# 2018-2019 Science Curriculum Map, Chemistry, Q1

## Reading Focus: Informational, Literature Writing Focus: Narrative, Informative/Explanatory

## Unifying Concept:
Students will understand the nature of matter and energy; the quantitative nature of chemistry.

<table>
<thead>
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<th>Quarter 1</th>
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<tbody>
<tr>
<td>Enduring Understandings:</td>
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<tr>
<td>Everything in the universe that we know is composed of matter and energy and can be identified based on physical and -chemical properties. Scientific inquiry involves asking scientifically oriented questions, collecting evidence, forming explanations, connecting explanations to scientific knowledge and theory, and communicating and justifying explanations. Chemistry is a quantitative science.</td>
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- How can one explain the structure, properties, and interactions of matter?  
- How do substances combine or change (react) to make new substances?  
- How does one characterize and explain these reactions and make predictions about them? |
| Academic Vocabulary: |
- Elements  
- Density  
- Volume  
- Mass  
- Chemical changes  
- Physical properties  
- Chemical properties  
- Elements  
- Physical changes  
- Heterogeneous  
- Homogeneous  
- Periodic table  
- Atom  
- Atomic model  
- Neutron  
- Molecule  
- Electron  
- Proton  
- Electric charge  
- Atomic structure  
- Chemical charge  
- Proton  
- Energy level  
- Isotope  
- Conservation electric charge  
- Electron configuration  
- Ion  
- Atomic model  
- Bohr model  
- Pudding model  
- Nucleus  
- Positive charge  
- Negative charge |

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### Highly-Leveraged Standards

#### Strand 5: Physical Science  
**HS.SS.C1 Structure and Properties of Matter:** Understand physical, chemical, and atomic properties of matter.  
**PO1.** Describe substances based on their physical properties.  
**PO2.** Describe substances based on their chemical properties.  
**PO3.** Predict properties of elements and compounds using trends of the periodic table (e.g., metals, non-metals, bonding – ionic/covalent).  
**PO4.** Separate mixtures of substances based on their physical properties.  
**PO5.** Describe the properties of electric charge and the conservation of electric charge.

#### Supporting Standards

**HS.SS.C3: Conservation of Energy and Increase in Disorder:** Understand ways that energy is conserved, stored, and transferred.  
**PO 1.** Describe the following ways in which energy is stored in a system:  
- mechanical  
- electrical  
- chemical  
- nuclear  
**PO 3.** Recognize that energy is conserved in a closed system.
**PO6.** Describe the following features and components of the atom:
- Protons, neutrons, electrons, mass, number and type of particles, structure, organization

**PO7.** Describe the historical development of models of the atom.

**PO8.** Explain the details of atomic structure (e.g., electron configuration, energy levels, isotopes).

### Constant Standards

**Strand 1: Inquiry Process (HLS-34%)**

**HS.S1.C1 Observations, Questions, and Hypotheses:** Formulate predictions, questions, or hypotheses based on observations. Evaluate appropriate resources.

**PO1.** Evaluate scientific information for relevance to a given problem

**PO2.** Develop questions from observations that transition into testable hypotheses.

**PO3.** Formulate a testable hypothesis.

**PO4.** Predict the outcome of an investigation based on prior evidence, probability, and/or modeling (not guessing or inferring).


**PO1.** Demonstrate safe and ethical procedures (e.g., use and care of technology, materials, organisms) and behavior in all science inquiry.

**PO2.** Identify the resources needed to conduct an investigation.

**PO3.** Design an appropriate protocol (written plan of action) for testing a hypothesis:
- Identify dependent and independent variables in a controlled investigation.
- Determine an appropriate method for data collection (e.g., using balances, thermometers, microscopes, spectrophotometer, using qualitative changes).
- Determine an appropriate method for recording data (e.g., notes, sketches, photographs, videos, journals (logs), charts, computers/calculators).

**PO4.** Conduct a scientific investigation that is based on a research design.

**PO5.** Record observations, notes, sketches, questions, and ideas using tools such as journals, charts, graphs, and computers.

**HS.S1.C3 Analysis, Conclusion, and Refinements:** Evaluate experimental design, analyze data to explain results and propose further investigations. Design models.

**PO1.** Interpret data that show a variety of possible relationship between variables, including:
- Positive relationship
- Negative relationship
- No relationship

**PO2.** Evaluate whether investigational data support or do not support the proposed hypothesis.

**PO3.** Critique reports of scientific studies (e.g., published papers, student reports).

**PO4.** Evaluate the design of an investigation to identify possible sources of procedural error, including:
- Sample size
- Trials
- Controls
- Analyses
PO5. Design models (conceptual or physical) of the following to represent “real world’ scenarios:
- Carbon cycle
- Water cycle
- Phase change
- Collisions

PO6. Use descriptive statistics to analyze data, including:
- Mean, Frequency and Range

PO7. Propose further investigations based on the findings of a conducted investigation.

**HS.S1.C4 Communication**: Communicate results of investigations.

PO1. For a specific investigation, choose an appropriate method for communicating the results.

PO2. Produce graphs that communicate data.

PO3. Communicate results clearly and logically.

PO4. Support conclusions with logical scientific arguments.

**Strand 2: History and Nature of Science**

**HS.S2.C1 History of Science as a Human Endeavor**: Identify individual, cultural, and technological contributions to scientific knowledge.

PO1. Describe how human curiosity and needs have influenced science, impacting the quality of life worldwide.

PO2. Describe how diverse people and/or cultures, past and present, have made important contributions to scientific innovations.

PO3. Analyze how specific changes in science have affected society.

PO4. Analyze how specific cultural and/or societal issues promote or hinder scientific advancements.

**HS.S2.C2 Nature of Scientific Knowledge**: Understand how science is a process for generating knowledge.

PO1. Specify the requirements of a valid, scientific explanation (theory), including that it be:
- Logical
- Subject to peer review
- Public
- Respectful of rules of evidence

PO2. Explain the process by which accepted ideas are challenged or extended by scientific innovation.

PO3. Distinguish between pure and applied science.

PO4. Describe how scientists continue to investigate and critically analyze aspects of theories.

**Strand 3: Science in Personal and Social Perspectives**

**HS.S3.C2 Science and Technology in Society**: Develop viable solutions to a need or problem.

PO1. Analyze the costs, benefits, and risks of various ways of dealing with the following needs or problems:
- Various forms of alternative energy
- Storage of nuclear waste
- Abandoned mines
- Greenhouse gases
- Hazardous wastes

**PO2.** Recognize the importance of basing arguments on a thorough understanding of the core concepts and principles of science and technology.

**PO3.** Support a position on a science or technology issue.

**PO4.** Analyze the use of renewable and nonrenewable resources in Arizona.

- Water, land, soil, minerals, air

**PO5.** Evaluate methods used to manage natural resources (e.g., reintroduction of wildlife, fire ecology).

**HS.S3.C3 Human Population Characteristics:** Analyze Factors that affect human populations.

**PO1.** Analyze social factors that limit the growth of a human population, including:

- Affluence, education, access to health care, cultural influences

**PO2.** Describe biotic (living) and abiotic (nonliving) factors that affect human populations.

**PO3.** Predict the effect of a change in a specific factor on a human population.

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| Social Justice Standards                     |                                                                |
| **Identity**                                 |                                                                |
| Students will know their family history and cultural background and can describe how their own identity is informed and shaped by their membership in multiple identity groups. (ID.9-12.2) |                                                                |
| Students will know that all their group identities and the intersection of those identities create unique aspects of who they are and that this is true for other people too. (ID.9-12.3) |                                                                |
| Students will express pride and confidence in their identity without perceiving or treating anyone else as inferior. (ID.9-12.4) |                                                                |
| **Diversity**                                |                                                                |
Students will use language and knowledge to accurately and respectfully describe how people (including themselves) are both similar to and different from each other and others in their identity groups. (DI.9-12.7)

Students will respectfully express curiosity about the history and lived experiences of others and will exchange ideas and beliefs in an open-minded way. (DI.9-12.8)

Students will relate to and build connections with other people by showing them empathy, respect and understanding, regardless of their similarities or differences. (DI.9-12.9)

**Justice**

Students will be aware of the advantages and disadvantages they have in society because of their membership in different identity groups, and their knowledge of how this has affected their lives. (JU.9-12.14)

**Action**

Students express empathy when people are excluded or mistreated because of their identities and concern when they personally experience bias. (AC.9-12.16)

Students have the courage to speak up to people when their words, actions or views are biased and hurtful, and they will communicate with respect even when others disagree. (AC.9-12.18)

**Teaching Tolerance Anti-Bias Framework** [https://www.tolerance.org/frameworks](https://www.tolerance.org/frameworks)

### Adopted Texts and Materials

#### Textbook:
- Chemistry: Zumdahl and Zumdahl, 9th Ed.
- Chemistry: Wilbraham, 5th Ed.
- Class set of student textbooks aligned to grade and state standards
- SciLinks
- Other titles may be available; please see TUSD Textbook Distribution Center on TUSD website

#### Additional Instructional Resources

- Chem Matters online magazine
- Science Geek website
- Chemmy Bear
- Chem Fiesta
- Chemistry Vocabulary
- Chemistry Lab resources
- ACS for Students
- Flinn Chemistry Resources
- Khan Academy Chemistry Videos
- TUSD Science web resources

### Instructional and Assessment Guides

#### Culturally Responsive Practices ([TUSD SPARKS, SPARKS Strategies](https://www.tolerance.org/frameworks))

**Pre/Post Unit Assessment Examples:**
- Lab Practical with Formal Report
- Chemistry Quizzes/Unit Exams

**Formative & Performance Assessment Examples**
- LABS- Lab activity assessments
- Bell work
- Closure activities
- KWL

#### Additional Instructional Resources

- Safety in the Science Classroom
- High School Lab Safety
- Science and Engineering Practices
- High Leveraged Instructional Standards
- American Chemical Society resources
- Standards for Literacy in Science
- Matter and Energy Teaching Resources
- Socratic Seminar
- Hess' Matrix
- DOK Levels
• Database online tool for assessments
• Engage in arguments with evidence and reasoning -Tools (e.g. to support or refute subject related claims).

Assessment Resources
• Chemistry On-line Chapter Self Assessments
• Science Assessment Tool
• http://pals.sri.com/ Assessment Resource Bank
• MOSART Assessment Resources
• DOK Stems
• Learning Goals in Chemistry
• Reading and Writing in the Science Classroom
• Writing about Graphs
• Chemistry and Unifying Themes of Science, professional reading
• Vee Map Components, professional reading

1Highly-Leveraged Standards are essential for students to learn because they have endurance (knowledge and skills relevant throughout a student’s lifetime); leverage (knowledge and skills used across multiple content areas); and essentiality (knowledge and skills necessary for success in future courses or grade levels). This definition for Highly-Leveraged Standards was adapted from the “power standard” definition on the website of the Millis Public Schools, K-12, Massachusetts, USA, 2016.

2Supporting Standards are emphasized during the quarter as they are integral to achieve mastery of the Highly Leveraged Standards. Mastery of these standards are measured using classroom assessments.

3Constant Standards are repeatedly addressed to reinforce grade-level mastery.
### Reading Focus: Informational, Literature
Writing Focus: Narrative, Informative/Explanatory

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<td><strong>Enduring Understandings:</strong></td>
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<td>There are six main types of chemical reactions</td>
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<tr>
<td>The products of a chemical reaction can be predicted using a set of rules.</td>
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<tr>
<td>A molecular formula gives the actual number of each element in a compound.</td>
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<tr>
<td>Limiting reactants determine the maximum amount of product.</td>
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<tr>
<td>All gases exhibit similar physical properties since they follow a basic set of gas laws.</td>
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<td>The kinetic theory provides an explanation of gas behavior.</td>
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<th>Essential Questions:</th>
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<tr>
<td>• How are chemical equations classified and differentiated?</td>
</tr>
<tr>
<td>• How does the conservation of atoms in chemical reactions lead to the ability to calculate the mass of products and reactants using the mole concept?</td>
</tr>
<tr>
<td>• How does the Kinetic Theory of Matter explain the behavior of gases?</td>
</tr>
<tr>
<td>• How do the various gas laws explain the relationship between pressure and volume, volume and temperature, pressure and temperature, and the number of particles in a gas sample?</td>
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<th>Academic Vocabulary:</th>
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<tr>
<td>Conservation of matter</td>
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<tr>
<td>Product(s)</td>
</tr>
<tr>
<td>Reactant(s)</td>
</tr>
<tr>
<td>Molecular formula</td>
</tr>
<tr>
<td>Conservation of atoms</td>
</tr>
<tr>
<td>Empirical formula</td>
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<tr>
<td>Chemical reaction</td>
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<tr>
<td>Chemical change</td>
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<tr>
<td>Balance (a reaction)</td>
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<tr>
<td>Compound</td>
</tr>
<tr>
<td>Ionic bond</td>
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<tr>
<td>Covalent bond</td>
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<tr>
<td>Avogadro’s number</td>
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<tr>
<td>Pressure</td>
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<td>Kelvin</td>
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<td>Temperature</td>
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<tr>
<td>Universal Gas Law</td>
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<tr>
<td>Volume</td>
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<tr>
<td>Limiting reactant</td>
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<tr>
<td>Universal Gas Constant</td>
</tr>
<tr>
<td>Percent yield</td>
</tr>
<tr>
<td>Kinetic theory of matter</td>
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<tr>
<td>Atmosphere (unit of measure)</td>
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</tbody>
</table>

### Highly-Leveraged Standards

**Strand 5: Physical Science**

**HS.S5.C4 Chemical Reactions:** Investigate relationships between reactants and products in chemical reactions.

- **PO1.** Apply the law of conservation of matter to changes in a system.
- **PO2.** Identify the indicators of chemical change, including formation of a precipitate, evolution of a gas, color change, absorption or release of heat energy.
- **PO3.** Represent a chemical reaction by using a balanced equation.
- **PO4.** Distinguish among the types of bonds (i.e., ionic, covalent, metallic, hydrogen bonding)
- **PO5.** Describe the mole concept and its relationship to Avogadro’s number
- **PO6.** Solve problems involving such quantities as moles, mass, molecules, volume of a gas, and molarity using the mole concept and Avogadro’s number.
- **PO7.** Predict the properties (e.g., melting point, boiling point, conductivity) of substances based upon bond type.

### Supporting Standards

**Strand 5: Physical Science**

**HS.S5.C1 Structure and Properties of Matter:** Understand physical, chemical, and atomic properties of matter.

- **PO1.** Describe substances based on their physical properties.
- **PO2.** Describe substances based on their chemical properties.
- **PO3.** Predict properties of elements and compounds using trends of the periodic table (e.g., metals, non-metals, bonding – ionic/covalent).
- **PO4.** Separate mixtures of substances based on their physical properties.
- **PO5.** Describe the properties of electric charge and the conservation of electric charge.
- **PO6.** Describe the following features and components of the atom:
  - Protons, neutrons, electrons, mass, number and type of particles, structure, organization
- **PO7.** Describe the historical development of models of the atom.
**PO8.** Quantify the relationships between reactants and products in chemical reactions (e.g., stoichiometry, equilibrium, energy transfers)  
**PO9.** Predict the products of a chemical reaction using types of reactions (e.g., synthesis, decomposition, replacement, combustion).  
**PO10.** Explain the energy transfers within chemical reactions using the law of conservation of energy.  
**PO11.** Predict the effect of various factors (e.g., temperature, concentration, pressure, catalyst) on the equilibrium state and on the rates of chemical reaction.

**HS.S5.C5 Interactions of Energy and Matter:** Understand the interactions of energy and matter.  
**PO1.** Describe various ways in which matter and energy interact (e.g., photosynthesis, phase change).

**Constant Standards**

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<th>Strand 1: Inquiry Process (HLS-34%)</th>
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Teaching Tolerance Anti-Bias Framework  [https://www.tolerance.org/frameworks](https://www.tolerance.org/frameworks)

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- Chemistry Quizzes/Unit Exams

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- Interactive quizzes; Bell work; Closure activities; KWL
- Database online tool for assessments
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### Assessment Resources
- Science Assessment Tool
- MOSART
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1. **Highly-Leveraged Standards** are essential for students to learn because they have endurance (knowledge and skills relevant throughout a student’s lifetime); leverage (knowledge and skills used across multiple content areas); and essentiality (knowledge and skills necessary for success in future courses or grade levels). This definition for Highly-Leveraged Standards was adapted from the “power standard” definition on the website of the Millis Public Schools, K-12, Massachusetts, USA, 2016.

2. **Supporting Standards** are emphasized during the quarter as they are integral to achieve mastery of the Highly Leveraged Standards. Mastery of these standards are measured using classroom assessments.

3. **Constant Standards** are repeatedly addressed to reinforce grade-level mastery.
### Reading Focus: Informational, Literature

### Writing Focus: Narrative, Informative/Explanatory

### Unifying Concept:
Students will understand how electrons contribute to chemical changes in acids and bases.

### Quarter 3

#### Enduring Understandings:
- The periodic table is a helpful tool in chemistry. Electrons are arranged systematically in an atom following a set of rules.
- There are three types of elements on the periodic table based on electron arrangement. Chemical compounds can be acids, bases or salts. Acids & bases can be weak or strong. Acid & base dissociation constants determine the strengths of acids & bases.

#### Essential Questions:
- How does the organization of the Periodic Table illustrate commonality and patterns of physical and chemical properties among the elements?
- Why do chemical bonds form and what factors determine the types of bonds formed between atoms?
- How can the concentration of solutions be calculated in terms of molarity, molality and percent by mass?
- How can stoichiometry be used to solve reactions taking place in solution?
- To what extent are acids and bases important in numerous chemical processes that occur around us, from industrial to biological processes, from the laboratory to the environment?

#### Academic Vocabulary:
- Periodic Table
- Chemical bonds
- Physical properties
- Chemical properties
- Atoms
- Molarity
- Molality
- Percent of Mass
- Stoichiometry
- Acids
- Chemical processes
- Elements
- Concentration of solutions
- Law of conservation
- Chemical charge
- Evolution of a gas
- Covalent
- Hydrogen bonding
- Combustion

#### Highly-Leveraged Standards

**Strand 5: Physical Science**

**HS.S5.C4 Chemical Reactions**: Investigate relationships between reactants and products in chemical reactions.

**PO1.** Apply the law of conservation of matter to changes in a system.

**PO2.** Identify the indicators of chemical change, including formation of a precipitate, evolution of a gas, color change, absorption or release of heat energy.

**PO3.** Represent a chemical reaction by using a balanced equation.

**PO4.** Distinguish among the types of bonds (i.e., ionic, covalent, metallic, hydrogen bonding)

**PO5.** Describe the mole concept and its relationship to Avogadro’s number

**PO8.** Quantify the relationships between reactants and products in chemical reactions (e.g., stoichiometry, equilibrium, energy transfers)

**Supporting Standards**

**HS.S5.C1 Structure and Properties of Matter**: Understand physical, chemical, and atomic properties of matter.

**PO1.** Describe substances based on their physical properties.

**PO2.** Describe substances based on their chemical properties.

**PO3.** Predict properties of elements and compounds using trends of the periodic table (e.g., metals, non-metals, bonding – ionic/covalent).

**PO4.** Separate mixtures of substances based on their physical properties.

**PO5.** Describe the properties of electric charge and the conservation of electric charge.

**PO6.** Describe the following features and components of the atom:
PO9. Predict the products of a chemical reaction using types of reactions (e.g., synthesis, decomposition, replacement, combustion).

PO10. Explain the energy transfers within chemical reactions using the law of conservation of energy.

PO11. Predict the effect of various factors (e.g., temperature, concentration, pressure, catalyst) on the equilibrium state and on the rates of chemical reaction.

PO12. Compare the nature, behavior, concentration, and strengths of acids and bases.

PO13. Determine the transfer of electrons in oxidation/reduction reactions.

HS.S5.C5 Interactions of Energy and Matter: Understand the interactions of energy and matter.

PO1. Describe various ways in which matter and energy interact (e.g., photosynthesis, phase change).

PO7. Describe the historical development of models of the atom.

PO8. Explain the details of atomic structure (e.g., electron configuration, energy levels, isotopes).

PO1. Evaluate scientific information for relevance to a given problem.

PO2. Develop questions from observations that transition into testable hypotheses.

PO3. Formulate a testable hypothesis.

PO4. Predict the outcome of an investigation based on prior evidence, probability, and/or modeling (not guessing or inferring).

HS.S1.C1 Observations, Questions, and Hypotheses: Formulate predictions, questions, or hypotheses based on observations. Evaluate appropriate resources.

PO1. Evaluate scientific information for relevance to a given problem.

PO2. Develop questions from observations that transition into testable hypotheses.

PO3. Formulate a testable hypothesis.

PO4. Predict the outcome of an investigation based on prior evidence, probability, and/or modeling (not guessing or inferring).


PO1. Demonstrate safe and ethical procedures (e.g., use and care of technology, materials, organisms) and behavior in all science inquiry.

PO2. Identify the resources needed to conduct an investigation.

PO3. Design an appropriate protocol (written plan of action) for testing a hypothesis:
   - Identify dependent and independent variables in a controlled investigation.
   - Determine an appropriate method for data collection (e.g., using balances, thermometers, microscopes, spectrophotometer, using qualitative changes).
   - Determine an appropriate method for recording data (e.g., notes, sketches, photographs, videos, journals (logs), charts, computers/calculators).

PO4. Conduct a scientific investigation that is based on a research design.

PO5. Record observations, notes, sketches, questions, and ideas using tools such as journals, charts, graphs, and computers.

HS.S1.C3 Analysis, Conclusion, and Refinements: Evaluate experimental design, analyze data to explain results and propose further investigations. Design models.

PO1. Interpret data that show a variety of possible relationship between variables, including:
   - Positive relationship
   - Negative relationship
   - No relationship
**PO2.** Evaluate whether investigational data support or do not support the proposed hypothesis.
**PO3.** Critique reports of scientific studies (e.g., published papers, student reports).
**PO4.** Evaluate the design of an investigation to identify possible sources of procedural error, including:
- Sample size
- Trials
- Controls
- Analyses

**PO5.** Design models (conceptual or physical) of the following to represent “real world” scenarios:
- Carbon cycle
- Water cycle
- Phase change
- Collisions

**PO6.** Use descriptive statistics to analyze data, including:
- Mean, Frequency and Range

**PO7.** Propose further investigations based on the findings of a conducted investigation.

**HS.S1.C4 Communication:** Communicate results of investigations.
**PO1.** For a specific investigation, choose an appropriate method for communicating the results.
**PO2.** Produce graphs that communicate data.
**PO3.** Communicate results clearly and logically.
**PO4.** Support conclusions with logical scientific arguments.

**Strand 2: History and Nature of Science**

**HS.S2.C1 History of Science as a Human Endeavor:** Identify individual, cultural, and technological contributions to scientific knowledge.
**PO1.** Describe how human curiosity and needs have influenced science, impacting the quality of life worldwide.
**PO2.** Describe how diverse people and/or cultures, past and present, have made important contributions to scientific innovations.
**PO3.** Analyze how specific changes in science have affected society.
**PO4.** Analyze how specific cultural and/or societal issues promote or hinder scientific advancements.

**HS.S2.C2 Nature of Scientific Knowledge:** Understand how science is a process for generating knowledge.
**PO1.** Specify the requirements of a valid, scientific explanation (theory), including that it be:
- Logical
- Subject to peer review
- Public
- Respectful of rules of evidence

**PO2.** Explain the process by which accepted ideas are challenged or extended by scientific innovation.
PO3. Distinguish between pure and applied science.

PO4. Describe how scientists continue to investigate and critically analyze aspects of theories.

**Strand 3: Science in Personal and Social Perspectives**

**HS.S3.C2 Science and Technology in Society:** Develop viable solutions to a need or problem.

**PO1.** Analyze the costs, benefits, and risks of various ways of dealing with the following needs or problems:
- Various forms of alternative energy
- Storage of nuclear waste
- Abandoned mines
- Greenhouse gases
- Hazardous wastes

**PO2.** Recognize the importance of basing arguments on a thorough understanding of the core concepts and principles of science and technology.

**PO3.** Support a position on a science or technology issue.

**PO4.** Analyze the use of renewable and nonrenewable resources in Arizona.
- Water, land, soil, minerals, air

**PO5.** Evaluate methods used to manage natural resources (e.g., reintroduction of wildlife, fire ecology).

**HS.S3.C3 Human Population Characteristics:** Analyze Factors that affect human populations.

**PO1.** Analyze social factors that limit the growth of a human population, including:
- Affluence, education, access to health care, cultural influences

**PO2.** Describe biotic (living) and abiotic (nonliving) factors that affect human populations.

**PO3.** Predict the effect of a change in a specific factor on a human population.

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**Social Justice Standards**
Identity
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Students will know that all their group identities and the intersection of those identities create unique aspects of who there are and that this is true for other people too. (ID.9-12.3)
Students will express pride and confidence in their identity without perceiving or treating anyone else as inferior. (ID.9-12.4)

Diversity
Students will use language and knowledge to accurately and respectfully describe how people (including themselves) are both similar to and different from each other and others in their identity groups. (DI.9-12.7)
Students will respectfully express curiosity about the history and lived experiences of others and will exchange ideas and beliefs in an open-minded way. (DI.9-12.8)
Students will relate to and build connections with other people by showing them empathy, respect and understanding, regardless of their similarities or differences. (DI.9-12.9)

Justice
Students will be aware of the advantages and disadvantages they have in society because of their membership in different identity groups, and their knowledge of how this has affected their lives. (JU.9-12.14)

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Teaching Tolerance Anti-Bias Framework  [https://www.tolerance.org/frameworks](https://www.tolerance.org/frameworks)

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3Constant Standards are repeatedly addressed to reinforce grade-level mastery.
**Reading Focus:** Informational, Literature  
**Writing Focus:** Narrative, Informative/Explanatory  

**Unifying Concept:**  
Students will understand that energy is always conserved and can be measured.

**Quarter 4**

**Enduring Understandings:**  
The first Law of Thermodynamics is the law of conservation of energy.  
Heat changes in chemical or physical processes can be calculated using calorimetry.  
Formation of any compound results in a change in enthalpy.  
An electric current produces a redox reaction in an electrolytic cell so the cell process is not spontaneous and is called electrolysis.  
The study of carbon and its compounds is a separate branch of chemistry called organic chemistry.  
There is a systematic way of naming organic compounds.

**Essential Questions:**  
- Why is there a natural tendency for a system to move in the direction of disorder or entropy?  
- How does the First Law of Thermodynamics explain what happens when substances are heated in closed systems?  
- How are enthalpy and entropy related?  
- How do chemical reactions attain a state of equilibrium and what factors affect the maintenance of equilibrium?  
- To what extent is organic chemistry different from inorganic chemistry?  
- Why is organic chemistry important?

**Academic Vocabulary:**  
- Laws of Thermodynamics  
- Compound  
- Law of conservation of energy  
- Chemical process  
- Calorimetry  
- Enthalpy  
- Redox reaction  
- Organic chemistry  
- Entropy  
- Equilibrium  
- Molecular  
- Energy  
- Physical process(es)  
- Electrolysis  
- Electric current  
- Electrolytic cell  
- Carbon  
- Chemical reactions  
- Inorganic chemistry  
- Nuclear

### Standards

#### Highly-Leveraged Standards

**Strand 5: Physical Science**

**HS.SS.C3 Conservation of Energy and Increase in Disorder:** Understand ways that energy is conserved, stored, and transferred.  
**PO1.** Describe the following ways in which energy is stored in a system.  
- Mechanical, electrical, chemical, nuclear  
**PO2.** Describe various ways in which energy is transferred from one system to another (e.g., mechanical contact, thermal conduction, electromagnetic radiation).  
**PO3.** Recognize that energy is conserved in a closed system.  
**PO4.** Calculate quantitative relationships associated with the conservation of energy.  
**PO5.** Analyze the relationship between energy transfer and disorder in the universe (2nd Law of Thermodynamics).  
**PO6.** Distinguish between heat and temperature.

#### Supporting Standards

**Strand 5: Physical Science**

**HS.SS.C1 Structure and Properties of Matter:** Understand physical, chemical, and atomic properties of matter.  
**PO1.** Describe substances based on their physical properties.  
**PO2.** Describe substances based on their chemical properties.  
**PO3.** Predict properties of elements and compounds using trends in the periodic table (e.g., metals, non-metals, bonding – ionic/covalent).  
**PO4.** Separate mixtures of substances based on their physical properties.  
**PO5.** Describe the properties of electric charge and the conservation of electric charge.  
**PO6.** Describe the following features and components of the atom:  
- Protons, neutrons, electrons, mass, number and type of particles, structure, organization  
**PO7.** Describe the historical development of models of the atom.
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**Constant Standards**

**Strand 1: Inquiry Process (HLS-34%)**

**HS.S1.C1 Observations, Questions, and Hypotheses:** Formulate predictions, questions, or hypotheses based on observations. Evaluate appropriate resources.

**PO1.** Evaluate scientific information for relevance to a given problem.

**PO2.** Develop questions from observations that transition into testable hypotheses.

**PO3.** Formulate a testable hypothesis.

**PO4.** Predict the outcome of an investigation based on prior evidence, probability, and/or modeling (not guessing or inferring).


**PO1.** Demonstrate safe and ethical procedures (e.g., use and care of technology, materials, organisms) and behavior in all science inquiry.

**PO2.** Identify the resources needed to conduct an investigation.
**PO3.** Design an appropriate protocol (written plan of action) for testing a hypothesis:
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**PO4.** Conduct a scientific investigation that is based on a research design.

**PO5.** Record observations, notes, sketches, questions, and ideas using tools such as journals, charts, graphs, and computers.

**HS.S1.C3 Analysis, Conclusion, and Refinements:** Evaluate experimental design, analyze data to explain results and propose further investigations. Design models.

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- Positive relationship
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- Carbon cycle
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**PO7.** Propose further investigations based on the findings of a conducted investigation.

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**Strand 2: History and Nature of Science**

**HS.S2.C1 History of Science as a Human Endeavor:** Identify individual, cultural, and technological contributions to scientific knowledge.
2018-2019 Science Curriculum Map, Chemistry, Q4

PO1. Describe how human curiosity and needs have influenced science, impacting the quality of life worldwide.

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PO3. Analyze how specific changes in science have affected society.

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- Develop and use models
- Plan and carry out investigations
- Analyze and interpret data
- Use mathematics and computational thinking
- Construct explanations and design solutions
- Engage in argument from evidence
- Obtain, evaluate, and communicate information

Cross boundaries between science disciplines and provide an organizational framework to connect knowledge from various disciplines into a coherent and scientifically based view of the world.

- Patterns
- Cause & Effect
- Structure & Function
- Stability & Change
- Systems & System Models
- Scale, Proportion, & Quantity
- Energy & Matter

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<td>- Conduct Research and construct explanations using words, visuals, and data (e.g. concept posters, lab experiments and lab reports)</td>
<td><strong>Writing about Graphs</strong></td>
</tr>
<tr>
<td>- Engage in Arguments with Evidence and Reasoning (Tools) (e.g. to support or refute subject related claims).</td>
<td><strong>Assessment Resources</strong></td>
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<tr>
<td>- Experimental Design--Design and conduct a fair test experiment identifying and controlling variables and using safe procedures</td>
<td>- Science Assessment Tool</td>
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<td>- <a href="http://pals.sri.com/">http://pals.sri.com/</a></td>
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<td>- MOSART</td>
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<td>- Chemistry On-line Chapter Self Assessments</td>
</tr>
<tr>
<td></td>
<td>- Writing about Graphs</td>
</tr>
</tbody>
</table>

¹ Specifically for mathematics, the **Highly-Leveraged Standards** are the **Major Content/Clusters** as defined by the AZCCRS Grade Level Focus documents. They should encompass a range of at least 65%-75% for Major Content/Clusters and a range of 25%-35% for Supporting Cluster Instruction. See the Grade Level Focus documents at: [http://www.azed.gov/azccrs/files/2015/01/k-8-major-and-supporting-content-emphasis.pdf](http://www.azed.gov/azccrs/files/2015/01/k-8-major-and-supporting-content-emphasis.pdf)

² **Supporting Standards** are emphasized during the quarter as they are integral to achieve mastery of the Highly Leveraged Standards. Mastery of these standards are used measured using classroom assessments.

³ **Constant Standards** are repeatedly addressed to reinforce grade-level mastery.