20 & 21	