Textbook Title: *Chemistry: Atoms First*					
Knowledge and Skills		**OpenStax Location**	**Details**	**Comments**	**Additional Resources**
Scientific Investigation and Reasoning TEKS begin at row 48.					
(4) Science concepts. The student knows the characteristics of matter and can analyze the relationships between chemical and physical changes and properties. The student is expected to:					
Chem.4A	differentiate between physical and chemical changes and properties;	Section 1.3, PDF pg 35-37	Each type of change and property is presented with visual examples.		Practice differentiating physical and chemical changes and properties in: Exercises: 1.3 Physical and Chemical Properties PDF pg 67-68 Questions 26-30.
Chem.4B	identify extensive properties such as mass and volume and intensive properties such as density and melting point;	Section 1.3, PDF pg 37	The paragraph underneath the image on PDF pg 37 offers a contrast between intensive and extensive properties.		Practice identifying extensive and intensive properties in: Exercises: 1.3 Physical and Chemical Properties PDF pg 68 Questions 31-33.
Chem.4C	compare solids, liquids, and gases in terms of compressibility, structure, shape, and volume; and	Section 1.2, PDF pg 24-25; Section 8.2, PDF pg 417-430	The introduction and comparison of solids, liquids, and gases receives early coverage regarding phases, structures, shapes, and volumes.	Compressibility isn't covered in detail until Section 8.6, PDF pg 453, in the context of non-ideal gas behavior, which is beyond the scope of this TEKS. Add/develop a list of questions or an activity to compare solids, liquids, gases in terms of compressibility (gas only), structure, shape, and volume. (Chapter 1 end questions n/a.)	
Chem.4D	classify matter as pure substances or mixtures through investigation of their properties.	Section 1.2, PDF pg 27-30	Pure substances versus mixtures are explained including visual examples, and a graphic on PDF pg 29 offers a helpful guide to determine if a sample of matter is a mixture or pure substance.	The TEK here says "investigation" so we would need to link to or develop a lab where the property is indeed getting investigated.	Practice classifying matter as pure substances or mixtures in: Exercises: 1.2 Phases and Classification of Matter PDF pg 66-67 *Questions 10-22.*
(5) Science concepts. The student understands the historical development of the Periodic Table and can apply its predictive power. The student is expected to:					
Chem.5A	explain the use of chemical and physical properties in the historical development of the Periodic Table;	Section 3.6, PDF pg 175-178	This section/these pages describe the discovery of periodic recurrence of similar properties among the elements the that led to the formulation of the periodic table.	The TEK here says "explain" the use of chemical and physical properties in the historical development of the periodic table." The chapter end questions do not meet the standard. However, Link to Learning on page 168 directs students to an interactive periodic table which could easily support a developed list of questions based on chemical and physical properties.	Link to Learning, PDF pg 178, provides an interactive periodic table, which can use to explore the properties of the elements (includes podcasts and videos of each element). https://www.rsc.org/periodic-table
Chem.5B	identify and explain the properties of chemical families, including alkali metals, alkaline earth metals, halogens, noble gases, and transition metals, using the Periodic Table; and	(1) Section 3.6, PDF pg 177-179 (2) Section 18.1 PDF pg 951-955 (3) Section 18.11 PDF pg 1014-1015 (4) Section 18.2 PDF pg 1019-1020 (5) Section 19.1 PDF pg 1040-1042	(1) This section/these pages introduce chemical families. A graphic of page 178 shows the location of alkali metals, alkaline earth metals, halogens, noble gases, and transition metals on the periodic table. (2) This section/these pages detail properties of the alkali metals and alkaline earth metals. (3) This section/these pages detail properties of the halogens. (4) This section/these pages detail the properties of the noble gases. (5) This section/these pages detail the identity, location, and properties of the transition metals.	Detailed descriptions are not presented until Chapters 18 and 19 and go beyond the scope of this TEK. Chapter end questions (Ch 18: halogens and noble gases, and Ch 19: transition metals) do not support the TEK.	Practice identifying elements as alkali metals, alkaline earth metals, halogens, noble gases, and transition metals, using the Periodic Table in Exercises: 3.6 The Periodic Table PDF pg 200-201 *Questions 87-92.* Practice explaining the properties of: alkali and alkaline earth metals in: Exercises: 18.1 Periodicity PDF pg 1024 *Questions 1-2.*

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Chem.5C	interpret periodic trends, including atomic radius, electronegativity, and ionization energy, using the Periodic Table.	(1) Section 3.5 PDF pg 168-171 (2) Section 3.5 PDF pg 172-174 (3) Section 4.2 PDF pg 211-212	(1) This section/these pages describe and explain the observed the trend in atomic size of elements. Trends for elements are presented in a graphic, atomic radius is defined and a graph of atomic radii presented, and an example for predicting atomic radii is provided. (2) This section/these pages describe and explain the observed the trend in ionization energies of elements. A graph of the first ionization energy for elements in the first five periods vs atomic number and a version of the periodic table showing first ionization energies of selected elements are presented. (3) This section/these pages describe and explain the observed the trend in electronegativity of elements. A version of the periodic table showing electronegativities of selected elements is presented.		Link to Learning PDF pg 168: explore an interactive visualization of periodic trends including atomic radius, electronegativity and ionization energy. https://periodictable.com/Properties/A/AtomicNumber.st.html (1) Practice interpreting periodic trends in atomic size in: Exercises: 3.5 Periodic Variation in Element Properties PDF pg 199-200 *Questions 67, 68, 75 and 76.* (2) Practice interpreting periodic trends in first ionization energies in: Exercises: 3.5 Periodic Variation in Element Properties PDF pg 199 *Questions 69-72.* (3) Practice interpreting periodic trends in electronegativity in: Exercises: 4.2 Covalent Bonding PDF pg 257 *Questions 15-18.*
(6) Science concepts. The student knows and understands the historical development of atomic theory. The student is expected to:					
Chem.6A	describe the experimental design and conclusions used in the development of modern atomic theory, including Dalton's Postulates, Thomson's discovery of electron properties, Rutherford's nuclear atom, and Bohr's nuclear atom;	(1) Sections 2.1 and 2.2 PDF pg 78-88 (2) Section 3.2 PDF pg 141-145	(1) These sections/these pages describe the experimental design and conclusion and contribution to the development of modern atomic theory by Dalton, Thomson, Rutherford and others. Section 2.1 states Dalton's Postulates and the use of the postulates to explain the laws of definite and multiple proportions. Several infographics and examples are provided. Section 2.2 outlines milestones in the development of modern atomic theory including a summary and interpretation of experimentation of Thomson and Rutherford. Several infographics are provided. (2) This section/these pages describe the Bohr model of the hydrogen atom.		Link to Learning PDF pg 84: explore an interactive presentation showcasing the historical development and work of JJ Thomson, including a recording of Thomson talking about the size of an electron in his own voice. https://history.aip.org/history/exhibits/electron/ Link to Learning PDF pg 87: view an interactive simulation of the Rutherford gold foil experiment demonstrating the basis for Rutherford's model of the nuclear atom. https://micro.magnet.fsu.edu/electromag/java/rutherford/ Link to Learning PDF pg 88: explore an PhET interactive simulation to investigate the differences between models of a "plum pudding" atom (Thomson) and a Rutherford atom by firing alpha particles at each. https://phet.colorado.edu/en/simulation/rutherford-scattering (1) Practice problems based on the experimental design and conclusions used in the development of modern atomic theory in Exercises: 2.1 Early Ideas in Atomic Theory PDF pg 116 Questions 1- 4 and 2.2 Evolution of Atomic Theory PDF pg 116-117 Questions 5-9. (2) Practice problems based on the conclusions used in the development of the Bohr model for hydrogen-like atoms in Exercises: 3.2 The Bohr Model PDF pg 194-195 Questions #16- 29.
Chem.6B	describe the mathematical relationships between energy, frequency, and wavelength of light using the electromagnetic spectrum;	Section 3.1 PDF pg 126-140	The pages titled: Chemistry: The Central Science introduce chemistry's interconnectedness with a vast array of other STEM disciplines. A graphic shows how the knowledge of chemistry is central to a wide range of scientific disciplines.		Practice describing (calculating) mathematical relationships (energy, frequency, wavelength of light) using the electromagnetic spectrum in Exercises: 3.1 Electromagnetic Energy pg 193-194 Questions 4, 5, 6, 7, 8, 9 and 13.

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Chem.6C	calculate average atomic mass of an element using isotopic composition; and	Section 2.3 PDF pg 89-96	This section/these pages define atomic mass unit and average atomic mass and explain how to calculate average atomic mass using isotopic composition. Two helpful interactive simulations are included in "Links to Learning" and provide virtual explorations that support the concept of average atomic mass.		Link to Learning PDF pg 95: use an interactive simulation to build atoms of the first 10 elements, see which isotopes exist, check nuclear stability and gain experience with isotope symbols. https://phet.colorado.edu/en/simulation/build-an-atom Note that Exercises 2.3 Atomic Structure and Symbolism PDF pg 117-8 (Questions #13, 14, and 15) are written to support this Link to Learning: Build an Atom. Link to Learning PDF pg 96: use an interactive simulation to explore isotopes of the first 10 elements and then make mixtures of the first 18 elements to gain experience with average atomic mass and check naturally occuring isotope ratios. https://phet.colorado.edu/en/simulation/isotopes-and-atomic-mass Note that Exercises 2.3 Atomic Structure and Symbolism PDF pg 119 (Questions #20 and 21) are written to support this Link to Learning: Isotopes and Atomic Mass Practice calculating average atomic mass of an element using isotopic composition in: Exercises: Atomic Structure and Symbolism PDF pg 119 Questions 22-24.
Chem.6D	express the arrangement of electrons in atoms of representative elements using electron configurations and Lewis valence electron dot structures.	(1) Section 3.4 PDF pg 158-165 (2) Section 4.4 PDF pg 223-224	(1) This section/these pages explain electron configuration and the order in which atomic orbitals are filled. Included are a diagram that depicts the energy order for atomic orbitals to derive ground state electron configuration, a periodic table with electron configuration for each subshell to derive electron configuration, and a periodic tables that shows outer-shell electron configuration of each element. (2) These pages introduce Lewis symbols to depict valence electron configuration for representative elements and ions. A table illustrates the Lewis symbol and electron configuration for elements in period three of the periodic table.		(1) Practice expressing electron configuration in: 3.4 Exercises Electronic Structure of Atoms (Electron Configurations) PDF pg 198 *Questions 48, 49, 55, 56, 60 and 61.* (2) Practice expressing electron configuration using Lewis symbols in Exercises 4.4 Lewis Symbols and Structures PDF pg 262 *Questions 34-35.*
(7) Science concepts. The student knows how atoms form ionic, covalent, and metallic bonds. The student is expected to:					
Chem.7A	name ionic compounds containing main group or transition metals, covalent compounds, acids, and bases using International Union of Pure and Applied Chemistry (IUPAC) nomenclature rules;	(1) Section 4.3 PDF pg 215-223 (2) Table of Common Polyatomic Ions PDF pg 182-183	(1) This section describes an a approach to naming ionic and molecular compounds, and acids (limited to inorganic compounds), based on nomenclature guidelines proposed by IUPAC. (2) A table of common polyatomic ions is provided that will be used repeated. Students should become familiar with this list.	A Link to Learning is present on PDF page 221 that provides practice with naming chemical compounds and writing chemical formulas.	Practice naming ionic and covalent compounds in: Exercises 4.3 Chemical Nomenclature *Questions 23, 24, 29, 30, and 32.*
Chem.7B	write the chemical formulas of ionic compounds containing representative elements, transition metals and common polyatomic ions, covalent compounds, and acids and bases;	(1) Section 4.3 PDF pg 215-223 (2) Table of Common Polyatomic Ions PDF pg 182-183	(1) This section describes an a approach to naming ionic and molecular compounds, and acids (limited to inorganic compounds), based on nomenclature guidelines proposed by IUPAC. (2) A table of common polyatomic ions is provided that will be used repeated. Students should memorize this list.		Practice writing the formulas of ionic and covalent compounds in: Exercises 4.3 Chemical Nomenclature *Questions 25, 26, 27, 28, 31, and 33.*
Chem.7C	construct electron dot formulas to illustrate ionic and covalent bonds;	Section 4.4 PDF pg 224-230	This section/these pages describe how to draw Lewis structures depicting ionic and covalent bonding. A step by step guide is provided for writing Lewis Structures with the Octet Rule (for simple molecules and molecular ions). Examples are provided.		Practice constructing Lewis structures to illustrate iconic and covalent bonding in Exercises 4.4 Lewis Symbols and Structures PDF pg 262-265 *Questions 36, 38, 39, 40, 41, 42, 43, 45, 47, 48, 49, and 50.*

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Knowledge and Skills		OpenStax Location	Details	Comments	Additional Resources
Chem.7D	describe metallic bonding and explain metallic properties such as thermal and electrical conductivity, malleability, and ductility; and	Section 3.6: PDF pgs. 175, 177 Section 10.5: PDF pg 570	(1) Malleability and conductivity are mentioned as periodic trends found in metals and depend on having electrons that can be removed easily. (2) Malleable and ductile are defined. (3) Metallic bonding is described and properties including thermal and electrical conductivity and malleability are attributed metallic solids.	Although metallic bonding Is defined in the text, a more detailed description of metallic bonding (as compared to ionic and covalent) is needed to fully address this TEKS. Metallic properties including (high) thermal and electrical conductivity, malleability and ductility are defined, but an explanation for how bond arrangement is responsible for these properties is needed to address the standard.	
Chem.7E	classify molecular structure for molecules with linear, trigonal planar, and tetrahedral electron pair geometries as explained by Valence Shell Electron Pair Repulsion (VSEPR) theory.	Section 4.6 PDF pg 237-245 and pg 248	This section/these pages explain how the VSEPR theory predicts the three dimensional arrangement of atoms in a molecule. including linear, trigonal plana, and tetrahedral electron pair geometries. Several examples are provided for predicting electron pair geometry and molecular structure. A helpful interactive simulation "Link to Learning" is included on PDF pg 248, with an example, that supports classification of molecular structure and electron-pair geometries of various molecules.	The text includes examples, illustrations, and discussion of trigonal bipyramidal geometry and octahedral geometry which is beyond the scope of this TEKS.	Link to Learning PDF pg 248: use an interactive simulation to virtually explore various molecules that support classification of their electron-pair geometries and molecular structures. https://phet.colorado.edu/en/simulation/molecule-shapes Exercises: Molecular Structure and Polarity PDF pg 272 Questions 104-106 are written to support this Link to Learning: Molecule Shapes Practice classifying molecular structures for molecules with linear, trigonal planar and tetrahedral electron pair geometries in Exercises 4.6 Molecular Structure and Polarity PDF pg 268-271 Questions 75, 81c, 81d, 82b, 82c, 82e, 83b, 83d, 83f, 84a, 84c, 84g, 85a, 85b, 85c, 85d, 85e, 85g, [86], 95a-i, 96a, 96b, 96c, and 96d.
(8) Science concepts. The student can quantify the changes that occur during chemical reactions. The student is expected to:					
Chem.8A	define and use the concept of a mole;	Section 2.4 PDF pg 104-111	This section/these pages define the mole and relationships between formula mass, the mole, and Avogadro's number are applied to compute various quantities that describe the composition of substances and compounds. Visual examples showing 1 mole of various element demonstrate relationships between the mole and atomic mass units. A table relates the average atomic mass (amu), molar mass (g/mole) and Avogadro's number of several elements. A short video helps with conceptualization of the vast number represented by a mole in a "Link to Learning" on PDF pg 106. Several examples for use of the mole are provided.		Practice using the concept of a mole in: Exercises: 2.4 Chemical Formulas PDF pg 122-123 *Questions 37-45, 47 and 49.*
Chem.8B	calculate the number of atoms or molecules in a sample of material using Avogadro's number;	Section 2.4 Chemical Formulas PDF pg 108 and 110-111	Example 2.9, PDF pg 108 and Example 2.12 on PDF pg 110-111 demonstrate calculations for the number of atoms or molecules in a substance using Avogadro's number.		Practice calculating the number of atoms or molecules in a substances using Avogadro's number in: Exercises: 2.4 Chemical Formulas PDF pg 124 *Questions 52, 53, 56, 57, 58 and 61.*
Chem.8C	calculate percent composition of compounds;	Section 6.2, PDF pg 323-330	This section/these pages define percent composition and provide example calculations of percent composition, determining percent composition from molecular and empirical formulas, and derivation of molecular and empirical formulas from percent composition.		Practice calculating percent composition of compounds in: Exercises: 6.2 Determining Empirical and Molecular Formulas PDF pg 347 Questions 8-18. For a additional worked examples illustrating the derivation of empirical formulas see: Link to Learning PDF pg 327 https://www.youtube.com/watch?v=mdNYDMoQ6As
Chem.8D	differentiate between empirical and molecular formulas;	Section 2.4, PDF pg 97-101	This section/these pages differentiate between empirical and molecular formulas. Several terms are defined, including empirical and molecular formulas. Helpful infographics and an example problem are provided.		Practice differentiating between empirical and molecular formulas in: Exercises: 2.4 Chemical Formulas PDF pg 120-121 *Questions 29-33.*
Chem.8E	write and balance chemical equations using the law of conservation of mass;	(1) Section 1.2, PDF pg 26 (2) Section 7.1 PDF pg 352-356	(1) The law of conservation of matter is defined on pg 26. (2) This section these pages use the law of conservation of matter to write and balance chemical equations. Step by step instruction is provided for balancing molecular equations. The use of (s), (l), (g) and (aq) in a chemical equation is explained.	Included, but beyond the scope of this TEKS, are examples and instructions for balancing complete ionic and net ionic equations, PDF pg 356-358.	Practice writing and balancing chemical equations using the law of conservation of mass (matter) in: Exercises: 7.1 Writing and Balancing Chemical Equations PDF pg 394-395 *Questions 1, 3, 4, 5, 6. 8, 9 and 10.* Link to Learning PDF pg 356 provides an interactive tutorial for additional practice balancing questions. https://phet.colorado.edu/en/simulation/balancing-chemical-equations

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Chem.8F	differentiate among **double replacement reactions**, including **acid-base** reactions and **precipitation** reactions, and **oxidation-reduction** reactions such as synthesis, decomposition, **single replacement**, and **combustion** reactions;	(1) Section 7.2 PDF pg 358-370 (2) Chemistry in Everyday Life PDF pg 32-33.	(1) This section/these pages define three common types of chemical reactions (precipitation, acid-base, and oxidation reduction reactions). Double replacement reactions, single replacement and combustion reactions are specifically defined. Precipitation, acid-base and oxidation reactions are explained and examples for predicting and classifying these reactions are included. Strong and weak acids are defined and introduced. (2) Decomposition of Water is introduced with an infographic in Chemistry in Everyday Life PDF pg 32-33.	Examples of synthesis and decomposition reactions are included but are not specifically identified or defined. A clear supplementary guide should be developed that specifically identifies, defines, explains and provides an example for: double replacement reactions, including acid base reactions and precipitation reactions, and oxidation-reduction such as synthesis, decomposition, single-replacement and combustion reactions.	Practice differentiating among double replacement reactions, including acid base reactions and precipitation reactions, and oxidation-reduction such as synthesis, decomposition, single-replacement and combustion reactions. in: Exercises 7.2 Classifying Chemical Reactions PDF pg 396-397 *Questions 12, 13, 14, 15, and 19* Link to Learning pg 366 provides an interactive exploration of strong and weak acids and bases. https://phet.colorado.edu/en/simulation/acid-base-solutions
Chem.8G	perform stoichiometric calculations, including determination of mass and gas volume relationships between reactants and products and percent yield; and	(1) Section 7.3 PDF pg. 373-378 (2) Section 8.3 PDF pg. 438-440 (3) Section 7.4 PDF pg. 381 -382	(1) In this section, explanations and examples are provided as to how to calculate mass relationships between reactants and products as well as molecules. Figure 7.14 on PDF pg. 367 illustrates the factors needed to determine the volume relationships, but no examples are given. (2) In this section, explanations and examples are given as to how to calculate gas volume relationships between reactants and products. (3) In this section, the concept of percent yield is explained and example problems are provided.		(1) Additional problems are provided on PDF pg. 400-401 #42-45 and 50-51. (2) Extra problems can be found on PDF p. 465, #71 and 72. (3) Additional problems are provided in the PDF pg. 402-403 #63-69.
Chem.8H	describe the concept of limiting reactants in a balanced chemical equation.	Section 7.4 PDF pg 388-391	In this section, the concept of limiting reactants is first described using everyday examples and then related to chemical reactions. The concept is explained and example problems are provided.		The "Link to Learning" on PDF pg. 380 takes the student to a PhET simulation that helps explain the concept of limiting and excess reactants. Additional problems can be found on PDF pg. 402 #60-61.
(9) Science concepts. The student understands the principles of ideal gas behavior, kinetic molecular theory, and the conditions that influence the behavior of gases. The student is expected to:					
Chem.9A	describe and calculate the relations between volume, pressure, number of moles, and temperature for an ideal gas as described by Boyle's law, Charles' law, Avogadro's law, Dalton's law of partial pressure, and the ideal gas law; and	(1) Section 8.2 PDF pg. 417-430 (2) Section 8.3 PDF pg. 433-438 - Dalton's Law of Partial Pressures	(1) In this section, each of the gas laws is covered with explanations as well as examples showing how to solve problems involving each equation. - Boyle's Law pg. 421-425 - Charles's Law pg. 419-421 - Avogadro's Law pg. 425-426 - Ideal Gas Law pg. 426-429 - Combined Gas Law pg. 426-428 - Gay-Lussac's Law pg. 417-419 - STP pg. 429 (2) In this section, Dalton's Law of Partial Pressures is explained and example problems are given and explained. Collecting gases over water and water vapor pressure are also covered in this section.		-Practice problems and additional questions can be found on pg. 462-463 in the PDF version of the book. - Boyle's Law Questions #19-20, 26 - Charles's Law Questions #29 - Avogadro's Law Questions #21-23 - Combined Gas Law Questions #28, 36-38 - Ideal Gas Law Questions #25, 31, 33 There are numerous resources in this section that help students to understand how changing one variable will affect another variable. - The "Link to Learning" on pg. 426 of the PDF takes the student to a PhET simulation that allows the student to change one variable (pressure, volume, or temperature) and see the effect that it has on another variable. - The "Link to Learning" on pg. 420 shows a video of a balloon being cooled in liquid nitrogen in order to demostrate the effect of temperature on the volume of a gas. - On pg. 424-425 there is a visual and an explanation explaining how Boyle's law controls a person's breathing. - On pg. 427-428, students can work a problem using the combined gas law in Scuba. - On pg. 428-429, students can learn about the interdependence between ocean depth and pressure in scuba diving. (2) Additional problems and questions dealing with Dalton's Law of Partial Pressures can be found on pg. 464 in the PDF version of the book. The corresponding questions and problems are #58-59, and 63.

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Chem.9B	describe the postulates of kinetic molecular theory.	Section 8.5 PDF pg. 448-452	This section lists the five postulates of the kinetic molecular theory and then explains how the different postulates are responsible for the behavior of gases in each of the gas laws.		The "Link to Learning" found on pg. 452 of the PDF takes the viewer to a PhET simulation that allows the student to change conditions on the gas and see how it affects the movement of the gas particles. This allows the student to see the kinetic molecular theory in action. Additional practice questions can be found on PDF pg. 466 #90-92.
(10) Science concepts. The student understands and can apply the factors that influence the behavior of solutions. The student is expected to:					
Chem.10A	describe the unique role of water in solutions in terms of polarity;	Section 11.2 PDF pg. 606	The text briefly explains how water dissolves an ionic compound. The figure 11.7 on p. 606 helps clarify the topic.	In the written description, water is never called a polar molecule. This only happens in Figure 11.7. This concept ought to be explained in more detail, using simpler terms for the high school chemistry student.	
Chem.10B	apply the general rules regarding solubility through investigations with aqueous solutions;	Section 7.2 PDF pg. 358-361	The solubility rules as well as some explanations are given in this section.	Since the standard uses the term "investigations" a lab activity needs to be found that will allow the students to test the solubility rules to determine which ionic compounds are soluble and which are insoluble.	TEKS Gateway provides some materials to help instruct this standard, accessible here: https://www.texasgateway.org/search-standards?subject=1666&grade=11107&strand=10912 Investigations can be found on OER Commons to connect with this standard: https://www.oercommons.org/courses/solutions-solubility-and-miscibility
Chem.10C	calculate the concentration of solutions in units of molarity;	Section 6.3 PDF pg. 331-334	This section defines the concept of molarity and provides examples and problems which show the students how to perform the calculations.		Additional problems for calculating molarity of solutions can be found on PDF pg. 347-349 #19-21, 22-23, 30-31, and 40.
Chem.10D	calculate the dilutions of solutions using molarity;	Section 6.3 PDF pg. 334-337	This section provides an explanation of the concept of dilution along with examples and practice problems allowing the student to calculate the concentrations of the dilutions.		Additional problems to practice calculating dilutions can be found on PDF pg. 349 #35 and 38.
Chem.10E	distinguish among types of solutions such as electrolytes and nonelectrolytes; unsaturated, saturated, and supersaturated solutions; and strong and weak acids and bases;	(1) Section 11.2 PDF pg. 614-617 (2) Section 11.3 PDF pg. 617 (3) Section 7.2 PDF pg. 362-364	(1) In this section, students are introduced to the concepts of electrolytes vs. nonelectrolytes. (2) In this section the concepts of saturated, unsaturated, and supersaturated solutions are introduced. (3) In this section, the concept of what causes a base or acid to be classified as strong or weak is explained. Examples of both strong and weak acids and strong and weak bases are given.	(2) The definitions of saturated, unsaturated, and supersaturated solutions are written at a higher level than that of a traditional high school book. It would be beneficial if the explanations could be simplified for high school level students.	(1) Additional questions regarding electrolytes can be located on PDF pg. 661 #14. (2) Additional questions dealing with the concepts of saturated, unsaturated, and supersaturated solutions are found on PDF pg. 661-662 #16-17, and #22. (3) The "Link to Learning" on PDF pg. 366 offers a microscopic view strong and weak acids and bases.
Chem.10F	investigate factors that influence solid and gas solubilities and rates of dissolution such as temperature, agitation, and surface area;	(1) Section 11.3 PDF pg. 626 (2) Section 17.2 PDF pg. 887-890 (2) Section 11.3 PDF pg. 618-621	(1) This section mentions the effect that temperature has on the solubility of a solid in a liquid. (2) Although this section deals with factors that affect reaction rates, it does explain why surface area changes solubility and why increasing temperature tends to speed up reactions. (3) This section deals with the solubility of a gas in a liquid. It deals primarily with the effects of pressure on gas solubilities. It does relate this to decompression sickness (the "bends") and opening a carbonated beverage. It does address the fact that increased temperature in lakes can result in fish kills due to decreased dissolved oxygen in the water.		Additional resources include additional questions #7-8 on PDF pg. 933. Texas Gateway includes resources on solutions including interactives where students observe the concepts in the standard.

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Chem.10G	define acids and bases and distinguish between Arrhenius and Bronsted-Lowry definitions and predict products in acid-base reactions that form water; and	(1) Section 14.1 PDF pg. 740-741 (2) Section 7.2 PDF pg. 364-366	(1) This section introduces the student to the definitions of an acid or a base according to the Arrhenius theory and the Bronsted-Lowry theory. The concept of conjugate acids and conjugate bases are also covered. (2) In this section, acid-base (neutralization) reactions are introduced and the students are given examples where they learn how to predict the products that will be formed in the reaction.	The Arrhenius definition of an acid and base could use more explanation since there is a single sentence given on PDF pg. 740. Students would also benefit from examples and an activity or problem that requires them to identify acids and bases as fitting the Arrhenius definition or the Bronsted-Lowry definition.	Additional resources include questions #9-10 on PDF pg. 790. These questions deal with acids, bases, conjugate acids, and conjugate bases under the Bronsted-Lowry definition. Additional neutralization equations can be found on PDF pg. 397-398 #21-22, and 25. For additional enrichment, the Chemistry in Everyday Life article on PDF pg. 365 addresses the concept of neutralization in the article on "Stomach Acids". The article on PDF pg. 365-366 shows how the concept of acids and bases are part of cooking in the "Culinary Aspects of Chemistry.
Chem.10H	define pH and calculate the pH of a solution using the hydrogen ion concentration.	Section 14.2 PDF pg. 743-749	This section of the text defines the concept of pH and provides examples and practice problems for calculating pH using hydrogen ion concentration.		Extra pH calculations can be found on PDF pg. 791 #18-25.
(11) Science concepts. The student understands the energy changes that occur in chemical reactions. The student is expected to:					
Chem.11A	describe energy and its forms, including kinetic, potential, chemical, and thermal energies;	Section 9.1 PDF pg. 472-475	This section provides a quick refresher on the basic types of energy.		The "Link to Learning" on PDF pg. 476 lets the student investigate various types of energy and the transfers that can occur between them.
Chem.11B	describe the law of conservation of energy and the processes of heat transfer in terms of calorimetry;	(1) Section 9.1 PDF pg. 473 (2) Section 9.1 PDF pg. 477-482 Section 9.2 PDF pg. 482-494	(1) This section mentions and briefly explains the law of conservation of energy. (2) This first section explains the process of heat transfer from the hotter object to the cooler object until both objects reach the same temperature. (3) The concept of calorimetry is explained in this section. The concept is expanded to include a bomb calorimeter and nutritional calories in order to demonstrate how this concept is used in "real life."		Additional questions can be found on PDF pg. 519 #1-2. Figure 9.6 on PDF pg. 476 illustrates the energy transfer between two objects with different temperatures. The "Link to Learning" on PDF pg. 474 illustrates the effect that changing temperature has on the motion of molecules.
Chem.11C	classify reactions as exothermic or endothermic and represent energy changes that occur in chemical reactions using thermochemical equations or graphical analysis; and	Section 9.4 PDF pg. 476	This section explains the concept of endothermic and exothermic reactions, but students are not shown how to tell whether a reaction is exothermic or endothermic by looking at a PE diagram or a thermochemical equation that includes the energy or heat component.	The terms exothermic and endothermic are defined in terms of chemical reactions. Examples of endothermic and exothermic reactions showing the energy or heat that is absorbed as a reactant or emitted as a product in a chemical reaction (thermochemical equation) is not included in the book. The energy that is absorbed or released in a half-reaction are shown in Section 9.3 PDF pg. 497-499. There are also no PE diagrams for either endothermic or exothermic reactions in the book; both of these are needed to cover the standard.	A question dealing with endothermic and exothermic reactions can be found on PDF pg. 660 #3. A visual that explains the transfer of energy in an endothermic and an exothermic reaction in a calorimeter can be found in Figure 9.11 on PDF pg. 483. Additional resources for enhancement can include the "Chemistry in Everyday Life" article on PDF pg 489 that deals with the "Thermochemistry of Hand Warmers."
Chem.11D	perform calculations involving heat, mass, temperature change, and specific heat.	(1) Section 9.1 PDF pg. 477-482 (2) Section 9.2 PDF pg. 482-494	(1) In this section, students are shown simple energy calculations and provided with simple practice problems on these calculations. (2) In this section, the calculations that are shown become more complicated and include examples and practice problems that involve solving for mass, temperature, or specific heat in addition to energy transferred.		Additional practice problems for calculating transfer of energy and calorimetry calculations can be found on PDF pg. 520-521 and include #6-12, 14, 19, 22, and 24. The "Link to Learning" on PDF pg. 492 demonstrates how energy transfer can be calculated using sample data. - If you want to show students how this concept applies to their lives, you can utilize the "Chemistry in Everyday Life" article that covers "Measuring Nutritional Calories" on PDF pg. 493-494. The other "Link for Learning" link on PDF pg. 492 discusses how a bomb calorimeter works.
(12) Science concepts. The student understands the basic processes of nuclear chemistry. The student is expected to:					

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Chem.12A	describe the characteristics of alpha, beta, and gamma radioactive decay processes in terms of balanced nuclear equations; and	(1) Section 20.2 PDF pg. 1093-1094 (2) Section 20.3 PDF pg. 1096-1098	(1) In this section, students are introduced to the radioactive particles that are emitted during nuclear decay. Figure 20.4 on PDF pg. 1094 organizes the particles and their characteristics in an easy to understand table. The concept of balancing nuclear equations is included with examples and practice problems provided. (2) In this section, the different types of nuclear decay are introduced. After written explanations of what occurs during alpha, beta, and gamma decay (along with positron decay and electron capture), Figure 20.7 on PDF pg. 1098 summarizes these different types of decay while providing a pictorial model, balanced nuclear equation, and a statement as to how each type of decay affects the atomic and mass numbers of the parent nuclide.		Additional practice questions and problems can be found on PDF pg. 1142-1145 #12-14, #19-20, and #45-46.
Chem.12B	compare fission and fusion reactions.	Section 20.4 PDF pg. 1110-1115, pg. 1120-1121	In this section, the concepts of fission and fusion are discussed. In addition to addressing what occurs in the atom in each of these reactions, students are introduced to the uses of each of these reactions including energy production, weapons, and medical testing. The "Link to Learning" found on PDF pg. 1111 provides the reader with a simulation of what occurs in a fission reaction.		Additional questions involving fission and fusion include #48 on PDF pg. 1145. If you want to enhance the knowledge of fission with the tie in to Nuclear Power plants, -The "Link to Learning" on PDF p. 1108 links to a 3 minute video showing how a nuclear reactor works. - The "Chemistry in Everyday Life" on PDF pg. 1118-1120 addresses the nuclear accidents that occurred at Three Mile Island, Chernobyl, and Fukushima, Japan. -The "Link to Learning" on PDF pg. 1120 covers current methods for nuclear waste management.
A variety of TEKS aligned Scientific Process materials can be found for free by visiting this website through the TEA: https://www.texasgateway.org/search-standards?subject=1666&grade=11107&strand=10890					
(1) Scientific processes. The student, for at least 40% of instructional time, conducts laboratory and field investigations using safe, environmentally appropriate, and ethical practices. The student is expected to:					
Chem.1A	demonstrate safe practices during laboratory and field investigations, including the appropriate use of safety showers, eyewash fountains, safety goggles or chemical splash goggles, as appropriate, and fire extinguishers;				
Chem.1B	know specific hazards of chemical substances such as flammability, corrosiveness, and radioactivity as summarized on the Safety Data Sheets (SDS); and	Section 1.3, PDF pg 37-38	The NFPA hazard diamond is presented, but a summary of SDSs is not presented.		Resource from OnTrack regarding MSDS interpretation: https://www.texasgateway.org/resource/material-safety-data-sheets
Chem.1C	demonstrate an understanding of the use and conservation of resources and the proper disposal or recycling of materials.				
(2) Scientific processes. The student uses scientific practices to solve investigative questions. The student is expected to:					
Chem.2A	know the definition of science and understand that it has limitations, as specified in subsection (b)(2) of this section;				
Chem.2B	know that scientific hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions are incorporated into theories;	Section 1.1 (PDF pg 22-23)	These pages/this section introduce(s) the scientific method, including that hypotheses are tentative and testable. Several terms are defined, including theory, with a helpful infographic.		Practice problems that identify a hypothesis, a law, or a theory. Exercises: 1.1 Chemistry in Context PDF pg 65 *Questions 2 - 3.*

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Chem.2C	know that scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well established and highly reliable explanations, but may be subject to change as new areas of science and new technologies are developed;	Section 1.1 (PDF pg 22-23)	These pages/this section introduce(s) scientific method, including that scientific theories are well-substantiated, comprehensive, testable explanations of particular aspects of nature; and that they they can be modified if new data become available. Several terms are defined, including scientific theories, with a helpful infographic.		Practice problems that identify a hypothesis, a law, or a theory. Exercises: 1.1 Chemistry in Context PDF pg 65 *Questions 2 - 3*.
Chem.2D	distinguish between scientific hypotheses and scientific theories;	Section 1.1 (PDF pg 22-23)	These pages/this section introduce(s) scientific method. The path of discovery that leads from question and observation to law or hypothesis to theory, combined with experimental verification of the hypothesis and any necessary modification of the theory, is called the scientific method. Several terms are defined, including scientific theories, with a helpful infographic.	verb: distinguish Practice problems are listed to the right, and they are the same as those for Chem.2B and Chem.2C. All three standards (2B, 2C and 2D) are about hypothesis and theory. Need to find or develop more questions or scenarios that demonstrate an ability to distinguish between hypothesis and theory. **Consult OnTrack Scientific Process Skills binder for many resources covering all science process skills:** https://www.texasgateway.org/binder/ontrack-scientific-process-skills	Practice problems that identify a hypothesis, a law, or a theory. Exercises: 1.1 Chemistry in Context PDF pg 65 *Questions 2 - 3*.
Chem.2E	plan and implement investigative procedures, including asking questions, formulating testable hypotheses, and selecting equipment and technology, including graphing calculators, computers and probes, electronic balances, an adequate supply of consumable chemicals, and sufficient scientific glassware such as beakers, Erlenmeyer flasks, pipettes, graduated cylinders, volumetric flasks, and burettes;				
Chem.2F	collect data and make measurements with accuracy and precision;	Section 1.4; Section 1.5, PDF pg 53-54	Section 1.4 introduces the properties of measurement and includes example problems where measurements are determined. Pages 43-44 specifically cover the difference between accuracy and precision.	Add/develop resource that encourages students to collect data and make measurements. Exercises and link to refresher provided in the column to the right (F), but still need resources for data collection (*with accuracy and precision*) and making measurements (*with accuracy and precision*)	Practice problems that classify accuracy vs. precision: Exercises: 1.5 Measurement Uncertainty, Accuracy, and Precision PDF pg 70-72 *Questions 44-54*. For a refresher or more practice with accuracy and precision see: https://www.chem.tamu.edu/class/fyp/mathrev/mr-sigfg.html
Chem.2G	express and manipulate chemical quantities using scientific conventions and mathematical procedures, including dimensional analysis, scientific notation, and significant figures;	Appendix B; PDF pg 1199-1206 Section 1.5; PDF pg 46-53 Section 1.6; PDF pg 54-58	Appendix B presents the essential mathematics of exponential arithmetic (scientific notation) including addition, subtraction, multiplication, division, squaring, cubing, and taking the square root of exponentials. Examples are provided. Section 1.5 introduces and explains how to represent uncertainty in quantities using significant figures and includes example problems. Section 1.6 introduces and explains the dimensional analysis (factor label) approach to mathematical calculations involving quantities and includes example problems.		For a refresher or more practice with scientific notation see: Link to Learning PDF pg 41 https://www.chem.tamu.edu/class/fyp/mathrev/mr-scnot.html https://www.chem.tamu.edu/class/fyp/mathrev/mr-expnt.html Practice expressing uncertainty of measurement using significant figures in: Exercises: 1.5 Measurement Uncertainty, Accuracy, and Precision PDF pg 70-72 Questions 44-54. For a refresher or more practice with significant figures see: https://www.chem.tamu.edu/class/fyp/mathrev/mr-sigfg.html Practice manipulating problems using dimensional analysis in: Exercises: 1.6 Mathematical Treatment of Measurement Results PDF pg 73-76 Questions 57- 92. For a refresher or more practice with dimensional analysis see: https://www.chem.tamu.edu/class/fyp/mathrev/mr-da.html
Chem.2H	organize, analyze, evaluate, make inferences, and predict trends from data; and	Exercises: 1.4 Measurements PDF pg 68 *Questions 41-43*	These questions direct students to use a phet interactive and require the student to organize, analyze, evaluate, and make inferences from data.	A start at supporting this standard could be done with the questions listed to the right. More needed to satisfy "predict trends from data." Potential resources to address these gaps can be found here via OnTrack: https://www.texasgateway.org/resource/data-analysis	Practice organizing, analyzing, evaluating, and making inferences from data in: Exercises: 1.4 Measurements PDF pg 68 *Questions 41-43.*
Chem.2I	communicate valid conclusions supported by the data through methods such as lab reports, labeled drawings, graphs, journals, summaries, oral reports, and technology-based reports.				
(3) Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to:					

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Chem.3A	analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, so as to encourage critical thinking by the student;				
Chem.3B	communicate and apply scientific information extracted from various sources such as current events, published journal articles, and marketing materials;				
Chem.3C	draw inferences based on data related to promotional materials for products and services;				
Chem.3D	evaluate the impact of research on scientific thought, society, and the environment;	(1) Section 2.4 PDF pg 101-102 Portrait of a Chemist: Lee Cronin, Can We "app" Chemistry? (2) Section 7.4 PDF pg 382 How Sciences Interconnect: Green Chemistry and Atom Economy (3) Section 8.4 PDF pg 447-448 How Sciences Interconnect: Use of Diffusion for Nuclear Energy Applications: Uranium Enrichment (4) Section 8.4 PDF pg 746-747 How Sciences Interconnect: Environmental Science (5) Section 19.1 PDF pg 1050-1051 How Sciences Interconnect: High Temperature Superconductors	These pages contain topics and resources that draw the students into scientific inquiry through selected topics. Some topics include a resource that is imbedded in the text, see the following: (1) Portrait of a Chemist: Lee Cronin, Can We "app" Chemistry? provided resource: https://www.ted.com/talks/lee_cronin_print_your_own_medicine (2) How Sciences Interconnect: Green Chemistry and Atom Economy provided resource: https://www.epa.gov/greenchemistry (4) How Sciences Interconnect: Environmental Science provided resource: https://www.epa.gov/acidrain	The TEKS verb is "evaluate." To fully support this standard, develop a list of questions such that students evaluate the impact of research on scientific thought, society, and the environment for items 1-5 in column C.	
Chem.3E	describe the connection between chemistry and future careers; and	Section 1.1 PDF pg 21-22	The pages titled: Chemistry: The Central Science introduce chemistry's interconnectedness with a vast array of other STEM disciplines. A graphic shows how the knowledge of chemistry is central to a wide range of scientific disciplines.		

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Knowledge and Skills		OpenStax Location	Details	Comments	Additional Resources
Chem.3F	describe the history of chemistry and contributions of scientists.	(1) Section 1.1 PDF pg 20-22 (2) Section 4.2 PDF pg 212-213 (3) Section 2.1 PDF pg 78-82 (4) Sections 2.2 PDF pg 83-88 (5) PDF pg: 101, 131, 212, 299, 442, 592, 654, 778, 919, 924, 1062,	(1) These pages in Section 1.1 briefly describe the historical development of chemistry. Achievements and contributions of various scientist are detailed throughout the text including: (2) Linus Pauling (3) Dalton (4) Thomson, Millikan, and Rutherford (5) Short articles titled "Portrait of a Chemist" present a short bio and an introduction to the work of prominent figures from history and present day so that students can see the "faces" of contributors in this field as well as science in action including the following scientists: Lee Cronin (PDF pg 101), Dorothy Hodgkin (PDF pg 131), Linus Pauling (PDF pg 212), Walter Kohn (PDF pg 299), Susan Solomon (PDF pg 442), Rosalind Franklin (PDF pg 592), Frederick Cottrell (PDF pg 654), Lawrence Henderson and Karl Hasselbalch (PDF pg 778), Fritz Haber (PDF pg 919), Mario Molina (PDF pg 924), Deanna D'Alessandro (PDF pg 1062)	See Chem.6A (overlapping TEKS) The text covers the TEKS, however this TEKS lends itself to a student research assignment or creation of a timeline detailing the contributions of scientists (showing showing development in a particular research field). Needs to be developed. Portrait of a Chemist articles could be used as a starting point.	Link to Learning PDF pg 84: explore an interactive presentation showcasing the historical development and work of JJ Thomson, including a recording of Thomson talking about the size of an electron in his own voice. https://history.aip.org/history/exhibits/electron/ Link to Learning PDF pg 87: view an interactive simulation of the Rutherford gold foil experiment demonstrating the basis for Rutherford's model of the nuclear atom. https://micro.magnet.fsu.edu/electromag/java/rutherford/ Link to Learning PDF pg 88: explore an PhET interactive simulation to investigate the differences between models of a "plum pudding" atom (Thomson) and a Rutherford atom by firing alpha particles at each. https://phet.colorado.edu/en/simulation/rutherford-scattering