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**Correlated to:**  
**Kentucky Combined Curriculum Document – Science**  
**(High School)**

<b>KENTUCKY COMBINED CURRICULUM DOCUMENT - SCIENCE</b>	<b>PAGE(S) WHERE TAUGHT (If submission is not a text, cite appropriate resource(s))</b>
Big Idea: Structure and Transformation of Matter (Physical Science) High School	
A basic understanding of matter is essential to the conceptual development of other big ideas in science. By high school, students will be dealing with evidence from both direct and indirect observations (microscopic level and smaller) to consider theories related to change and conservation of matter. The use of models (and an understanding of their scales and limitations) is an effective means of learning about the structure of matter. Looking for patterns in properties is also critical to comparing and explaining differences in matter.	
Academic Expectations	
2.1 Students understand scientific ways of thinking and working and use those methods to solve real-life problems.	SE/TE: 2, 4, 7, 12, 28, 46, 55, 68, 75, 76, 86, 88, 97, 105, 106, 109, 124, 132, 144, 147, 169, 170, 173, 179, 188, 190, 200, 211, 212, 215, 231, 232, 253, 262, 267, 282, 302, 324, 326, 344, 352, 362, 364, 369, 381, 382, 387, 403, 406, 409, 419, 430, 433, 435, 436, 449, 450, 455, 467, 468, 471, 478, 490, 494, 513, 514, 531, 532, 539, 544, 554, 559, 563, 577, 578, 581, 590, 601, 602, 615, 621, 622, 627, 632, 641, 644, 655, 664, 680, 701, 702, 719, 720, 725, 739, 740, 766, 782, 808
2.2 Students identify, analyze, and use patterns such as cycles and trends to understand past and present events and predict possible future events.	SE/TE: 2-4, 7
2.4 Students use the concept of scale and scientific models to explain the organization and functioning of living and nonliving things and predict other characteristics that might be observed.	SE/TE: 2-4, 335, 436, 493, 533, 767, 772-775
2.5 Students understand that under certain conditions nature tends to remain the same or move toward a balance.	SE/TE: 15-19, 16, 188-204, 410, 454
Program of Studies: Understandings	
SC-H-STM-U-1 - Students will understand that the configuration of atoms in a molecule determines the molecule's properties. Shapes are particularly important in how molecules interact with others.	SE/TE: 325-326, 327, 328-329, 330, 331

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<p>SC-H-STM-U-2 - Students will understand that an enormous variety of biological, chemical and physical phenomena can be explained by changes in the arrangement and motion of atoms and molecules.</p>	<p>SE/TE: 334-335, 450-461</p>
<p>SC-H-STM-U-3 - Students will understand that 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.</p>	<p>SE/TE: 335-336</p>
<p>SC-H-STM-U-4 - Students will understand that 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</p>	<p>SE/TE: 331, 333, 646, 788-789</p>
<p>SC-H-STM-U-5 - Students will understand that 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.</p>	<p>SE/TE: 337, 345, 363, 382, 389-390, 406, 421-422, 451, 452-453, 454-455, 456-457, 458-461</p>
<p>SC-H-STM-U-6 - Students will understand that 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.</p>	<p>SE/TE: 331, 334</p>
<p>SC-H-STM-U-7 - Students will understand that chemical reactions have a variety of essential real-world applications, such as oxidation and various metabolic processes.</p>	<p>SE/TE: 160, 331, 334</p>

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SC-H-STM-U-8 - Students will understand that a system may stay the same because nothing is happening or because things are happening but exactly counterbalance one another.	SE/TE: 15-19, 16, 188-204, 410, 454
SC-H-STM-U-9 - Students will understand that accurate record-keeping, openness and replication are essential for maintaining credibility with other scientists and society.	SE/TE: 2-4
Program of Studies: Skills and Concepts	
SC-H-STM-S-1 - Students will classify samples of matter from everyday life as being elements, compounds, or mixtures	SE/TE: 325-326, 331
SC-H-STM-S-2 - Students will investigate the kinetic molecular theory of matter	SE/TE: 406, 408
SC-H-STM-S-3 - Students will construct and/or interpret diagrams that illustrate ionic and covalent bonding	SE/TE: 331, 334
SC-H-STM-S-4 - Students will predict compound formation and bond type as either ionic or covalent	SE/TE: 331, 334
SC-H-STM-S-5 - Students will identify and test variables that affect reaction rates	SE/TE: 331, 334
SC-H-STM-S-6 - Students will use evidence/data from chemical reactions to predict the effects of changes in variables (concentration, temperature, properties of reactants, surface area and catalysts)	SE/TE: 331, 334, 335, 336
SC-H-STM-S-7 - Students will explore the relationships among temperature, particle number, pressure and volume in the Universal Gas Law	SE/TE: 389-390
SC-H-STM-S-8 - Students will explain the organizational structure (design) and communicate the usefulness of the Periodic Table to determine potential combinations of elements	SE/TE: 335-336

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SC-H-STM-S-9 - Students will investigate the role of intermolecular or intramolecular interactions on the physical properties (solubility, density, polarity, boiling/melting points) of compounds	SE/TE: 346-347, 348-349, 350-352, 354-355, 363-365, 366-368, 369-370, 371-371, 373-374, 391, 421-422
SC-H-STM-S-10 - Students will relate the chemical behavior of an element, including bonding, to its location on the periodic table	SE/TE: 335-336
SC-H-STM-S-11 - Students will relate the structure of water to its function as the universal solvent	SE/TE: 415, 419-422
SC-H-STM-S-12 - Students will design and conduct experiments to determine the conductivity of various materials	SE/TE: 684
SC-H-STM-S-13 - Students will create and/or interpret graphs and equations to depict and analyze patterns of change	SE/TE: 57-58, 834-836
SC-H-STM-S-14 - Students will 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)	SE/TE: 160, 331, 334
SC-H-STM-S-15 - Students will generate investigable questions and conduct experiments or non-experimental research to address them, using evidence to defend conclusions.	SE/TE: 2, 4, 7, 12, 28, 46, 55, 68, 75, 76, 86, 88, 97, 105, 106, 109, 124, 132, 144, 147, 169, 170, 173, 179, 188, 190, 200, 211, 212, 215, 231, 232, 253, 262, 267, 282, 302, 324, 326, 344, 352, 362, 364, 369, 381, 382, 387, 403, 406, 409, 419, 430, 433, 435, 436, 449, 450, 455, 467, 468, 471, 478, 490, 494, 513, 514, 531, 532, 539, 544, 554, 559, 563, 577, 578, 581, 590, 601, 602, 615, 621, 622, 627, 632, 641, 644, 655, 664, 680, 701, 702, 719, 720, 725, 739, 740, 766, 782, 808

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Related Core Content for Assessment	
SC-HS-1.1.1 - Students will classify or make generalizations about elements from data of observed patterns in atomic structure and/or position on the periodic table. The periodic table is a consequence of the repeating pattern of outermost electrons. DOK 2	SE/TE: 335-336
SC-HS-1.1.2 - Students will understand that the atom's nucleus is composed of protons and neutrons that are much more massive than electrons. When an element has atoms that differ in the number of neutrons, these atoms are called different isotopes of the element.	SE/TE: 331, 333, 646, 788-789
SC-HS-1.1.3 - Students will understand that solids, liquids and gases differ in the distances between molecules or atoms and therefore the energy that binds them together. In solids, the structure is nearly rigid; in liquids, molecules or atoms move around each other but do not move apart; and in gases, molecules or atoms move almost independently of each other and are relatively far apart. The behavior of gases and the relationship of the variables influencing them can be described and predicted.	SE/TE: 337, 344-345, 382
SC-HS-1.1.4 - Students will understand that in conducting materials, electrons flow easily; whereas, in insulating materials, they can hardly flow at all. Semiconducting materials have intermediate behavior. At low temperatures, some materials become superconductors and offer no resistance to the flow of electrons.	SE/TE: 431-432, 651-652
SC-HS-1.1.5 - Students will explain the role of intermolecular or intramolecular interactions on the physical properties (solubility, density, polarity, conductivity, boiling/melting points) of compounds. The physical properties of compounds reflect the nature of the interactions among molecules. These interactions are determined by the structure of the molecule including the constituent atoms. DOK 2	SE/TE: 346-347, 348-349, 350-352, 354-355, 363-365, 366-368, 369-370, 371-371, 373-374, 391, 421-422

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<p>SC-HS-1.1.6 - Students will: identify variables that affect reaction rates; predict effects of changes in variables (concentration, temperature, properties of reactants, surface area and catalysts) based on evidence/data from chemical reactions. Rates of chemical reactions vary. Reaction rates depend on concentration, temperature and properties of reactants. Catalysts speed up chemical reactions. DOK 3</p>	<p>SE/TE: 331, 334</p>
<p>SC-HS-1.1.7 - Students will: construct diagrams to illustrate ionic or covalent bonding; predict compound formation and bond type as either ionic or covalent (polar, nonpolar) and represent the products formed with simple chemical formulas. Bonds between atoms are created when outer electrons are paired by being transferred (ionic) or shared (covalent). A compound is formed when two or more kinds of atoms bind together chemically. DOK 2</p>	<p>SE/TE: 331, 334</p>
<p>SC-HS-1.1.8 - Students will: explain the importance of chemical reactions in a real-world context; justify conclusions using evidence/data from chemical reactions. Chemical reactions (e.g., acids and bases, oxidation, combustion of fuels, rusting, tarnishing) occur all around us and in every cell in our bodies. These reactions may release or absorb energy. DOK 3</p>	<p>SE/TE: 160, 331, 334</p>

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Big Idea: Motion and Forces (Physical Science) High School	
Whether observing airplanes, baseballs, planets, or people, the motion of all bodies is governed by the same basic rules. At the middle level, qualitative descriptions of the relationship between forces and motion will provide the foundation for quantitative applications of Newton's Laws. These ideas are more fully developed at the high school level along with the use of models to support evidence of motion in abstract or invisible phenomena such as electromagnetism.	
Academic Expectations	
2.1 Students understand scientific ways of thinking and working and use those methods to solve real-life problems.	SE/TE: 2, 4, 7, 12, 28, 46, 55, 68, 75, 76, 86, 88, 97, 105, 106, 109, 124, 132, 144, 147, 169, 170, 173, 179, 188, 190, 200, 211, 212, 215, 231, 232, 253, 262, 267, 282, 302, 324, 326, 344, 352, 362, 364, 369, 381, 382, 387, 403, 406, 409, 419, 430, 433, 435, 436, 449, 450, 455, 467, 468, 471, 478, 490, 494, 513, 514, 531, 532, 539, 544, 554, 559, 563, 577, 578, 581, 590, 601, 602, 615, 621, 622, 627, 632, 641, 644, 655, 664, 680, 701, 702, 719, 720, 725, 739, 740, 766, 782, 808
2.2 Students identify, analyze and use patterns such as cycles and trends to understand past and present events and predict possible future events.	SE/TE: 2-4, 7
2.3 Students identify and analyze systems and the ways their components work together or affect each other.	SE/TE: 112-113
Program of Studies: Understandings	
SC-H-MF-U-1 - Students will understand that 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.	SE/TE: 18, 29, 30, 31, 32, 38-39, 47, 48-49, 50, 51-52, 53-55, 56, 57-58, 59, 69, 70, 71, 72, 73, 74, 75-79, 87, 171-174, 192-194, 213-215, 216, 218, 263-268, 269-275
SC-H-MF-U-2 - Students will understand that 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.	SE/TE: 2-4, 29-32, 335, 436, 493, 533, 767, 772-775

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SC-H-MF-U-3 - Students will understand that all motion is relative to whatever frame of reference is chosen, for there is no motionless frame from which to judge all motion.	SE/TE: 283-286, 287-291, 292-293, 294-295
SC-H-MF-U-4 - Students will understand that the strength of the gravitational force between objects is proportional to the masses and weakens rapidly with increasing distance between them.	SE/TE: 195-196, 198, 223-225, 233-235, 237-239, 240-241, 242-243, 244, 245-246, 247, 248, 249-254, 308-316
SC-H-MF-U-5 - Students will understand that 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.	SE/TE: 645-647, 648-650, 652, 653-654, 655-657, 665-667, 668-671, 672-674, 681, 682, 683, 684, 685, 686-689, 690, 691-692, 693-694, 705, 705-706, 707, 710-712, 721-725, 726-727, 728, 729, 732-733, 741-742, 743-745, 746, 747-749, 751
SC-H-MF-U-6 - Students will understand that 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.	SE/TE: 331-333, 647, 774-775, 783-784
SC-H-MF-U-7 - Students will understand that 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.	SE/TE: 331-333, 647, 774-775, 783-784
Program of Studies: Skills and Concepts	
SC-H-MF-S-1 - Students will design and conduct investigations involving the motion of objects and report the results in a variety of ways	SE/TE: 18, 29, 30, 31, 32, 38-39, 47, 48-49, 50, 51-52, 53-55, 56, 57-58, 59, 69, 70, 71, 72, 73, 74, 75-79, 87, 171-174, 192-194, 213-215, 216, 218, 263-268, 269-275

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SC-H-MF-S-2 - Students will investigate Newton's Laws of Motion and Gravitation. Experimentally test inertia and gravitational acceleration	SE/TE: 33-34, 36-38, 88-89, 90-92, 93-97, 108-109, 110-111, 114-116, 195-204, 213-215, 223-225
SC-H-MF-S-3 - Students will experimentally test conservation of momentum. Use tables, charts and graphs in making arguments and claims in oral and written presentations	SE/TE: 125-132, 133-134, 135-136, 219-220, 221-222, 303-304
SC-H-MF-S-4 - Students will create and analyze graphs, ensuring that they do not misrepresent results by using inappropriate scales or by failing to specify the axes clearly	SE/TE: 57-58, 834-836
SC-H-MF-S-5 - Students will develop investigable questions that guide explorations of the interrelationship between electricity and magnetism	SE/TE: 645-647, 648-650, 652, 653-654, 655-657, 665-667, 668-671, 672-674, 681, 682, 683, 684, 685, 686-689, 690, 691-692, 693-694, 705, 705-706, 707, 710-712, 721-725, 726-727, 728, 729, 732-733, 741-742, 743-745, 746, 747-749, 751
SC-H-MF-S-6 - Students will investigate the attraction and repulsion of electrical charges to predict the behavior of charged objects	SE/TE: 645-646, 656
SC-H-MS-S-7 - Students will create conceptual and mathematical models of motion and test them against real-life phenomena	SE/TE: 18, 29, 30, 31, 32, 38-39, 47, 48-49, 50, 51-52, 53-55, 56, 57-58, 59, 69, 70, 71, 72, 73, 74, 75-79, 87, 171-174, 192-194, 213-215, 216, 218, 263-268, 269-275
SC-H-MF-S-8 - Students will explain why the strength of the nuclear force is responsible for the great energy release involved in nuclear reactions	SE/TE: 785-786, 809-811, 81-815, 816, 817-820, 821-824
SC-H-MF-S-9 - Students predict which forces would be predominant in a given system and explain	SE/TE: 13, 14, 16, 17, 18, 19-22, 87, 90-92, 93, 107, 108-109, 110-111, 116, 145-146, 175-177, 178-180, 189-190, 191-192

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Related Core Content for Assessment	
SC-HS-1.2.1 - Students will: select or construct accurate and appropriate representations for motion (visual, graphical and mathematical); defend conclusions/explanations about the motion of objects and real-life phenomena from evidence/data. Objects change their motion only when a net force is applied. Newton's Laws of motion are used to describe the effects of forces on the motion of objects. Conservation of mechanical energy and conservation of momentum may also be used to predict motion. DOK 3	SE/TE: 18, 29, 30, 31, 32, 33-34, 36-37, 38-39, 47, 48-49, 50, 51-52, 53-55, 56, 57-58, 59, 69, 70, 71, 72, 73, 74, 75-79, 87, 88-89, 90-92, 93-97, 108-109, 110-111, 114-116, 125-132, 133-134, 135-136, 171-174, 192-194, 195-204, 213-215, 216, 218, 219-220, 221-222, 223-225, 263-268, 269-275, 303-304
SC-HS-1.2.2 - Students will: explain the relationship between electricity and magnetism; propose solutions to real life problems involving electromagnetism. Electricity and magnetism are two aspects of a single electromagnetic force. Moving electric charges produce magnetic forces or "fields" and moving magnets produce electric forces or "fields". This idea underlies the operation of electric motors and generators. DOK 3	SE/TE: 645-647, 648-650, 652, 653-654, 655-657, 665-667, 668-671, 672-674, 681, 682, 683, 684, 685, 686-689, 690, 691-692, 693-694, 705, 705-706, 707, 710-712, 721-725, 726-727, 728, 729, 732-733, 741-742, 743-745, 746, 747-749, 751
SC-HS-1.2.3 - Students will understand that the electric force is a universal force that exists between any two charged objects. Opposite charges attract while like charges repel.	SE/TE: 645-646, 656

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Big Idea: Energy Transformations (Unifying Concepts) High School	
Energy transformations are inherent in almost every system in the universe—from tangible examples at the elementary level, such as heat production in simple Earth and physical systems to more abstract ideas beginning at middle school, such as those transformations involved in the growth, dying and decay of living systems. The use of models to illustrate the often invisible and abstract notions of energy transfer will aid in conceptualization, especially as students move from the macroscopic level of observation and evidence (primarily elementary school) to the microscopic interactions at the atomic level (middle and high school levels). Students in high school expand their understanding of constancy through the study of a variety of phenomena. Conceptual understanding and application of the laws of thermodynamics connect ideas about matter with energy transformations within all living, physical and Earth systems.	
Academic Expectations	
2.1 Students understand scientific ways of thinking and working and use those methods to solve real-life problems.	SE/TE: 2, 4, 7, 12, 28, 46, 55, 68, 75, 76, 86, 88, 97, 105, 106, 109, 124, 132, 144, 147, 169, 170, 173, 179, 188, 190, 200, 211, 212, 215, 231, 232, 253, 262, 267, 282, 302, 324, 326, 344, 352, 362, 364, 369, 381, 382, 387, 403, 406, 409, 419, 430, 433, 435, 436, 449, 450, 455, 467, 468, 471, 478, 490, 494, 513, 514, 531, 532, 539, 544, 554, 559, 563, 577, 578, 581, 590, 601, 602, 615, 621, 622, 627, 632, 641, 644, 655, 664, 680, 701, 702, 719, 720, 725, 739, 740, 766, 782, 808
2.2 Students identify, analyze, and use patterns such as cycles and trends to understand past and present events and predict possible future events.	SE/TE: 2-4, 7
2.3 Students identify and analyze systems and the ways their components work together or affect each other.	SE/TE: 112-113
2.4 Students use the concept of scale and scientific models to explain the organization and functioning of living and nonliving things and predict other characteristics that might be observed.	SE/TE: 2-4, 335, 436, 493, 533, 767, 772-775
2.5 Students understand that under certain conditions nature tends to remain the same or move toward a balance.	SE/TE: 15-19, 16, 188-204, 410, 454

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Program of Studies: Understandings	
SC-H-ET-U-1 - Students will understand that 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.	SE/TE: 790-791, 792-794, 795-797, 798-799
SC-H-ET-U-2 - Students will understand that 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.	SE/TE: 153-154, 471, 475-478, 479
SC-H-ET-U-3 - Students will understand that 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.	SE/TE: 491-494, 495-496, 497, 498-499, 500-503, 504, 505-506, 517, 518, 519, 520, 521-523, 524-525, 536, 537-538, 539, 540-541, 542-543, 544-546, 556-558, 560-561, 562-563, 564-565, 566-567, 568-569, 570-573, 579, 580-585, 586, 587-590, 591-595, 603-609, 610-613, 614-616, 625-627, 628-630, 631-632, 633-634, 635-636
SC-H-ET-U-4 - Students will understand that 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.	SE/TE: 160, 161-162, 436, 559
SC-H-ET-U-5 - Students will understand that 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.	SE/TE: 160, 436, 559
SC-H-ET-U-6 - Students will understand that energy stored in food is released by a series of internal chemical reactions that reorganize the molecules into a form useable by the organism.	SE/TE: 160

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SC-H-ET-U-7 - Students will understand that a variety of carbon compounds are essential to the processes that occur in all organisms.	SE/TE: 160
SC-H-ET-U-8 - Students will understand that 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.	SE/TE: 409, 410, 411-412, 413-414, 415, 433-435, 470-471, 473, 474-475, 480-481
SC-H-ET-U-9 - Students will understand that 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.	SE/TE: 145-148, 149, 150, 151-152, 155-157, 158-160, 161-162
SC-H-ET-U-10 - Students will understand that 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.	SE/TE: 155-157, 158-160, 161-162
SC-H-ET-U-11 - Students will understand that 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.	SE/TE: 160, 415-416
SC-H-ET-U-12 - Students will understand that 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.	SE/TE: 5, 163, 204, 236, 248, 275, 290, 292, 476, 481, 518, 526, 611, 648, 673, 709, 727, 729, 745, 751, 756, 793, 817

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SC-H-ET-U-13 - Students will understand that 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.	SE/TE: 2-4, 5, 163, 204, 236, 248, 275, 290, 292, 476, 481, 518, 526, 611, 648, 673, 709, 727, 729, 745, 751, 756, 793, 817
Program of Studies: Skills and Concepts	
SC-H-ET-S-1 - Students will classify and describe nuclear reactions and their products	SE/TE: 785-786, 790-791, 792-794, 795, 796-797, 798-799
SC-H-ET-S-2 - Students will investigate the forces inside the nucleus and evaluate the risk/benefits of nuclear energy	SE/TE: 785-786, 809-811, 81-815, 816, 817-820, 821-824
SC-H-ET-S-3 - Students will apply the law of conservation of energy and explore heat flow in real-life phenomena	SE/TE: 153-154, 163, 433-435, 436, 437-443
SC-H-ET-S-4 - Students will investigate waves, the rules describing wave behavior and energy transfer via waves in real life phenomena (e.g., nuclear medicine, industrial applications)	SE/TE: 491-494, 495-496, 497, 498-499, 500-503, 504, 505-506, 517, 518, 519, 520, 521-523, 524-525, 536, 537-538, 539, 540-541, 542-543, 544-546, 556-558, 560-561, 562-563, 564-565, 566-567, 568-569, 570-573, 579, 580-585, 586, 587-590, 591-595, 603-609, 610-613, 614-616, 625-627, 628-630, 631-632, 633-634, 635-636
SC-H-ET-S-5 - Students will investigate the flow of matter and energy between organisms and the environment and model the cyclic nature of this process	SE/TE: 153-154, 163, 305-306
SC-H-ET-S-6 - Students will explain the metabolic process of photosynthesis and describe the molecules it assembles to store solar energy	SE/TE: 160
SC-H-ET-S-7 - Students will describe the metabolic processes that allow energy stored in food to be made available to the organism	SE/TE: 160
SC-H-ET-S-8 - Students will explore the composition and function of the carbon compounds involved in metabolism	SE/TE: 160

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SC-H-ET-S-9 - Students will apply the concept of entropy to molecular interactions and to interactions within the universe	SE/TE: 480-481
SC-H-ET-S-10 - Students will analyze a variety of energy sources, their potential uses and their relative costs/benefits	SE/TE: 145-148, 149, 150, 151-152, 155-157, 158-160, 161-162
SC-H-ET-S-11 - Students will investigate the relationship of energy input vs. useful energy output in mechanical systems	SE/TE: 155-157, 158-160
SC-H-ET-S-12 - Students will model and explain the relationships and energy flow existing in various Earth systems	SE/TE: 153-154, 471, 475-478, 479
SC-H-ET-S-13 - Students will use weather data to model the complex interactions responsible for weather and climate	SE/TE: 161, 415-416
SC-H-ET-S-14 - Students will describe how science and technology interact. Research and investigate the impact of technology on society and how technological advances have driven scientific research	SE/TE: 2-4, 5, 163, 204, 236, 248, 275, 290, 292, 476, 481, 518, 526, 611, 648, 673, 709, 727, 729, 745, 751, 756, 793, 817

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SC-H-ET-S-15 - Students will describe how science and technology interact. Research and investigate the impact of technology on society and how technological advances have driven scientific research	SE/TE: 2-4, 5, 163, 204, 236, 248, 275, 290, 292, 476, 481, 518, 526, 611, 648, 673, 709, 727, 729, 745, 751, 756, 793, 817
Related Core Content for Assessment	
SC-HS-4.6.1 - Students will: explain the relationships and connections between matter, energy, living systems and the physical environment; give examples of conservation of matter and energy. As matter and energy flow through different organizational levels (e.g., cells, organs, organisms, communities) and between living systems and the physical environment, chemical elements are recombined in different ways. Each recombination results in storage and dissipation of energy into the environment as heat. Matter and energy are conserved in each change. DOK 3	SE/TE: 153-154, 305-306
SC-HS-4.6.2 - Students will: predict wave behavior and energy transfer; apply knowledge of waves to real life phenomena/investigations. Waves, including sound and seismic waves, waves on water and electromagnetic waves, can transfer energy when they interact with matter. Apparent changes in frequency can provide information about relative motion. DOK 3	SE/TE: 491-494, 495-496, 497, 498-499, 500-503, 504, 505-506, 517, 518, 519, 520, 521-523, 524-525, 536, 537-538, 539, 540-541, 542-543, 544-546, 556-558, 560-561, 562-563, 564-565, 566-567, 568-569, 570-573, 579, 580-585, 586, 587-590, 591-595, 603-609, 610-613, 614-616, 625-627, 628-630, 631-632, 633-634, 635-636
SC-HS-4.6.3 - Students will understand that electromagnetic waves, including radio waves, microwaves, infrared radiation, visible light, ultraviolet radiation, x-rays and gamma rays result when a charged object is accelerated.	SE/TE: 491, 515, 516, 517, 536, 572, 753-755

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<p>SC-HS-4.6.4 - Students will: describe the components and reservoirs involved in biogeochemical cycles (water, nitrogen, carbon dioxide and oxygen); explain the movement of matter and energy in biogeochemical cycles and related phenomena. The total energy of the universe is constant. Energy can change forms and/or be transferred in many ways, but it can neither be created nor destroyed. Movement of matter between reservoirs is driven by Earth's internal and external sources of energy. These movements are often accompanied by a change in physical and chemical properties of the matter. Carbon, for example, occurs in carbonate rocks such as limestone, in the atmosphere as carbon dioxide gas, in water as dissolved carbon dioxide and in all organisms as complex molecules that control the chemistry of life. DOK 3</p>	<p>SE/TE: 160, 442-443</p>
<p>SC-HS-4.6.5 - Students will describe and explain the role of carbon-containing molecules and chemical reactions in energy transfer in living systems. Living systems require a continuous input of energy to maintain their chemical and physical organization since the universal tendency is toward more disorganized states. The energy for life primarily derives from the Sun. Plants capture energy by absorbing light and using it to break weaker bonds in reactants (such as carbon dioxide and water) in chemical reactions that result in the formation of carbon-containing molecules. These molecules can be used to assemble larger molecules (e.g., DNA, proteins, sugars, fats). In addition, the energy released when these molecules react with oxygen to form very strong bonds can be used as sources of energy for life processes. DOK 3</p>	<p>SE/TE: 160, 161</p>
<p>SC-HS-4.6.6 - Students will understand that heat is the manifestation of the random motion and vibrations of atoms.</p>	<p>SE/TE: 409, 410, 411-412, 413-414, 415, 433-435, 470-471, 473, 474-475</p>

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<p>SC-HS-4.6.7 - Students will: explain real world applications of energy using information/data; evaluate explanations of mechanical systems using current scientific knowledge about energy. The universe becomes less orderly and less organized over time. Thus, the overall effect is that the energy is spread out uniformly. For example, in the operation of mechanical systems, the useful energy output is always less than the energy input; the difference appears as heat. DOK 2</p>	<p>SE/TE: 155-157, 158-159, 470-471, 475-478, 479, 480-481</p>
<p>SC-HS-4.6.8 - Students will: describe the connections between the functioning of the Earth system and its sources of energy (internal and external); predict the consequences of changes to any component of the Earth system. Earth systems have sources of energy that are internal and external to the Earth. The Sun is the major external source of energy. Two primary sources of internal energy are the decay of radioactive isotopes and the gravitational energy from Earth's original formation. DOK 3</p>	<p>SE/TE: 154, 160, 161, 162, 249, 441-443, 785-786, 792, 793, 794</p>
<p>SC-HS-4.6.9 - Students will: explain the cause and effect relationship between global climate and weather patterns and energy transfer (cloud cover, location of mountain ranges, oceans); predict the consequences of changes to the global climate and weather patterns. Global climate is determined by energy transfer from the Sun at and near Earth's surface. This energy transfer is influenced by dynamic processes such as cloud cover and the Earth's rotation and static conditions such as the position of mountain ranges and oceans. DOK 3</p>	<p>SE/TE: 161, 415-416</p>

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<p>SC-HS-4.6.10 - Students will: identify the components and mechanisms of energy stored and released from food molecules (photosynthesis and respiration); apply information to real-world situations. Energy is released when the bonds of food molecules are broken and new compounds with lower energy bonds are formed. Cells usually store this energy temporarily in the phosphate bonds of adenosine triphosphate (ATP). During the process of cellular respiration, some energy is lost as heat. DOK 3</p>	<p>SE/TE: 160</p>
<p>SC-HS-4.6.11 - Students will: explain the difference between alpha and beta decay, fission and fusion; identify the relationship between nuclear reactions and energy. Nuclear reactions convert a fraction of the mass of interacting particles into energy, and they can release much greater amounts of energy than atomic interactions. Fission is the splitting of a large nucleus into smaller pieces. Fusion is the joining of two nuclei at extremely high temperature and pressure. Fusion is the process responsible for the energy of the Sun and other stars. DOK 2</p>	<p>SE/TE: 785- 786, 790-791, 792-794, 795, 796-797, 798-799, 809-811, 812-815, 816, 817-820, 821-824</p>
<p>SC-HS-4.6.12 - Students will understand that the forces that hold the nucleus together, at nuclear distances, are usually stronger than the forces that would make it fly apart.</p>	<p>SE/TE: 331-333, 783-785</p>