

Instructional Focus Document

Grade 8 Science

TITLE : 2018-2019 Unit 02: Investigating Chemical Formulas and Reactions

SUGGESTED DURATION : 10 days

UNIT OVERVIEW

During this Unit

This unit bundles student expectations addressing chemical formulas and chemical reactions. Students learn how formulas are used to reveal the composition of substances, and indicate the number of atoms of each element in a substance. They analyze chemical formulas to determine the numbers of atoms of each element present in a compound. Students use scientific practices and a variety of tools to investigate how evidence of chemical reactions indicate that new substances with different properties are formed, and the relationship between chemical reactions and the law of conservation of mass. Students construct models of chemical formulas and chemical reactions and identify the advantages and limitations of models. Additionally, students communicate and discuss their observations, and record and organize data in their notebooks. Students continue to demonstrate safe practices as outlined in Texas Education Agency-approved safety standards, and consider environmentally appropriate and ethical practices with resources during investigations.

Note:

There are three perspectives that can be used to demonstrate an understanding of chemical reactions and their relationship with the law of conservation of mass; the macro level, the micro level, and scientific conventions.

Macro level investigations of chemical reactions and the conservation of mass will be the most familiar with students since they are directly related to the experiences students can have in the classroom. Students can determine the total mass in grams of the reactants, observe evidence of chemical reactions, and determine the mass in grams of the products. Students can verify that the total mass of reactants and products are equal in reactions occurring in a closed system to demonstrate the law of conservation of mass. Students can account for lost or gained mass in reactions occurring in an open system. For example, if a gas is produced and released into the atmosphere, a student can mass the remaining solid or liquid product and determine the mass of the released gas.

An understanding of the micro level perspective of chemical reactions and the conservation of mass comes from conceptual instruction of the phenomena. Students use models of chemicals and demonstrate changing bonds between atoms. Students can be expected to understand that the numbers of atoms in a chemical reaction will not change and only the arrangement of the atoms and bonds change in the chemical reaction to adhere to the law of conservation of mass.

An understanding of the scientific conventions used to illustrate chemical reactions and the law of conservation of mass is only partially expected in the streamlined TEKS. Students are no longer expected to recognize balanced chemical equations. However, an understanding of chemical formulas as a convention for representing chemicals can still be expected. Students can still be expected to recognize that a chemical equation is a representation of a chemical reaction and can be used to assess student's conceptual micro level understanding or macro level calculations to demonstrate conservation of mass. For example, a student could be shown a balanced chemical equation with the mass of each reactant indicated and the mass of one product indicated. The student could be expected to find the unknown mass of a second product to demonstrate the relationship between chemical reactions and the law of conservation of mass (e.g., Grade 8 Science STAAR Spring 2016 item # 30).

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Streamlining Note

TEKS 8.5E was revised to include the law of conservation of mass. 8.5F was deleted. See the *Science TEKS Streamlining Side by Side Grade 8* (link in System Resources below).

Prior Content Connections

- Grade 6
 - [6.5A](#) – Know that an element is a pure substance represented by a chemical symbol and that a compound is a pure substance represented by a chemical formula.
 - [6.5C](#) – Identify the formation of a new substance by using the evidence of a possible chemical change such as production of a gas, change in temperature, production of a precipitate, or color change.
- Grade 7
 - [7.6A](#) – Distinguish between physical and chemical changes in matter.
- Grade 8
 - [8.5A](#) – Describe the structure of atoms, including the masses, electrical charges, and locations, of protons and neutrons in the nucleus and electrons in the electron cloud.
 - [8.5B](#) – Identify that protons determine an element's identity and valence electrons determine its chemical properties, including reactivity.
 - [8.5C](#) – Interpret the arrangement of the Periodic Table, including groups and periods, to explain how properties are used to classify elements.

After this Unit

In high school, students will study chemical formulas, chemical reactions, chemical equations, and the law of conservation of mass in more detail.

STAAR Note

The Grade 8 Science STAAR will directly assess student expectations in the following reporting categories:

- Reporting Category 1: Matter and Energy

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- ◊ [7.6A](#) – Supporting Standard
- ◊ [8.5D](#) – Readiness Standard
- ◊ [8.5E](#) – Readiness Standard

According to Research

“By the end of 8th grade, students should know that:

- Atoms may link together in well-defined molecules, or may be packed together in crystal patterns. Different arrangements of atoms into groups compose all substances and determine the characteristic properties of substances. 4D/M1cd*
- An important kind of reaction between substances involves the combination of oxygen with something else—as in burning or rusting. 4D/M6b*
- No matter how substances within a closed system interact with one another, or how they combine or break apart, the total mass of the system remains the same. 4D/M7a*
- The idea of atoms explains the conservation of matter: If the number of atoms stays the same no matter how the same atoms are rearranged, then their total mass stays the same. 4D/M7b
- Substances react chemically in characteristic ways with other substances to form new substances with different characteristic properties. 4D/M11** (NSES)
- If samples of both the original substances and the final substances involved in a chemical reaction are broken down, they are found to be made up of the same set of elements. 4D/M12**
- The idea of atoms explains chemical reactions: When substances interact to form new substances, the atoms that make up the molecules of the original substances combine in new ways. 4D/M13***

American Association for the Advancement of Science. (2009). *Benchmarks on-line*. Retrieved from <http://www.project2061.org/publications/bsl/online/bolintro.htm>.

OVERARCHING UNDERSTANDINGS AND QUESTIONS

Scientists investigate natural phenomena in order to understand and explain each phenomenon in terms of systems.

- What is the value of knowing and understanding natural phenomena?
- How are the properties of systems and their components related to their classification?
- How are the components, processes, and / or patterns of systems interrelated?

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Scientific investigation is an orderly process to ensure that scientific claims are credible.

- Why is credibility so important in the scientific field?
- How is scientific knowledge generated and validated?

Data is systematically collected, organized, and analyzed in terms of patterns and relationships to develop reasonable explanations and make predictions.

- What gives meaning to data?
- What is the value of observing patterns and relationships in data?

Scientists analyze, evaluate, and critique each other's work using principles of scientific investigations in order to build on one another's ideas through new investigations.

- How can we know what to believe about a scientific claim?
- What is the value of scientific literacy?

PERFORMANCE ASSESSMENT(S)	OVERARCHING CONCEPTS UNIT CONCEPTS	UNIT UNDERSTANDINGS
Grade 8 Unit 02 Chemical Reactions PA Click on the PA title to view related rubric. The Science Discovery Center has asked you to provide a display that teaches others about chemical	Systems • Matter Classifications	Chemical formulas reveal the composition of a substance. • In what ways do chemical formulas inform us about substances?

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PERFORMANCE ASSESSMENT(S)	OVERARCHING CONCEPTS UNIT CONCEPTS	UNIT UNDERSTANDINGS
formulas and chemical reactions. Using data from classroom experiences, please include the following in your display and any other resources you feel are necessary for understanding. Chemical formula: • Provide a chemical formula with subscripts. • List each element in the formula and how many atoms of each element are present. • Explain how you count the number of atoms of each element of a chemical formula. • List the total number of atoms present in the chemical formula. • Explain how you calculate the total number of atoms present in the chemical formula. Chemical reaction: • Illustrate a chemical reaction including two reactants and one product. • Illustrate how each reactant appeared prior to the reaction and how the product appeared after the reaction. • Explain the evidence indicating a new substance is formed. • Explain how the properties of the reactants and products differ.	• Elements • Compounds • Chemical reaction Properties • Symbols • Subscripts • Products • Reactants Patterns • Reactants yield products Models • Chemical formulas • Chemical reactions Constancy • Conservation of mass	Properties of matter change when substances are chemically combined, separated, or rearranged. • In what ways can we identify when a new substance has been formed? • In what ways can a chemical reaction be represented? All of the atoms in a chemical reaction can be accounted for before and after the reaction. • How can we determine that mass is conserved during a chemical reaction?

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PERFORMANCE ASSESSMENT(S)	OVERARCHING CONCEPTS UNIT CONCEPTS	UNIT UNDERSTANDINGS
Explain or illustrate how the law of conservation of mass relates to a chemical reaction. Standard(s): 8.2C, 8.2E, 8.5D, 8.5E, ELPS.c.1E, ELPS.c.5D, ELPS.c.5G	Change - Production of gas - Temperature - Production of precipitate - Color - Arrangement of atoms - New substance - New properties	



MISCONCEPTIONS / UNDERDEVELOPED CONCEPTS

Misconceptions:

- Students may think the law of conservation of mass does not apply to chemical reactions, rather than understanding the mass, number, and kind of atoms being equal in the products and reactants of a chemical reaction.
- Students may think that atoms can appear or disappear during chemical reactions, rather than understanding that the law of conservation of mass applies to the atomic level as well.
- Students may think that atoms of an element can combine to form atoms of a new element during a chemical reaction, rather than understanding that the atoms remain the same and only the arrangement of those atoms into different chemical configuration occurs.

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UNIT VOCABULARY

Key Content Vocabulary:

- **Chemical change** – the formation of a new substance with different properties; cannot be undone by physical means
- **Chemical equation** – a representation of a chemical reaction by symbols and numbers
- **Chemical formula** – a representation of a molecule or compound in which the elements are represented by their symbols and subscripts represent the number of atoms of each element
- **Chemical reaction** – a change caused by the interaction of two or more substances (reactants) resulting in the formation of new substances (products)
- **Compound** – a substance made of two or more elements
- **Law of conservation of mass** – matter is not created or destroyed; only rearranged
- **Molecule** – combined atoms of the same element (e.g., O₂)
- **Precipitate** – the formation of solids from a solution
- **Product** – substance(s) resulting from a chemical reaction
- **Reactant** – substances that are combined and changed during a chemical reaction
- **Subscript** – the number written to the right and slightly below an element in a chemical formula; represents the number of atoms of an element present in a chemical formula

Related Vocabulary:

- Element
- Physical change

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UNIT ASSESSMENT ITEMS	SYSTEM RESOURCES	OTHER RESOURCES
Unit Assessment Items that have been published by your district may be accessed through Search All Components in the District Resources tab. Assessment items may also be found using the Assessment Creator if your district has granted access to that tool.	2018-2019 Grade 8 Unit 02 Sample Guiding Questions: Investigating Chemical Formulas and Reactions Science Grade 8 STAAR Blueprint and Item Percentages Science Grade 8 7.6A TEKS Resource System STAAR Analysis Science Grade 8 8.5D TEKS Resource System STAAR Analysis Science Grade 8 8.5E TEKS Resource System STAAR Analysis Streamlined Science TEKS Side by Side Grade 8	State: Texas Education Agency – <i>Texas Safety Standards</i> http://www.tea.state.tx.us/index2.aspx?id=5483 (look under Documents) Texas Education Agency – STAAR Grade 8 Science Reference Materials http://www.tea.state.tx.us/student.assessment/staar/science/ (look under Grade 8) Texas Education Agency – Griddable Questions for Science http://www.tea.state.tx.us/student.assessment/staar/science/ (look under STAAR Science Resources) Texas Gateway for Online Resources by TEA – <i>Matter and Energy: Chemical Formulas</i> https://www.texasgateway.org/resource/matter-and-energy-chemical-formulas Texas Gateway for Online Resources by TEA – <i>Matter and Energy – Chemical Reactions</i> https://www.texasgateway.org/resource/matter-and-energy-chemical-reactions

TEKS# SE#	TEKS	UNIT LEVEL SPECIFICITY
	Knowledge and Skills Statements (TEKS) identified by TEA are in <i>italicized, bolded,</i>	Supporting information / clarifications (specificity) written by TEKS Resource System are in blue text.

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	<i>black text.</i> - Student Expectations (TEKS) identified by TEA are in bolded, black text. - Student Expectations (TEKS) are labeled as Readiness, Supporting, and Process standards if identified by TEA. - Portions of the Student Expectations (TEKS) that are not included in this unit but are taught in previous or future units are indicated by a strike-through.	- Unit-specific clarifications are in <i>italicized, blue text</i>. - Information from Texas Education Agency (TEA), Texas College and Career Readiness Standards (TxCCRS), and American Association for the Advancement of Science (AAAS) Project 2061 is labeled.
<u>8.1</u>	<i>Scientific investigation and reasoning. The student, for at least 40% of instructional time, conducts laboratory and field investigations following safety procedures and environmentally appropriate and ethical practices. The student is expected to:</i>	
<u>8.1A</u>	Demonstrate safe practices during laboratory and field investigations as outlined in Texas Education Agency-approved safety standards.	Demonstrate SAFE PRACTICES DURING LABORATORY AND FIELD INVESTIGATIONS Including, but not limited to: - Wear appropriate safety equipment - Know the location of safety equipment - Follow classroom guidelines, as outlined in Texas Education Agency-approved safety standards - Possible examples may include: - Read or study the science activity or laboratory investigation prior to conducting the investigation

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		• Know and follow all safety rules prior to the investigation • Be alert during the laboratory time • Do not attempt unauthorized activities • If a chemical spill occurs, report it immediately and follow the instructions of the teacher • Keep your area clean • Do not enter preparatory or equipment storage rooms or chemical storerooms • Always wash your hands for at least 20 seconds with soap and warm water before leaving the laboratory • Use lab equipment appropriately Note(s): • STAAR: ◊ The process skills will be incorporated into at least 40% of the test questions and will be identified along with content standards. • TEA: ◊ <i>Texas Education Agency Texas Safety Standards</i> http://www.tea.state.tx.us/index2.aspx?id=5483 • Project 2061: By the end of the 8th grade, students should know that: ◊ Science ethics demand that scientists must not knowingly subject coworkers, students, or community residents to health or property risks without their prior knowledge and consent. 1C/M5b* • TxCCRS: ◊ I. Nature of Science – C2 – Understand and apply safe procedures in the laboratory and field, including chemical, electrical, and fire safety and safe handling of live or preserved organisms. ◊ I. Nature of Science – C3 – Demonstrate skill in the safe use of a wide variety of apparatuses, equipment, techniques, and procedures.

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8.1B	Practice appropriate use and conservation of resources, including disposal, reuse, or recycling of materials.	Practice APPROPRIATE USE AND CONSERVATION OF RESOURCES Including, but not limited to: • Use of resources ◊ Disposal of materials • Laboratory materials • Conservation of resources ◊ Reuse of materials ◊ Recycling of materials • Paper • Glass • Plastic • Metal Note(s): • STAAR: ◊ The process skills will be incorporated into at least 40% of the test questions and will be identified along with content standards. • Project 2061: By the end of the 8th grade, students should know that: ◊ Recycling materials and the development of substitutes for those materials can reduce the rate of depletion of resources but may also be costly. Some materials are not easily recycled. 4B/M10c* ◊ The wasteful or unnecessary use of natural resources can limit their availability for other purposes. Restoring depleted soil, forests, or fishing grounds can be difficult and costly. 4B/M11a* ◊ The benefits of Earth's resources—such as fresh water, air, soil, and trees—can be

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		reduced by deliberately or inadvertently polluting them. The atmosphere, the oceans, and the land have a limited capacity to absorb and recycle waste materials. In addition, some materials take a long time to degrade. Therefore, cleaning up polluted air, water, or soil can be difficult and costly. 4B/M11bc*
<u>8.2</u>	<i>Scientific investigation and reasoning. The student uses scientific practices during laboratory and field investigations. The student is expected to:</i>	
<u>8.2A</u>	Plan and implement comparative and descriptive investigations by making observations, asking well defined questions, and using appropriate equipment and technology.	Plan, Implement COMPARATIVE AND DESCRIPTIVE INVESTIGATIONS Including, but not limited to: • Comparative and descriptive investigations • Making observations • Asking well-defined questions • Using appropriate equipment and technology Note(s): • STAAR: ◊ The process skills will be incorporated into at least 40% of the test questions and will be identified along with content standards. • TEA: ◊ Comparative and descriptive investigations (Texas Education Agency. (2007-2011). Laboratory and Field Investigations – FAQ, August 2010. Retrieved from http://www.tea.state.tx.us/index2.aspx?id=5483)

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		- Comparative investigations involve collecting data on different organisms/objects/features/events, or collecting data under different conditions (e.g., time of year, air temperature, location) to make a comparison. The hypothesis identifies one independent (manipulated) variable and one dependent (responding) variable. A —fair test* can be designed to measure variables so that the relationship between them is determined. - Descriptive investigations involve collecting qualitative and/or quantitative data to draw conclusions about a natural or man-made system (e.g., rock formation, animal behavior, cloud, bicycle, electrical circuit). A descriptive investigation includes a question, but no hypothesis. Observations are recorded, but no comparisons are made and no variables are manipulated. * A fair test is conducted by making sure that only one factor (variable) is changed at a time, while keeping all other conditions the same. - TxCCRS: I. Nature of Science – A3 – Formulate appropriate questions to test understanding of natural phenomena.
8.2B	Design and implement experimental investigations by making observations, asking well defined questions, formulating testable hypotheses, and using appropriate equipment and technology.	Design, Implement INVESTIGATIONS Including, but not limited to: Experimental Making observations Asking well-defined questions Formulating testable hypotheses Using appropriate equipment and technology

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		Note(s): • STAAR: ◊ The process skills will be incorporated into at least 40% of the test questions and will be identified along with content standards. • TEA: ◊ Comparative and experimental investigations (Texas Education Agency. (2007-2011). Laboratory and Field Investigations – FAQ, August 2010. Retrieved from http://www.tea.state.tx.us/index2.aspx?id=5483) • Experimental investigations involve designing a —fair test* similar to a comparative investigation, but a control is identified. The variables are measured in an effort to gather evidence to support or not support a causal relationship. This is often called a —controlled experiment. • * A fair test is conducted by making sure that only one factor (variable) is changed at a time, while keeping all other conditions the same. • TxCCRS: ◊ I. Nature of Science – A3 – Formulate appropriate questions to test understanding of natural phenomena. ◊ I. Nature of Science – B1 – Design and conduct scientific investigations in which hypotheses are formulated and tested.
8.2C	Collect and record data using the International System of Units (SI) and qualitative means such as labeled drawings, writing, and graphic organizers.	Collect, Record DATA Including, but not limited to: • Quantitative means ◊ Using the International System of Units (SI)

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		• Qualitative means ◊ Labeled drawings ◊ Writing ◊ Graphic organizers Note(s): • STAAR: ◊ The process skills will be incorporated into at least 40% of the test questions and will be identified along with content standards. • TxCCRS: ◊ I. Nature of Science – D3 – Demonstrate appropriate use of a wide variety of apparatuses, equipment, techniques, and procedures for collecting quantitative and qualitative data.
8.2D	Construct tables and graphs, using repeated trials and means, to organize data and identify patterns.	Construct TABLES AND GRAPHS Including, but not limited to: • Using repeated trials and means • Organize data • Identify patterns Note(s): • STAAR: ◊ The process skills will be incorporated into at least 40% of the test questions and will be identified along with content standards.

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		- TxCCRS: I. Nature of Science – E1 – Use several modes of expression to describe or characterize natural patterns and phenomena. These models of expression include narrative, numerical, graphical, pictorial, symbolic, and kinesthetic.
8.2E	Analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends.	Analyze DATA Including, but not limited to: - Formulate reasonable explanations - Making claims (statements) from data - Providing evidence from data in order to support claims - Communicate valid conclusions supported by data - Using reasoning (argumentation) to explain or justify the claims - Predict trends Note(s): - STAAR: - The process skills will be incorporated into at least 40% of the test questions and will be identified along with content standards. - Project 2061: By the end of the 8th grade, students should know that: - Even with similar results, scientists may wait until an investigation has been repeated many times before accepting the results as correct. 1A/M1b
8.3	<i>Scientific investigation and reasoning. The student uses critical thinking, scientific reasoning, and</i>	

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	<i>problem solving to make informed decisions and knows the contributions of relevant scientists. The student is expected to:</i>	
8.3A	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.	Analyze, Evaluate, Critique SCIENTIFIC EXPLANATIONS, SO AS TO ENCOURAGE CRITICAL THINKING BY THE STUDENT Including, but not limited to: • Use ◊ Empirical evidence ◊ Logical reasoning ◊ Experimental and observational testing Note(s): • STAAR: ◊ The process skills will be incorporated into at least 40% of the test questions and will be identified along with content standards. • Project 2061: By the end of the 8th grade, students should know that: ◊ Scientific knowledge is subject to modification as new information challenges prevailing theories and as a new theory leads to looking at old observations in a new way. 1A/M2 ◊ Some scientific knowledge is very old and yet is still applicable today. 1A/M3 ◊ Scientific investigations usually involve the collection of relevant data, the use of logical reasoning, and the application of imagination in devising hypotheses and explanations to make sense of the collected data. 1B/M1b* ◊ If more than one variable changes at the same time in an experiment, the outcome of the experiment may not be clearly attributable to any one variable. It may not always be possible to prevent outside variables from influencing an investigation (or even to identify

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		all of the variables). 1B/M2ab • TxCCRS: ◊ I. Nature of Science – A1 – Utilize skepticism, logic, and professional ethics in science. ◊ I. Nature of Science – A4 – Rely on reproducible observations of empirical evidence when constructing, analyzing, and evaluating explanations of natural events and processes.
8.3B	Use models to represent aspects of the natural world such as an atom , a molecule, space , or a geologic feature .	Use MODELS Including, but not limited to: • Representing aspects of the natural world ◊ A molecule • Possible examples may include: ◊ Physical models ◊ Conceptual models ◊ Mathematical models Note(s): • STAAR: ◊ The process skills will be incorporated into at least 40% of the test questions and will be identified along with content standards.
8.3C	Identify advantages and limitations of models such as size, scale, properties, and materials.	Identify ADVANTAGES AND LIMITATIONS OF MODELS

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		Including, but not limited to: • Size • Scale • Properties • Materials Note(s): • STAAR: ◊ The process skills will be incorporated into at least 40% of the test questions and will be identified along with content standards. • TxCCRS: ◊ V. Cross-Disciplinary Themes – E2 – Use scale to relate models and structures. ◊ VII. Chemistry – B1 – Summarize the development of atomic theory. Understand that models of the atom are used to help understand the properties of elements and compounds.
<u>8.4</u>	<i>Scientific investigation and reasoning. Scientific investigation and reasoning. The student knows how to use a variety of tools and safety equipment to conduct science inquiry. The student is expected to:</i>	
<u>8.4A</u>	Use appropriate tools, including lab journals/notebooks, beakers, meter sticks , graduated cylinders, anemometers , psychrometers , hot plates , test tubes, spring scales , balances, microscopes , thermometers, calculators, computers, spectroscopes , timing	Use APPROPRIATE TOOLS TO COLLECT, RECORD, AND ANALYZE INFORMATION Including, but not limited to:

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	devices, and other necessary equipment to collect, record, and analyze information.	• Lab journal / (science) notebooks • Beakers • Graduated cylinders • Test tubes • Balances • Thermometers • Calculators • Computers • Timing devices • Other equipment as needed to teach the curriculum Note(s): • STAAR: ◦ The process skills will be incorporated into at least 40% of the test questions and will be identified along with content standards. • TxCCRS: ◦ I. Nature of Science – D3 – Demonstrate appropriate use of a wide variety of apparatuses, equipment, techniques, and procedures for collecting quantitative and qualitative data.
<u>8.4B</u>	Use preventative safety equipment, including chemical splash goggles, aprons, and gloves, and be prepared to use emergency safety equipment, including an eye/face wash, a fire blanket, and a fire extinguisher.	Use SAFETY EQUIPMENT Including, but not limited to: • Preventative safety equipment ◦ Chemical splash goggles

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		◊ Aprons ◊ Gloves • Emergency safety equipment ◊ Eye / face wash ◊ Fire blanket ◊ Fire extinguisher Note(s): • STAAR: ◊ The process skills will be incorporated into at least 40% of the test questions and will be identified along with content standards. • TxCCRS: ◊ I. Nature of Science – C3 – Demonstrate skill in the safe use of a wide variety of apparatuses, equipment, techniques, and procedures.
<u>8.5</u>	<i>Matter and energy. The student knows that matter is composed of atoms and has chemical and physical properties. The student is expected to:</i>	
<u>8.5D</u>	Recognize that chemical formulas are used to identify substances and determine the number of atoms of each element in chemical formulas containing subscripts. <i>Readiness Standard</i>	Recognize USES OF CHEMICAL FORMULAS Including, but not limited to: • Chemical formula – a representation of a molecule or compound in which the elements are represented by their symbols and subscripts represent the number of atoms of each element • Identify substances

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		Determine THE NUMBER OF ATOMS OF EACH ELEMENT IN CHEMICAL FORMULAS CONTAINING SUBSCRIPTS Including, but not limited to: • Differentiate between numbers of atoms of each element present in a formula and total number of atoms present in the formula overall ◊ Count number of atoms of individual elements present within a formula • Parentheses are used to indicate more than one group of atoms within a chemical formula. The subscript outside the parentheses indicates the number of groups within the parentheses ◊ Example: • $(\text{NH}_4)_2\text{CO}_3$ - there are two groups of NH_4 • $\text{NH}_4 + \text{NH}_4 = (\text{NH}_4)_2$ • N = 2 atoms • H = 8 atoms ◊ Coefficients in front of a chemical formula represent how many molecules of a given formula are present. No coefficient represents one. • Example: ◊ $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$ ◊ $1 \text{ N}_2 = \text{N}_2$ ◊ $3\text{H}_2 = \text{H}_2 + \text{H}_2 + \text{H}_2$ (6 atoms of H) ◊ $2\text{NH}_3 = \text{NH}_3 + \text{NH}_3$ (2 atoms of N and 6 atoms of H) ◊ Coefficients with parentheses and subscripts in a chemical formula represent how many molecules of a given formula are present. No coefficient represents one. • Example:

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TITLE : 2018-2019 Unit 02: Investigating Chemical Formulas and Reactions

SUGGESTED DURATION : 10 days

TEKS# SE#	TEKS	UNIT LEVEL SPECIFICITY
		◊ $4\text{Fe}(\text{OH})_3 = \text{Fe}(\text{OH})_3 + \text{Fe}(\text{OH})_3 + \text{Fe}(\text{OH})_3 + \text{Fe}(\text{OH})_3$ ◊ 4 atoms of Fe ◊ 12 atoms of O ◊ 12 atoms of H ◊ Count number of total atoms within a formula • Example: ◊ $(\text{NH}_4)_2\text{CO}_3$ - there are two groups of NH_4 ◊ $2 \times (1 \text{ atom of N} + 4 \text{ atoms of H}) + 1 \text{ atom of C} + 3 \text{ atoms of O}$ ◊ $2(1 + 4) + 1 + 3$ ◊ $2(5) + 4$ ◊ $10 + 4 = 14$ total atoms in $(\text{NH}_4)_2\text{CO}_3$ Note(s): • STAAR: ◊ The STAAR Grade 8 Science Reference Materials include a Periodic Table of the elements. ◊ This is the first time students have been introduced to chemical formulas. ◊ Students in Grade 6 have been introduced to elements, compounds, and chemical symbols (6.5A, 6.5B). ◊ Students may be assessed by conceptual / verbal knowledge of the information found in chemical formulas or through analysis of formulas. ◊ Students may be assessed with coefficients and parentheses in a chemical formula with subscripts. (Grade 8 STAAR 2018, Qu #22)
<u>8.5E</u>	Investigate how evidence of chemical reactions indicates that new substances with different	<u>Investigate</u>

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	properties are formed and how that relates to the law of conservation of mass. <i>Readiness Standard</i>	HOW EVIDENCE OF CHEMICAL REACTIONS INDICATES THAT NEW SUBSTANCES ARE FORMED AND HOW THAT RELATES TO THE LAW OF CONSERVATION OF MASS Including, but not limited to: • Physical change – change which alters the physical properties of a substance without changing its identity • Chemical change – the formation of a new substance with different properties; cannot be undone by physical means • Observe and recognize signs of chemical change ◊ Production of a gas • Odor • Bubbling ◊ Change in temperature ◊ Production of a precipitate • Precipitate – the formation of solids from a solution ◊ Color change (permanent) ◊ Production of light ◊ Change in mass • Compare differences in properties between products and reactants of chemical equations • Law of conservation of mass – matter is not created or destroyed; only rearranged ◊ Macro scale • Scientists can measure the total mass of the reactants prior to a chemical reaction and the total mass of products after a chemical reaction • When all matter is accounted for, scientists can confirm the law of conservation of mass by showing the total mass of the reactants equals the total mass of the products ◊ If a chemical reaction is performed in a closed system, the total mass of the products may be more or less than the total mass of the reactants

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		◊ Possible examples: • Gas is formed during a chemical reaction and not massed • Solid particles (e.g., smoke) are released and not massed • Gaseous water cooling and condensing on the system containing the reaction adding to the mass ◊ Micro scale • During chemical reactions, atoms of substances (reactants) are rearranged to form a new substance (products) • Recognize that all of the atoms involved in a chemical reaction can be accounted for Note(s): • STAAR: ◊ Students in Grade 6 have been introduced to evidence of chemical changes (6.5D). Students in Grade 7 have distinguished between chemical and physical changes in matter (7.6A). ◊ Students are no longer expected to recognize whether a chemical equation containing coefficients is balanced or not and how that relates to the law of conservation of mass. ◊ Chemical equations may be included in future STAAR items as additional context for items addressing the student expectation, but the skill of evaluating the numbers of atoms on either side of the equation will not be required (see Grade 8 Science STAAR Spring 2016 item 30). • Project 2061: By the end of the 8th grade, students should know that: ◊ Atoms may link together in well-defined molecules, or may be packed together in crystal patterns. Different arrangements of atoms into groups compose all substances and determine the characteristic properties of substances. 4D/M1cd ◊ Substances react chemically in characteristic ways with other substances to form new substances with different characteristic properties. 4D/M11** (NSES) ◊ No matter how substances within a closed system interact with one another, or how they

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		combine or break apart, the total mass of the system remains the same. 4D/M7a* ◊ The idea of atoms explains the conservation of matter: If the number of atoms stays the same no matter how the same atoms are rearranged, then their total mass stays the same. 4D/M7b ◊ If samples of both the original substances and the final substances involved in a chemical reaction are broken down, they are found to be made up of the same set of elements. 4D/M12** ◊ The idea of atoms explains chemical reactions: When substances interact to form new substances, the atoms that make up the molecules of the original substances combine in new ways. 4D/M13** • TxCCRS: ◊ VII. Chemistry – E1 – Classify chemical reactions by type. Describe the evidence that a chemical reaction has occurred. ◊ VII. Chemistry – H2 – Understand energy changes and chemical reactions.

ELPS#	SUBSECTION C: CROSS-CURRICULAR SECOND LANGUAGE ACQUISITION ESSENTIAL KNOWLEDGE AND SKILLS.
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The English Language Proficiency Standards (ELPS), as required by 19 Texas Administrative Code, Chapter 74, Subchapter A, §74.4, outline English language proficiency level descriptors and student expectations for English language learners (ELLs). School districts are required to implement ELPS as an integral part of each subject in the required curriculum.

School districts shall provide instruction in the knowledge and skills of the foundation and enrichment curriculum in a manner that is linguistically accommodated commensurate with the student's levels of English language proficiency to ensure that the student learns the knowledge and skills in the required curriculum.

School districts shall provide content-based instruction including the cross-curricular second language acquisition essential knowledge and skills in subsection (c) of the ELPS in a manner that is linguistically accommodated to help the student acquire English language proficiency.

<http://ritter.tea.state.tx.us/rules/tac/chapter074/ch074a.html#74.4>

Choose appropriate ELPS to support instruction.

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