Correlation to Indiana's Science Academic Standards

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Standard #: Course	Standard	Topic	Objective	student text pg	detail	investigation pg	detail
CP.1.01 Integrated Chemistry - Physics	Standard 1: Principles of Integrated Chemistry – Physics	Structure and Properties of Matter	Understand and explain that atoms have a positive nucleus (consisting of relatively massive positive protons and neutral neutrons) surrounded by negative electrons, some of which may be lost, gained, or shared when interacting with other atoms.	311	location/size/charge of subatomic particles	132	building atom models
				311	protons/neutrons/electrons	133	location of electrons in atom
				318	proton/electron attraction	133	protons and neutrons
				324	use the periodic table to predict chemical formulas	136	ions
				324	which element is more likely to combine with other elements?	136	model stable and neutral atoms
				335	chemical bonding and the periodic table	137	build atomic models
				388	showing valence electrons in a diagram	140	find the number of electrons in outermost level
						140	review subatomic particles
						141	whan an atom ionizes
						141	modeling a chemical bond

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Standard #: Course	Standard	Topic	Objective	student text pg	detail	investigation pg	detail
CP.1.02 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Structure and Properties of Matter	Realize that and explain how a neutral atom's atomic number and mass number can be used to determine the number of protons, neutrons, and electrons that make up an atom.	315 315 316 322 322 322 322	atomic number discussed atoms of same element have same atomic number mass number discussed atomic mass on the periodic table mass number on the periodic table atomic number on the periodic table chemical symbols and element names	132 133 133 133 136 136 137	atomic number determines what element that atom is identify mass number identify atomic number identify element symbol and name mass number atomic number importance of atomic number
CP.1.03 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Structure and Properties of Matter	Understand, and give examples to show, that isotopes of the same element have the same numbers of protons and electrons but differ in the numbers of neutrons.	316	isotopes explained	133 136	exploring isotopes understanding isotopes

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Standard #: Course	Standard	Topic	Objective	student text pg	detail	investigation pg	detail
CP.1.04 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Structure and Properties of Matter	Know and explain that physical properties can be used to differentiate among pure substances, solutions, and heterogeneous mixtures.	278	mixtures can be separated by physical means	114	separating a homogeneous mixture
				291	density is independent of amount of substance		
				292	elasticity is a physical property of matter		
				292	hardness is a physical property of matter		
				293	brittleness is a physical property of matter		
				294	tensile strength is a physical property of matter		
				294	malleability is a physical property of matter		
CP.1.05 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Changes in Matter	Distinguish among chemical and physical changes in matter by identifying characteristics of these changes.	294	development of Kevlar brand fiber	146	investigate and observe chemical and physical changes in the lab
				353	physical and chemical changes and digestion		
				355	physical and chemical changes in tire recycling		
				372	determine if changes are chemical or physical		

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Standard #: Course	Standard	Topic	Objective	student text pg	detail	investigation pg	detail
CP.1.06 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Changes in Matter	Understand and explain how an atom can acquire an unbalanced electrical charge by gaining or losing electrons.	324 324 335	use the periodic table to predict chemical formulas which element is more likely to combine with other elements? chemical bonding and the periodic table	136 141 141	ions whan an atom ionizes modeling a chemical bond
CP.1.07 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Changes in Matter	Identify the substances gaining and losing electrons in simple oxidation-reduction reactions.	388	showing valence electrons in a diagram	136 140 141 143	ions find the number of electrons in outermost level whan an atom ionizes ionic compounds
CP.1.08 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Changes in Matter	Know and explain that the nucleus of a radioactive isotope is unstable and may spontaneously decay, emitting particles and/or electromagnetic radiation.	387	fusion and fission explained	138 160	fusion and fission radioactive decay
CP.1.09 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Changes in Matter	Show how the predictability of the nuclei decay rate allows radioactivity to be used for estimating the age of materials that contain radioactive substances.	393 393 400	carbon dating radioisotopes in science and medicine research pros and cons of nuclear technology	160 161	radioactive decay research pros and cons of uses for radioactive elements

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Standard #: Course	Standard	Topic	Objective	student text pg	detail	investigation pg	detail
CP.1.10 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Changes in Matter	Understand that the Periodic Table is a listing of elements arranged by increasing atomic number, and use it to predict whether a selected atom would gain, lose, or share electrons as it interacts with other selected atoms.	320	groups of elements	133	using the periodic table
				321	groups of elements and valence shells	136	ions
				321	studying the periodic table	136	building and studying the periodic table
				329	periodic table columns and valence electrons	141	build model of Na and Cl atoms and explain why they bond to form a molecule
				330	bonding and periodic table position	141	whan an atom ionizes
				332	periodic table and electronegativities	142	arrangement of electrons and groups of elements
				332	metals nonmetals and metalloids		
				335	periodic table and oxidation numbers		

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Standard #: Course	Standard	Topic	Objective	student text pg	detail	investigation pg	detail
CP.1.11 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Changes in Matter	Understand and give examples to show that an enormous variety of biological, chemical, and physical phenomena can be explained by changes in the arrangement and motion of atoms and molecules.	354	new substances are formed when a chemical change occurs	157	predict the products of double displacement reactions
				354	chemical reactions and digestion	162	investigating combustion reactions
				357	combustion reaction	162	carbon reactions and the environment
				361	heartburn reaction	162	structure of fossil fuels
				361	chemical reactions in living systems	162	importance of fossil fuels
				364	carbon chains		
				378	combustion reactions		
				378	consumer chemistry		
				381	MRE ration heater reaction		
				394	photosynthesis and carbon reactions		
				395	chemistry of the atmosphere		
				395	fossil fuels and carbon reactions		
				395	chemistry of the atmosphere		
				397	carbon reactions		
				444	chemical reactions and the formation of acid rain		
				487	simple sugars are transported to cells		

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Standard #: Course	Standard	Topic	Objective	student text pg	detail	investigation pg	detail
				487	chemical reactions in living systems		
				487	biomolecules and energy		
				488	fats proteins and carbohydrates		
				489	metabolism and stored energy		
CP.1.12 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Changes in Matter	Realize and explain that because mass is conserved in chemical reactions, balanced chemical equations must be used to show that atoms are conserved.	363	history of law of conservation of mass	149	balance these equations
				371	which of the equations is balanced?	150	investigate conservation of mass in effervescent tablet reaction

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Standard #: Course	Standard	Topic	Objective	student text pg	detail	investigation pg	detail
CP.1.13 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Changes in Matter	Explain that the rate of reactions among atoms and molecules depends on how often they encounter one another, which is in turn affected by the concentrations, pressures, and temperatures of the reacting materials.	361	chemical reactions in living systems	156	predict products in a double displacement reaction
				364	formation of petroleum is a very slow chemical reaction	162	investigating combustion reactions
				378	combustion reactions	166	design experiments to explore dissolving rate
				378	consumer chemistry	170	solubility and pressure
				381	MRE ration heater reaction		
				395	chemistry of the atmosphere		
				395	chemistry of the atmosphere		
				397	carbon reactions		
				406	molecular motion and dissolving rate		
				406	molecular motion and dissolving rate		
				407	surface area and dissolving rate		
				413	pressure and the solubility of gases		
				421	why water is a nearly universal solvent		
				423	polar solutes		
				444	chemical reactions and the formation of acid rain		
				487	chemical reactions in living systems		

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Standard #: Course	Standard	Topic	Objective	student text pg	detail	investigation pg	detail
CP.1.14 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Changes in Matter	Understand and explain that catalysts are highly effective in encouraging the interaction of other atoms and molecules.	364	formation of petroleum is a very slow chemical reaction	156	predict products in a double displacement reaction
CP.1.15 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Energy Transformations	Understand and explain that whenever the amount of energy in one place or form diminishes, the amount in other places or forms increases by the same amount.	84 85 88 90 91 92 92 93 96 96	work input and output some input work is converted to heat potential and kinetic energy explained conservation of energy explained energy conversions where does "spent" energy go? energy transformations and conservation different forms of energy described explain the "lost" energy prove that energy is conserved	31 36 37 38 38 188	work output vs. work input energy conservation and the roller coaster investigating conservation of energy with rollercoaster explore energy transformations conservation of energy and energy transformations specific heat and conservation of energy

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Standard #: Course	Standard	Topic	Objective	student text pg	detail	investigation pg	detail
CP.1.16 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Energy Transformations	Explain that heat energy in a material consists of the disordered motions of its atoms or molecules.	284 451 451	changes of state increasing temperature means increasing motion of molecules temperature and kinetic energy	119 119	energy and phase changes adding heat energy to melt an ice cube
CP.1.17 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Energy Transformations	Know and explain that transformations of energy usually transform some energy into the form of heat, which dissipates by radiation or conduction into cooler surroundings.	469 481 491 493	thermal conductivity explained global warming heat generated in mechanical systems using heat to do mechanical work	119 190	investigate temperature and energy transfer in melting process investigate and rank materials for thermal conductivity
CP.1.18 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Energy Transformations	Recognize and describe the heat transfer associated with a chemical reaction or a phase change as either exothermic or endothermic, and understand the significance of the distinction.	381 382	exothermic reactions and MREs endothermic reactions and cold packs	147 158 158	feel the heat generated by chemical reaction measure energy changes in 3 different reactions investigate energy changes in chemical reactions

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Standard #: Course	Standard	Topic	Objective	student text pg	detail	investigation pg	detail
CP.1.19 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Energy Transformations	Understand and explain that the energy released whenever heavy nuclei split or light nuclei combine is roughly a million times greater than the energy absorbed or released in a chemical reaction. (E=mc2)	387	fusion and fission explained	138	fusion and fission
CP.1.20 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Energy Transformations	Realize and explain that the energy in a system* is the sum of both potential energy and kinetic energy.	91	following an energy transformation	36 38	energy conservation and the roller coaster identify potential/kinetic energy conversions
CP.1.21 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Motion	Understand and explain that the change in motion of an object (acceleration) is proportional to the net force applied to the object and inversely proportional to the object's mass.	33 45 49 51 64	understanding acceleration Newton's second law summarized Newton's second law in detail net force explained solving problems using f=ma	14 16 19	acceleration is the rate at which speed changes thinking about force discover 2nd law of motion

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Standard #: Course	Standard	Topic	Objective	student text pg	detail	investigation pg	detail
CP.1.22 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Motion	Recognize and explain that whenever one object exerts a force on another, an equal and opposite force is exerted back on it by the other object.	45 59	Newton's third law summarized Newton's third law in detail	22 23	car and ramp and Newton's 3rd law using 3rd law to explain common phenomena

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Standard #: Course	Standard	Topic	Objective	student text pg	detail	investigation pg	detail
CP.1.23 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Motion	Understand and explain that the motion of an object is described by its position, velocity, and acceleration.	14	how to calculate speed	8	calculating speed
				15	compare and contrast speed and velocity	9	collect data and calculate speed of car
				20	find speed of bumblebee	10	calculate speed of the car
				20	calculate speed of car	12	calculate speed of moving car
				24	accurate speed measurements	12	model the car's motion graphically
				29	position vs. time graph discussion	12	find speed of car at different positions
				30	position vs. time graphs	13	make a position vs. time graph
				32	average speed vs. instantaneous	14	acceleration is the rate at which speed changes
				32	average speed discussed	14	calculate speed of car at two places on the ramp
				36	examples of acceleration	15	make a speed vs. time graph
				37	speed vs. time graph discussion	15	changes in motion can be represented graphically
				37	speed vs. time graphs	17	caclulate speed of car
				42	calculate speed from distance/time graph	20	investigate effect of gravity on motion
				52	the effect of gravity	21	effect of friction on the car
				56	friction explained	36	find speed of marble
				64	research effect of friction on human joints		

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Standard #: Course	Standard	Topic	Objective	student text pg	detail	investigation pg	detail
CP.1.24 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Motion	Recognize and explain that waves are described by their velocity, wavelength, frequency or period, and amplitude.	179	what is a cycle?	83	find speed of a wave
				182	concept of frequency explained	86	adjust frequency of a standing wave
				182	concept of period explained	90	what is sound and how do we hear it?
				192	analyze systems to find cycle/period/frequency	105	explore relationship between color and wavelength
				219	frequency of sound and pitch		
				221	importance of wavelength of sound waves		
				242	color and frequency of light waves		

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Standard #: Course	Standard	Topic	Objective	student text pg	detail	investigation pg	detail
CP.1.25 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Motion	Understand and explain that waves can superpose on one another, bend around corners, reflect off surfaces, be absorbed by materials they enter, and change direction when entering a new material.	197	transverse and longitudinal waves	82	study wave pulses on elastic cord
				201	waves and refraction	84	make different types of waves in a ripple tank
				201	reflection in water waves and light waves	85	observing reflection in water waves
				201	waves and absorption	87	investigating resonance
				201	waves and reflection	88	natural frequency and resonance of standing waves on a string
				202	refraction and eyeglasses	95	interference and sound waves
				204	resonance explained	95	investigate interference with sound waves
				205	standing waves on a string	96	investigating sound resonance
				206	constructive and destructive interference	101	examine light through diffraction grating
				210	can wave interference sink a ship?	102	polarization of a spring wave
				210	natural frequency of a building and earthquakes	102	polarization of water waves
				223	interference of sound waves	103	polarization of light
				225	consonance and dissonance and beats	106	tracing incident and reflected rays
				240	polarization of light	107	investigate how light interacts with mirrors
				258	refraction in optical systems	108	tracing incident and refracted rays
				258	forming images with lenses		
				261	refraction and lenses		

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Standard #: Course	Standard	Topic	Objective	student text pg	detail	investigation pg	detail
				263	index of refraction	108	explore refraction with a prism
				263	index of refraction	108	explore refraction with lenses
				273	find the angle of reflection	108	investigate how light interacts with a prism
				476	absorption and emission	110	finding focal point and focal length of a lens
						111	plotting images formed when light is refracted by a lens
CP.1.26 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Motion	Realize and explain that all motion is relative to whatever frame of reference is chosen, for there is no absolute motionless frame from which to judge all motion.	13	speed is relative		
				18	what is the speed of an object that is standing still?		
				25	conceptual models of motion		

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Standard #: Course	Standard	Topic	Objective	student text pg	detail	investigation pg	detail
CP.1.27 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Forces of Nature	Recognize and describe that gravitational force is an attraction between masses and that the strength of the force is proportional to the masses and decreases rapidly as the square of the distance between the masses increases.	52 52 54 55 106 106	gravity depends on mass the effect of gravity Newton's law of universal gravitation calculating gravitational force between objects electrical force is incredibly strong! electrical forces	20	investigate effect of gravity on motion
CP.1.28 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Forces of Nature	Realize and explain that electromagnetic forces acting within and between atoms are vastly stronger than the gravitational forces acting between atoms.	389 389 389	electromagnetic force strong nuclear force forces in the nucleus	136	strong force

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Standard #: Course	Standard	Topic	Objective	student text pg	detail	investigation pg	detail
CP.1.29 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Forces of Nature	Understand and explain that 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.	324 324 335 389 389 389	use the periodic table to predict chemical formulas which element is more likely to combine with other elements? chemical bonding and the periodic table electromagnetic force strong nuclear force forces in the nucleus	136 136 141 141	strong force ions whan an atom ionizes modeling a chemical bond
CP.1.30 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Forces of Nature	Understand and explain that in materials, there are usually equal proportions of positive and negative charges, making the materials as a whole electrically neutral.	311 311 318	location/size/charge of subatomic particles protons/neutrons/electrons proton/electron attraction	132 133 133 136 137 140	building atom models location of electrons in atom protons and neutrons model stable and neutral atoms build atomic models review subatomic particles

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Standard #: Course	Standard	Topic	Objective	student text pg	detail	investigation pg	detail
CP.1.31 Integrated Chemistry-Physics	Standard 1: Principles of Integrated Chemistry – Physics	Forces of Nature	Realize and explain that moving electric charges produce magnetic forces, and moving magnets produce electric forces.	164	what is an electromagnet?	66	build an electromagnet
				166	increased current vs. strength of magnetic field	67	find out what happens to strength of electromagnet when current is increased
				166	building an electromagnet		
				168	how electric motors work	68	investigate how an electric motor works
				170	dissecting an electric motor	73	exploring electric generators
				171	electromagnetic induction explained	73	use magnetic induction to create an electric field
CP.2.01 Integrated Chemistry-Physics	Standard 2: Historical Perspectives of Integrated Chemistry – Physics		Explain that Antoine Lavoisier invented a whole new field of science based on a theory of materials, physical laws, and quantitative methods, with the conservation of matter at its core.	312	Dalton's contributions	150	investigate conservation of mass in effervescent tablet reaction
				321	Mendeleev's periodic table		
				332	Linus Pauling and electronegativities		
				363	history of law of conservation of mass		
				363	Antoine Lavoisier		
				393	accomplishments of Marie Curie		
				393	Marie and Pierre Curie		

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Standard #: Course	Standard	Topic	Objective	student text pg	detail	investigation pg	detail
CP.2.02 Integrated Chemistry-Physics	Standard 2: Historical Perspectives of Integrated Chemistry – Physics		Describe how Lavoisier's system for naming substances and describing their reactions contributed to the rapid growth of chemistry by enabling scientists everywhere to share their findings about chemical reactions with one another without ambiguity.	312 321 332 336 338 339 363 393 393	Dalton's contributions Mendeleev's periodic table Linus Pauling and electronegativities writing a chemical formula summary of chemical formula writing rules naming compounds Antoine Lavoisier accomplishments of Marie Curie Marie and Pierre Curie	143 143 145	name chemical compounds predict chemical formulas determine empirical formula
CP.2.03 Integrated Chemistry-Physics	Standard 2: Historical Perspectives of Integrated Chemistry – Physics		Explain that John Dalton's modernization of the ancient Greek ideas of element, atom, compound, and molecule strengthened the new chemistry by providing physical explanations for reactions that could be expressed in quantitative terms.	311 311 313 324	all matter is formed from atoms all matter is formed from atoms development of atomic theory research and create a poster to illustrate development of atomic model	130 132	investigate Rutherford's gold foil experiment comparing atoms

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Standard #: Course	Standard	Topic	Objective	student text pg	detail	investigation pg	detail
CP.2.04 Integrated Chemistry-Physics	Standard 2: Historical Perspectives of Integrated Chemistry – Physics		Explain that Isaac Newton created a unified view of force and motion in which motion everywhere in the universe can be explained by the same few rules. Note that his mathematical analysis of gravitational force and motion showed that planetary orbits...	34 45 45 54 55 73 86 105 107 115 131 160 456	Aristotle vs. Newton Newton's Laws of Motion Newton's Principia Newton and the force of gravity Newton and the apple legend Leonardo DaVinci James Watt Benjamin Franklin Charles-Augustin Coulomb Volta's batteries Georg Ohm's work with circuits Faraday's contributions contributions of Joule		

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Standard #: Course	Standard	Topic	Objective	student text pg	detail	investigation pg	detail
CP.2.05 Integrated Chemistry-Physics	Standard 2: Historical Perspectives of Integrated Chemistry – Physics		Describe that Newton's system was based on the concepts of mass, force, and acceleration, his three laws of motion relating them, and a physical law stating that the force of gravity between any two objects in the universe…	34	Aristotle vs. Newton	16	2nd law
				45	Newton's Laws of Motion	20	force and motion with car and ramp
				48	Newton's laws explained and applied		
				50	Newton's second law applied		
				52	gravity depends on mass		
				54	Newton's law of universal gravitation		
				54	Newton and the force of gravity		
				55	calculating gravitational force between objects		
				105	Benjamin Franklin		
				107	Charles-Augustin Coulomb		
CP.2.06 Integrated Chemistry-Physics	Standard 2: Historical Perspectives of Integrated Chemistry – Physics		Explain that the Newtonian model made it possible to account for such diverse phenomena as tides, the orbits of the planets and moons, the motion of falling objects, and Earth's equatorial bulge.	52	the effect of gravity	20	investigate effect of gravity on motion
				52	gravity depends on mass		
				54	Newton's law of universal gravitation		
				55	calculating gravitational force between objects		

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Standard #: Course	Standard Topic	Objective	student text pg	detail	investigation pg	detail
CP.2.07 Integrated Chemistry-Physics	Standard 2: Historical Perspectives of Integrated Chemistry – Physics	Describe that among the surprising ideas of Albert Einstein's special relativity is that nothing can travel faster than the speed of light, which is the same for all observers no matter how they or the light source happen to be moving.		featured in ancillary component featured in CPO Science Foundations of Physics program		featured in ancillary component
CP.2.08 Integrated Chemistry-Physics	Standard 2: Historical Perspectives of Integrated Chemistry – Physics	Explain that the special theory of relativity is best known for stating that any form of energy has mass, and that matter itself is a form of energy. (E=mc2)		featured in ancillary component featured in CPO Science Foundations of Physics program		featured in ancillary component
CP.2.09 Integrated Chemistry-Physics	Standard 2: Historical Perspectives of Integrated Chemistry – Physics	Describe that general relativity theory pictures Newton's gravitational force as a distortion of space and time.	52 54 55	gravity depends on mass Newton's law of universal gravitation calculating gravitational force between objects		

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Standard #: Course	Standard	Topic	Objective	student text pg	detail	investigation pg	detail
CP.2.10 Integrated Chemistry-Physics	Standard 2: Historical Perspectives of Integrated Chemistry – Physics		Explain that Marie and Pierre Curie made radium available to researchers all over the world, increasing the study of radioactivity and leading to the realization that one kind of atom may change into another kind, and so must be made up of smaller parts.	312 393	contributions of Fermi contributions of Marie and Pierre Curie		
CP.2.11 Integrated Chemistry-Physics	Standard 2: Historical Perspectives of Integrated Chemistry – Physics		Explain that Rutherford and his colleagues discovered that the heavy radioactive element uranium spontaneously splits itself into a slightly lighter nucleus and a very light helium nucleus.	313 324	development of atomic theory research and create a poster to illustrate development of atomic model	130	investigate Rutherford's gold foil experiment

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Standard #: Course	Standard	Topic	Objective	student text pg	detail	investigation pg	detail
CP.2.12 Integrated Chemistry-Physics	Standard 2: Historical Perspectives of Integrated Chemistry – Physics		Describe that later, Austrian and German scientists showed that when uranium is struck by neutrons, it splits into two nearly equal parts plus one or two extra neutrons.	387	fusion and fission explained	138	fusion and fission