

## Kentucky Physics Standards Correlation

*Program of Studies - Science - High School*  
 (Only the *Big Ideas* related to physics are shown.)

	Physics for Scientists and Engineers	Principles of Physics	Conceptual Physics	Virtual Physics Labs
<b>Big Idea: Structure and Transformation of Matter (Physical Science)</b>				

**High School Enduring Knowledge – Understandings**

*Students will understand that*

<ul style="list-style-type: none"> <li>• the configuration of atoms in a molecule determines the molecule's properties. Shapes are particularly important in how molecules interact with others.</li> </ul>	21.12, 21.15	21.11, 21.14		
<ul style="list-style-type: none"> <li>• an enormous variety of biological, chemical and physical phenomena can be explained by changes in the arrangement and motion of atoms and molecules.</li> </ul>				
<ul style="list-style-type: none"> <li>• when elements are listed in order by their number of protons, the same sequence of properties appears over and over again in the list. The structure of the periodic table reflects this sequence of properties, which is caused by the repeating pattern of outermost electrons.</li> </ul>				
<ul style="list-style-type: none"> <li>• not all atoms of an element are truly identical. Some may vary in their number of neutrons (isotopes) or electrons (ions). These variations result in properties which are different than the more common forms of that element.</li> </ul>	44.3	43.3	38.3	
<ul style="list-style-type: none"> <li>• Changes of state occur when enough energy is added to or removed from the atoms/molecules of a substance to change their average energy of vibration. Most solids expand as they are heated, and if sufficient energy is added the atoms/molecules lose their rigid structure and become free to move past each other as a liquid. In gases the energy of vibration is enough that individual atoms/molecules are free to move independently.</li> </ul>	19.21	19.18	18.14	

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<ul style="list-style-type: none"> <li>elements are able to form an almost limitless variety of chemical compounds by the sharing or exchange of their electrons. The rate at which these combinations occur is influenced by a number of variables. The compounds produced may vary tremendously in their physical and chemical properties.</li> </ul>				
<ul style="list-style-type: none"> <li>chemical reactions have a variety of essential real-world applications, such as oxidation and various metabolic processes.</li> </ul>				
<ul style="list-style-type: none"> <li>a system may stay the same because nothing is happening or because things are happening but exactly counterbalance one another.</li> </ul>	Chapters 5, 6 and 12	Chapters 5, 6 and 12	Chapters 5 and 11	Helicopters in flight
<ul style="list-style-type: none"> <li>accurate record-keeping, openness and replication are essential for maintaining credibility with other scientists and society.</li> </ul>				

### High School Skills and Concepts

#### *Students will*

<ul style="list-style-type: none"> <li>classify samples of matter from everyday life as being elements, compounds, or mixtures</li> </ul>				
<ul style="list-style-type: none"> <li>Investigate the kinetic molecular theory of matter</li> </ul>	Chapter 20	Chapter 20	Chapter 19	Pressure, volume and temperature
<ul style="list-style-type: none"> <li>construct and/or interpret diagrams that illustrate ionic and covalent bonding</li> </ul>				
<ul style="list-style-type: none"> <li>predict compound formation and bond type as either ionic or covalent</li> </ul>				
<ul style="list-style-type: none"> <li>identify and test variables that affect reaction rates</li> </ul>				
<ul style="list-style-type: none"> <li>use evidence/data from chemical reactions to predict the effects of changes in variables (concentration, temperature, properties of reactants, surface area and catalysts)</li> </ul>				
<ul style="list-style-type: none"> <li>explore the relationships among temperature, particle number, pressure and volume in the Universal Gas Law</li> </ul>	20.2 - 20.10	20.2 - 20.10	19.2 - 19.9	Pressure, volume and temperature
<ul style="list-style-type: none"> <li>explain the organizational structure (design) and communicate the usefulness of the Periodic Table to determine potential combinations of elements</li> </ul>				
<ul style="list-style-type: none"> <li>investigate the role of intermolecular or intramolecular interactions on the physical properties (solubility, density, polarity, boiling/melting points) of compounds</li> </ul>				

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<ul style="list-style-type: none"> <li>relate the chemical behavior of an element, including bonding, to its location on the periodic table</li> </ul>				
<ul style="list-style-type: none"> <li>relate the structure of water to its function as the universal solvent</li> </ul>				
<ul style="list-style-type: none"> <li>design and conduct experiments to determine the conductivity of various materials</li> </ul>				
<ul style="list-style-type: none"> <li>create and/or interpret graphs and equations to depict and analyze patterns of change</li> </ul>	Throughout the book	Throughout the book	Throughout the book	<ul style="list-style-type: none"> <li>Helicopters in flight</li> <li>Pressure, volume and temperature</li> <li>Electric golf</li> <li>Generators and transformers</li> </ul>
<ul style="list-style-type: none"> <li>explore real-life applications of a variety of chemical reactions (e.g., acids and bases, oxidation, rusting, tarnishing) and communicate findings/present evidence in an authentic form (transactive writing, public speaking, multimedia presentations)</li> </ul>				
<ul style="list-style-type: none"> <li>generate investigable questions and conduct experiments or non-experimental research to address them, using evidence to defend conclusions</li> </ul>				All labs

### Big Idea: Motion and Forces (Physical Science)

#### High School Enduring Knowledge – Understandings

*Students will understand that*

<ul style="list-style-type: none"> <li>representing and describing motion in a variety of ways provides data that can be used to construct explanations and make predictions about real-life phenomena.</li> </ul>	Chapters 2 - 11	Chapters 2 - 11	Chapters 2 - 10	<ul style="list-style-type: none"> <li>Skee-Ball</li> <li>Firing a cannon</li> <li>Juggling objects</li> <li>Navigating race tracks</li> </ul>
<ul style="list-style-type: none"> <li>the usefulness of a model can be tested by comparing its predictions to actual observations in the real world. But a close match does not necessarily mean that the model is the only “true” model or the only one that would work.</li> </ul>				All labs
<ul style="list-style-type: none"> <li>all motion is relative to whatever frame of reference is chosen, for there is no motionless frame from which to judge all motion.</li> </ul>	4.22	4.21	4.14	

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	Physics for Scientists and Engineers	Principles of Physics	Conceptual Physics	Virtual Physics Labs
<ul style="list-style-type: none"> <li>the strength of the gravitational force between objects is proportional to the masses and weakens rapidly with increasing distance between them.</li> </ul>	13.1	13.1	12.1	·Orbiting satellites
<ul style="list-style-type: none"> <li>electricity and magnetism are two inseparable aspects of the same force (electromagnetism). Moving electrical charges produce magnetic forces and moving magnetic fields produce electrical forces. Electrical current is due to the motion of charge and has a specific direction.</li> </ul>	27.1, Chapters 31, 32	27.1, Chapters 31, 32	25.1, Chapters 28, 29	·Generators and transformers
<ul style="list-style-type: none"> <li>electromagnetic forces acting within and between atoms are vastly stronger than the gravitational forces acting between the atoms. At the atomic level, electric forces between oppositely charged electrons and protons hold atoms and molecules together and thus are involved in all chemical reactions. On a larger scale, these forces hold solid and liquid materials together and act between objects when they are in contact—as in sticking or sliding friction.</li> </ul>	23.10 - 23.11, 42.9	23.10 - 23.11, 42.9	22.9 - 22.10, 36.8	
<ul style="list-style-type: none"> <li>the forces that hold the nucleus of an atom together are much stronger than the electromagnetic force. That is why such great amounts of energy are released from the nuclear reactions in the sun and other stars.</li> </ul>	44.5 - 44.14	43.5 - 43.14	38.5 - 38.14	

### High School Skills and Concepts

*Students will*

<ul style="list-style-type: none"> <li>design and conduct investigations involving the motion of objects and report the results in a variety of ways</li> </ul>	2.0, 2.7, 4.0, 4.10, 4.14, 7.0, 8.0, 9.0, 10.0, 11.0	2.0, 2.7, 4.0, 4.9, 4.13, 7.0, 8.0, 9.0, 10.0, 11.0	2.0, 2.7, 4.0, 4.5, 4.9, 6.0, 7.0, 8.0, 9.0, 10.0	·Skee-Ball ·Firing a cannon ·Juggling objects ·Navigating race tracks
<ul style="list-style-type: none"> <li>investigate Newton's Laws of Motion and Gravitation. Experimentally test inertia and gravitational acceleration</li> </ul>	5.0, 13.0	5.0, 13.0	5.0, 12.0	·Helicopters in flight ·Orbiting satellites
<ul style="list-style-type: none"> <li>experimentally test conservation of momentum. Use tables, charts and graphs in making arguments and claims in oral and written presentations</li> </ul>	8.0	8.0	7.0	

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<ul style="list-style-type: none"> <li>create and analyze graphs, ensuring that they do not misrepresent results by using inappropriate scales or by failing to specify the axes clearly</li> </ul>				<ul style="list-style-type: none"> <li>Helicopters in flight</li> <li>Pressure, volume and temperature</li> <li>Electric golf</li> <li>Generators and transformers</li> </ul>
<ul style="list-style-type: none"> <li>develop investigable questions that guide explorations of the interrelationship between electricity and magnetism</li> </ul>				<ul style="list-style-type: none"> <li>Generators and transformers</li> </ul>
<ul style="list-style-type: none"> <li>investigate the attraction and repulsion of electrical charges to predict the behavior of charged objects</li> </ul>	23.0	23.0	22.0	<ul style="list-style-type: none"> <li>Electric golf</li> </ul>
<ul style="list-style-type: none"> <li>create conceptual and mathematical models of motion and test them against real-life phenomena</li> </ul>	Chapters 2-11	Chapters 2-11	Chapters 2-10	<ul style="list-style-type: none"> <li>Skee-Ball</li> <li>Firing a cannon</li> <li>Juggling objects</li> <li>Navigating race tracks</li> </ul>
<ul style="list-style-type: none"> <li>explain why the strength of the nuclear force is responsible for the great energy release involved in nuclear reactions</li> </ul>	44.5 - 44.14	43.5 - 43.14	38.5 - 38.14	
<ul style="list-style-type: none"> <li>predict which forces would be predominant in a given system and explain</li> </ul>	Chapter 5	Chapter 5	Chapter 5	

### Big Idea: The Earth and the Universe (Earth/Space Science)

#### High School Enduring Knowledge – Understandings

*Students will understand that*

<ul style="list-style-type: none"> <li>gravity played an essential role in the formation of the universe and is one of the fundamental forces that controls the function of the universe and the systems within it.</li> </ul>	13.1	13.1	12.1	
<ul style="list-style-type: none"> <li>current estimates of the ages of the Earth (4.6 billion years) and the universe (10+ billion years) are based on a variety of measurement techniques that have unique strengths and limitations. The same evidence that establishes the extreme age of the universe also indicates its vastness.</li> </ul>				
<ul style="list-style-type: none"> <li>stars have cycles of birth and death, and the lives of large stars end in explosions that provide the elements to create new stars and planets. All living things on Earth are also formed from this recycled matter.</li> </ul>				

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	Physics for Scientists and Engineers	Principles of Physics	Conceptual Physics	Virtual Physics Labs
<ul style="list-style-type: none"> <li>the speed of light is dwarfed by the vastness of the universe, resulting in the human view of the sky being essentially a “look back in time” as we view light that was emitted long in the past and has been traveling across the cosmos to reach Earth.</li> </ul>	35.0	34.0	30.0	
<ul style="list-style-type: none"> <li>the shape and location of the continents have been gradually changing for millions of years because density differences inside the mantle result in convection currents. These changes, as well as more rapid ones (e.g. earthquakes, volcanoes, tsunamis) can impact living organisms.</li> </ul>				
<ul style="list-style-type: none"> <li>mathematical models and computer simulations are used in studying evidence from many sources to form a scientific account of the universe.</li> </ul>				
<ul style="list-style-type: none"> <li>scientists rely on increasingly sophisticated methods of measurement in order to investigate a variety of phenomena that were previously immeasurable.</li> </ul>				
<ul style="list-style-type: none"> <li>curiosity, honesty, openness and skepticism are highly regarded in science, and are incorporated into the way science is carried out.</li> </ul>				

### High School Skills and Concepts

#### *Students will*

<ul style="list-style-type: none"> <li>compare methods used to measure the ages of geologic features</li> </ul>				
<ul style="list-style-type: none"> <li>research the historical rise in acceptance of the theory of Plate Tectonics and the geological/biological consequences of plate movement</li> </ul>				
<ul style="list-style-type: none"> <li>analyze the supporting evidence for the nebular theory of formation of the solar system</li> </ul>				
<ul style="list-style-type: none"> <li>analyze the supporting evidence for the Big Bang theory of formation of the universe</li> </ul>				
<ul style="list-style-type: none"> <li>explain the role of gravity in the formation and function of the universe</li> </ul>	Chapter 13	Chapter 13	Chapter 12	<ul style="list-style-type: none"> <li>·Orbiting satellites</li> <li>·Mission to Mars</li> </ul>
<ul style="list-style-type: none"> <li>investigate, describe and document patterns of interaction of matter and gravity</li> </ul>	Chapter 13	Chapter 13	Chapter 12	<ul style="list-style-type: none"> <li>·Orbiting satellites</li> <li>·Mission to Mars</li> </ul>
<ul style="list-style-type: none"> <li>describe the life cycle of stars and the products/consequences of their deaths</li> </ul>				

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<ul style="list-style-type: none"> <li>explain how technological solutions permit the study of phenomena too faint, small, distant or slow to be directly measured</li> </ul>				
<ul style="list-style-type: none"> <li>employ scientific notation to communicate and compare astronomical phenomena</li> </ul>	1.3, 1.11 - 1.13	1.3, 1.11 - 1.13	1.3	<ul style="list-style-type: none"> <li>Orbiting satellites</li> <li>Mission to Mars</li> </ul>
<ul style="list-style-type: none"> <li>explore real-life implications of current findings in Earth/space research and communicate findings in an authentic form, exemplifying the traits of curiosity, honesty, openness and skepticism</li> </ul>				

### Big Idea: Energy Transformations (Unifying Concepts)

#### High School Enduring Knowledge – Understandings

*Students will understand that*

<ul style="list-style-type: none"> <li>transformations that occur within the nuclei of atoms release vastly greater energy than those that involve only electrons, and result in the emission of radiation and/or transformation of elements.</li> </ul>	Chapter 44	Chapter 43	Chapter 38	
<ul style="list-style-type: none"> <li>while the total amount of energy in the universe is constant, the amount that is available for useful transformations is always decreasing. Systems within the universe will cease to function once the energy differential becomes zero.</li> </ul>	Chapters 7 and 22	Chapters 7 and 22	Chapters 6 and 21	
<ul style="list-style-type: none"> <li>waves, including electromagnetic radiation, are an important form of energy transfer. Waves are governed by rules that can be investigated and used to predict/explain their behavior.</li> </ul>	Chapters 16, 17, 18, 35	Chapters 16, 17, 18, 34	Chapters 15, 16, 17, 30	<ul style="list-style-type: none"> <li>Birds on a wire</li> <li>Playing Beethoven's Fifth Symphony</li> </ul>
<ul style="list-style-type: none"> <li>many elements and compounds are involved in continuous cyclic processes where they are stored by and/or flow between organisms and the environment. These processes require a continuous supply of energy to occur.</li> </ul>				
<ul style="list-style-type: none"> <li>radiant energy from the sun is stored in a chemical form in plants as a result of photosynthesis. This energy transformation allows plants to use simple molecules, such as carbon dioxide and water, to assemble the complex molecules needed to increase their mass.</li> </ul>				

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<ul style="list-style-type: none"> <li>energy stored in food is released by a series of internal chemical reactions that reorganize the molecules into a form useable by the organism.</li> </ul>				
<ul style="list-style-type: none"> <li>a variety of carbon compounds are essential to the processes that occur in all organisms.</li> </ul>				
<ul style="list-style-type: none"> <li>heat is a manifestation of the random motion and vibrations of atoms or molecules within a substance. Interactions between or among atoms or molecules naturally move toward states of higher disorder.</li> </ul>	19.7, 19.9, 22.5, 22.8, 22.18	19.5, 19.7, 22.5, 22.8, 22.9	18.5, 18.6, 21.4 - 21.6	
<ul style="list-style-type: none"> <li>many different sources of energy are used for a variety of purposes, including powering machines designed to do useful work. Regardless of function or energy source, the useful energy output of any machine is always less than the total energy input.</li> </ul>	22.2, Chapter 22	22.2, Chapter 22	21.2, Chapter 21	
<ul style="list-style-type: none"> <li>all Earth systems/processes require either an internal or external source of energy to function. Changes to any component, or to the quantity or type of energy input, may influence all components of the system.</li> </ul>	7.22, Chapter 7	7.19, Chapter 7	6.16, Chapter 6	
<ul style="list-style-type: none"> <li>weather and climate are the direct or indirect result of transfer of solar energy, and changes in one part of the system may influence all of the others. The complexity of the system and the number of variables involved requires very complex mathematical models in order to make accurate predictions.</li> </ul>				
<ul style="list-style-type: none"> <li>technological problems often create a demand for new scientific knowledge, and new technologies make it possible for scientists to conduct their research more effectively or to conduct new lines of research. The availability of new technology often sparks scientific advances.</li> </ul>	14.7, 24.13, 29.25, 30.11, 30.15, 40.3, 40.22, 42.24	14.7, 24.13, 29.25, 30.12, 30.16, 39.3, 39.16, 41.23	13.6, 23.10, 28.12, 28.15, 36.20	

## Kentucky Physics Standards Correlation

	Physics for Scientists and Engineers	Principles of Physics	Conceptual Physics	Virtual Physics Labs
<ul style="list-style-type: none"> <li>technology affects society because it solves practical problems and serves human needs. Science affects society by stimulating thought or satisfying curiosity, or by influencing views of the world, or by providing knowledge necessary for new technological advances.</li> </ul>	11.19, 14.22, 23.15, 28.4, 28.19, 30.3, 30.5, 30.27, 32.16, 35.27, 38.18, 40.3, 40.22, 42.18, 42.19, 42.20, 42.24	11.14, 14.22, 23.15, 28.4, 28.16, 30.3, 30.5, 30.26, 32.13, 34.23, 37.16, 39.3, 39.16, 41.17, 41.18, 41.19, 41.23	10.7, 13.15, 22.12, 26.3, 26.11, 28.3, 28.5, 28.19, 30.10, 33.12, 36.15, 36.16, 36.20	

### High School Skills and Concepts

*Students will*

<ul style="list-style-type: none"> <li>classify and describe nuclear reactions and their products</li> </ul>	44.13 - 44.16	43.13 - 43.16	38.13 - 38.15	
<ul style="list-style-type: none"> <li>investigate the forces inside the nucleus and evaluate the risk/benefits of nuclear energy</li> </ul>	44.5, 44.13	43.5, 43.13	38.5, 38.13	
<ul style="list-style-type: none"> <li>apply the law of conservation of energy and explore heat flow in real-life phenomena</li> </ul>	7.22 - 7.25, 19.25 - 19.30, Chapters 21,22	7.19 - 7.22, 19.22 - 19.27, Chapters 21,22	6.16 - 6.19, 18.17 - 18.20, Chapters 20,21	
<ul style="list-style-type: none"> <li>investigate waves, the rules describing wave behavior and energy transfer via waves in real life phenomena (e.g., nuclear medicine, industrial applications)</li> </ul>	Chapters 16, 17, 18	Chapters 16, 17, 18	Chapters 15, 16, 17	<ul style="list-style-type: none"> <li>Birds on a wire</li> <li>Playing Beethoven's Fifth Symphony</li> </ul>
<ul style="list-style-type: none"> <li>investigate the flow of matter and energy between organisms and the environment and model the cyclic nature of this process</li> </ul>				
<ul style="list-style-type: none"> <li>explain the metabolic process of photosynthesis and describe the molecules it assembles to store solar energy</li> </ul>				
<ul style="list-style-type: none"> <li>describe the metabolic processes that allow energy stored in food to be made available to the organism</li> </ul>				
<ul style="list-style-type: none"> <li>explore the composition and function of the carbon compounds involved in metabolism</li> </ul>				
<ul style="list-style-type: none"> <li>apply the concept of entropy to molecular interactions and to interactions within the universe</li> </ul>	22.5 - 22.8, 22.18 - 22.19	22.5 - 22.9	21.4 - 21.6	
<ul style="list-style-type: none"> <li>analyze a variety of energy sources, their potential uses and their relative costs/benefits</li> </ul>				
<ul style="list-style-type: none"> <li>investigate the relationship of energy input vs. useful energy output in mechanical systems</li> </ul>	Chapters 21, 22	Chapters 21, 22	Chapters 20, 21	

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<ul style="list-style-type: none"> <li>• model and explain the relationships and energy flow existing in various Earth systems</li> </ul>				
<ul style="list-style-type: none"> <li>• use weather data to model the complex interactions responsible for weather and climate</li> </ul>				
<ul style="list-style-type: none"> <li>• describe how science and technology interact. Research and investigate the impact of technology on society and how technological advances have driven scientific research</li> </ul>				