

## Lakewood School District Curriculum Guide

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|---------------------------|--|
| <b>Grade: High School</b> | <b>Content Area: Science - Chemistry</b> |
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**Original Adoption:** 2023 NJSLs English Language Arts and English as a Second Language (8-21-24); Math NJSLs Mathematics (8-21-24); 2020 NJSLs Science, Social Studies, Career Readiness, Life Literacies & Key Skills, Computer Design & Thinking, Visual & Performing Arts, World Language, Comprehensive Health and Physical Education (5-11-22)

**Created By:**

### Recommended Pacing Guide

|  |         |
|--|---------|
| Unit 1: Structure and Properties of Matter | 40 days |
| Unit 2: Chemical Bonding and Interactions  | 50 days |
| Unit 3: Chemical Quantities                | 38 days |
| Unit 4: Chemical Transformations           | 58 days |

### Alignment with State Mandates

The following colors are used throughout this document to indicate areas in which the curriculum is aligned with the following NJSA requirements:

- Holocaust and genocides ([N.J.S.A. 18A:35-28](#))
- History and contributions of African-Americans (Amistad Law) ([N.J.S.A. 18A:35-4.43](#))
- Highlight and promote diversity and inclusion (Diversity & Inclusion Law) ([N.J.S.A. 18A:35-4.36a](#))
- History of disabled and LGBT persons included in middle and high school curriculum ([Section 18A:35-4.35](#))
- Climate Change - to prepare students to understand how and why climate change happens, the impact it has on our local and global communities and to act in informed and sustainable ways. Please [click here](#) for specific examples (by subject).

### Unit 1: Structure and Properties of Matter

**40 days**

#### New Jersey Learning Standards-Science

|                 |   |
|-----------------|---|
| <b>HS-PS1-3</b> | Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.   |
| <b>HS-PS3-1</b> | Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.  |
| <b>HS-PS3-4</b> | Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics). |

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| <b>Science and Engineering Practices</b>  | <b>Discipline Core Ideas/Unit Enduring Understandings</b>  | <b>Crosscutting Concepts</b>   |
|---|--|--|
| <p><b>Using Mathematics and Computational Thinking</b><br/>Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.</p> <ul style="list-style-type: none"> <li>● Create a computational model or simulation of a phenomenon, designed device, process, or System.</li> </ul> <p><b>Planning and Carrying Out Investigations</b><br/>Planning and carrying out investigations to answer questions or test solutions to problems in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.</p> <ul style="list-style-type: none"> <li>● Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the</li> </ul> | <p><b>PS3.A: Definitions of Energy</b></p> <ul style="list-style-type: none"> <li>● Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system’s total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms.</li> </ul> <p><b>PS3.B: Conservation of Energy and Energy Transfer</b></p> <ul style="list-style-type: none"> <li>● Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system.</li> <li>● Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.</li> <li>● Uncontrolled systems always evolve toward more stable states—that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down).</li> <li>● Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior.</li> <li>● The availability of energy limits what can occur in any system.</li> </ul> | <p><b>Patterns</b></p> <ul style="list-style-type: none"> <li>● Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.</li> </ul> <p><b>Systems and System Models</b></p> <ul style="list-style-type: none"> <li>● Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.</li> <li>● When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.</li> </ul> <p><b>Connections to Nature of Science</b><br/>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</p> <ul style="list-style-type: none"> <li>● Science assumes the universe is a vast single system in which basic laws are consistent.</li> </ul> |

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| <p>precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.</p> | <p><b>PS3.D: Energy in Chemical Processes</b></p> <ul style="list-style-type: none"> <li>● Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment.</li> </ul> |  |
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| <b>Social and Emotional Learning Standards</b> |   |
|--|---|
| <b>Self-Awareness</b>                          | <ul style="list-style-type: none"> <li>● Recognize one’s personal traits, strengths, and limitations</li> <li>● Recognize the importance of self-confidence in handling daily tasks and challenges</li> </ul>   |
| <b>Self-Management</b>                         | <ul style="list-style-type: none"> <li>● Recognize the skills needed to establish and achieve personal and educational goals</li> <li>● Identify and apply ways to persevere or overcome barriers through alternative methods to achieve one’s goals</li> </ul> |
| <b>Social Awareness</b>                        | <ul style="list-style-type: none"> <li>● Demonstrate an understanding of the need for mutual respect when viewpoints differ</li> </ul>  |
| <b>Responsible Decision-Making</b>             | <ul style="list-style-type: none"> <li>● Develop, implement and model effective problem solving and critical thinking skills</li> </ul>   |

| <b>Interdisciplinary Connections</b>                                       |   |
|--|---|
| <b>ELA Standards</b>   |   |
| <ul style="list-style-type: none"> <li>● <b>RL.CR.11–12.1</b></li> </ul>   | <p>Accurately cite strong and thorough textual evidence and make relevant connections to strongly support a comprehensive analysis of multiple aspects of what a literary text says explicitly and inferentially, as well as interpretations of the text; this may include determining where the text leaves matters uncertain.</p> |
| <ul style="list-style-type: none"> <li>● <b>SL.PE.11–12.1.A</b></li> </ul> | <p>Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.</p>  |
| <b>Math Standards</b>  |   |
| <ul style="list-style-type: none"> <li>● <b>HSN-Q.A.1</b></li> </ul>       | <p>Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.</p>  |
| <ul style="list-style-type: none"> <li>● <b>MP.4</b></li> </ul>            | <p>Model with mathematics.</p>  |

| <b>Computer Science &amp; Design Thinking</b>   |  |
|---|--|
| <b>8.1 Computer Science</b>   |  |
| <ul style="list-style-type: none"> <li>● 8.1.5.DA.1: Collect, organize, and display data in order to highlight relationships or support a claim.</li> </ul> |  |

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### **8.2 Design Thinking**

- 8.2.5.ED.2: Collaborate with peers to collect information, brainstorm to solve a problem, and evaluate all possible solutions to provide the best results with supporting sketches or models.
- 8.2.5.ED.3: Follow step by step directions to assemble a product or solve a problem, using appropriate tools to accomplish the task.
- 8.2.8.ED.3: Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).

### **Career Readiness, Life Literacies & Key Skills**

#### **9.1 Personal Financial Literacy**

- 9.1.5.EG.1: Explain and give examples of what is meant by the term “tax.”
- 9.1.8.FI.4: Analyze the interest rates and fees associated with financial products.
- 9.1.8.FP.7: Identify the techniques and effects of deceptive advertising.

#### **9.4 Life Literacies & Key Skills**

- 9.4.5.CT.3: Describe how digital tools and technology may be used to solve problems.
- 9.4.8.TL.3: Select appropriate tools to organize and present information digitally.

### **Evidence of Student Learning**

#### **Formative Tasks:**

- Oral Questioning
- Student Conference
- Self-Assessment
- Hand Signals
- Communicators
- Graphic Organizers
- Teacher Observation
- DOL
- Quiz Classwork
- NJSLA Released questions
- Problem of the Day

#### **Alternative Assessments:**

- Teacher-Created Projects
- <https://www.khanacademy.org/>
- Completion of webquests
- On-Line Laboratory activities
- Online assessment activities example:
  - Kahoot
  - Quizizz

#### **Summative Assessments:**

- Unit Tests
- Midterm Exam
- Final Exam

#### **Benchmark Assessments:**

- Quarterly Benchmarks
- Beginning/End of Year Assessment
- Unit Common Assessment

### **Knowledge & Skills**

#### **Enduring Understandings:**

- The observable properties of substances at the bulk scale are determined by the arrangement of

#### **Essential Questions:**

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particles and the strength of electrical forces between them.

- Evidence from controlled investigations can be used to infer particle-level interactions that are not directly observable.

Energy within a system can be tracked, calculated, and modeled to explain how changes in one component affect other components.

- Computational models support the analysis of energy flow, conservation, and transfer within complex systems.
- Thermal energy is transferred between objects of different temperatures through interactions among particles.

In closed systems, thermal energy transfer results in a more uniform distribution of energy over time.

- The second law of thermodynamics explains why energy transfers have predictable directionality and limitations.

Scientific explanations of matter and energy rely on integrating experimental evidence, modeling, and systems-based reasoning to explain macroscopic phenomena.

- How are the macroscopic properties of solids, liquids, and gases explained by the differences at the particle level?
- What does the role of energy play in phase transitions?
- How can phase transitions be represented using phase diagrams and heating curves?
- How can the properties and behavior of gases be predicted from kinetic molecular theory?

### **Content**

*Students will know...*

- Solids, liquids and gases have different properties as a result of the motion of particles and interactions among them.
- All measurements have uncertainty, and their level of precision must be accounted for in the design of an experiment and the recording of data.
- The amount of energy transferred during the heating and cooling of matter or changing its state is determined by the interactions among the particles that make up the matter.
- Observable properties of gases can be measured experimentally and explained using an understanding of particle motion.

### **Skills**

*Students will be able to ...*

- Create and/or evaluate models that illustrate how the motion and arrangement of particles differ among solids, liquids, and gases.
- Describe how the properties of solids, liquids, and gases are related to particle arrangement.
- Create and/or evaluate models that illustrate how changes in temperature influence the motion of particles in solids, liquids, and gases.
- Justify the choice of equipment used to make a measurement, based on precision.
- Record measured values to the proper experimental precision.
- Create and/or evaluate particulate and graphical models representing the density of pure substances.
- Explain the relationship between the density and the arrangement of particles within a pure substance.
- Perform calculations relating to the density of pure substances.
- Create and/or evaluate a claim about the

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relationship between transfer of thermal energy and the temperature change in different samples.

- Perform calculations using data gathered from a simple constant-pressure calorimetry experiment.
- Use data to explain the direction of energy flow into or out of a system.
- Explain the relationship between changes in states of matter and the attractions among particles.
- Create and/or interpret models representing phase changes.
- Create and/or interpret heating and cooling curves and/or phase diagrams of pure substances.
- Calculate the energy transferred when a substance changes state.
- Create and/or evaluate models that illustrate how a gas exerts pressure.
- Explain the relationship between pressure in a gas and collisions.
- Explain the relationship between the macroscopic properties of a sample of a gas using the kinetic molecular theory.
- Create and/or evaluate modes that illustrate how a sample of gas responds to changes in macroscopic properties.
- Determine mathematically and/or graphically the quantitative relationship between macroscopic properties of gases.
- Perform calculations relating to the macroscopic properties of gases.

### Core Instructional & Supplemental Materials

**Suggested Activities/Resources:**

- Lab Safety
- Quizizz
- Kahoot
- Performance Task: Cooling an Alcohol
- Performance Task: Determine Properties of an Unknown Substance
- Group Measurement Activity

**Supplemental resources:**

- Pre-AP Teachers Resources Unit 1 and 2
- [www.explorellearning.com](http://www.explorellearning.com)
- [www.cK-12.org](http://www.cK-12.org)
  - Free Online Textbooks, Flashcards, Adaptive Practice, Real World Examples, Simulations
- [Race & Social Justice Teacher Resources](#)
- [Molecular Theory](#)

**Suggested Accommodations****English Language Learners:**

- Multi-Sensory Instruction
- Flexible Grouping
- Small Group Instruction
- Peer Buddies
- Graphic Organizers
- Chunking Information
- Scaffolded Questioning
- Manipulatives/Concrete Models
- Build Background/Vocabulary
- Math Word Wall/Word Bank
- Gradual Release Model
- Visual Cues
- Visual Models
- Technology Integration
- Hands-On/Experiential Activities
- Native language support when possible
- Sheltered English Instructional Strategies
- Provide additional time

**Special Education/Students with Disabilities:**

- Extra help opportunities provided
- Credit Recovery
- Allow use of a calculator, when appropriate
- Modified length and time frame of assignments
- Alternate assessments with extended time
- Provide guided notes and study guides as needed
- Preferential Seating
- Extra Practice
- Directions repeated, clarified, and reworded
- Breakdown task into manageable units
- Differentiated instruction
- Use of manipulatives
- Math tool paper available
- Cooperative learning groups
- Supplemental books
- Repeat, reword or clarify directions
- Small group instruction as needed
- Instructional technology as needed/required
- Effective teacher questioning; ranging from fact recall to higher order critical thinking questions

**504 Plans:**

- Extra help opportunities provided
- Credit Recovery
- Allow use of a calculator, when appropriate

- Modified length and time frame of assignments
- Alternate assessments with extended time
- Provide guided notes and study guides as needed
- Preferential Seating
- Extra Practice
- Directions repeated, clarified, and reworded
- Breakdown task into manageable units
- Differentiated instruction
- Use of manipulatives
- Math tool paper available
- Cooperative learning groups
- Supplemental books
- Repeat, reword or clarify directions
- Small group instruction as needed
- Instructional technology as needed/required
- Effective teacher questioning; ranging from fact recall to higher order critical thinking questions

**Gifted and Talented:**

- Cooperative Learning Groups
- Enriched Assignments
- Tiered Assignments
- Word Problems
- NJSLA questions
- Model Curriculum Questions
- Inquiry Based Project
- Interest Based/Choice Activities

**Students at Risk of Failure:**

- Extended Time
- Multi-Sensory Instruction
- Flexible Grouping
- Small Group Instruction
- Peer Buddies
- Graphic Organizers
- Chunking Information
- Scaffolded Questioning
- Tiered Activities
- Manipulatives/Concrete Models
- Build Background/Vocabulary
- Math Word Wall/Word Bank
- Modified Assignments
- Gradual Release Model
- Preferential Seating
- Brain Breaks
- Visual Cues
- Visual Models
- Technology Integration
- Assistive Technology

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- Credit Recovery

**Economically Disadvantaged:**

- Pre-teach vocabulary using visuals and gestures
- Chunk texts
- Summarize as you go
- Preview lessons
- Graphic organizers
- Highlight key words
- Sentence starters
- Prompting and cueing
- Activate schema
- Build background knowledge

**Culturally Diverse:**

- Create pictures, posters, art, books, maps, flags, etc to hang in the classroom.
- Create an emotionally positive classroom climate.
- Bring in guest speakers
- Create effective communication
- Model and teach cultural respect
- Build relationships with students by interviewing students to understand their background

**Unit 2: Chemical Bonding and Interactions**

**50 days**

[New Jersey Learning Standards-Science](#)

|                 |   |
|-----------------|---|
| <b>HS-PS1-1</b> | Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.                 |
| <b>HS-PS1-3</b> | Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. |

| Science and Engineering Practices   | Discipline Core Ideas/Unit Enduring Understandings   | Crosscutting Concepts   |
|---|--|---|
| <p><b>Developing and Using Models</b><br/>Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.</p> <ul style="list-style-type: none"> <li>• Use a model to predict the</li> </ul> | <p><b>PS1.A: Structure and Properties of Matter</b></p> <ul style="list-style-type: none"> <li>• Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons.</li> <li>• The periodic table orders elements horizontally by the number of protons in the atom’s nucleus and places those with similar chemical properties in</li> </ul> | <p><b>Patterns</b></p> <ul style="list-style-type: none"> <li>• Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.</li> </ul> |

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| <p>relationships between systems or between components of a system.</p> <p><b>Planning and Carrying Out Investigations</b><br/>         Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.</p> <ul style="list-style-type: none"> <li>● Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.</li> </ul> | <p>columns. The repeating patterns of this table reflect patterns of outer electron states.</p> <ul style="list-style-type: none"> <li>● The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms.</li> </ul> <p><b>PS2.B: Types of Interactions</b></p> <ul style="list-style-type: none"> <li>● Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (secondary)</li> </ul> |  |
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| <b>Social and Emotional Learning Standards</b> |   |
|--|---|
| <b>Self-Awareness</b>                          | <ul style="list-style-type: none"> <li>● Recognize one’s personal traits, strengths, and limitations</li> <li>● Recognize the importance of self-confidence in handling daily tasks and challenges</li> </ul>   |
| <b>Self-Management</b>                         | <ul style="list-style-type: none"> <li>● Recognize the skills needed to establish and achieve personal and educational goals</li> <li>● Identify and apply ways to persevere or overcome barriers through alternative methods to achieve one’s goals</li> </ul> |
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| <b>Interdisciplinary Connections</b>                                     |   |
|--|---|
| <b>ELA Standards</b>   |   |
| <ul style="list-style-type: none"> <li>● <b>L.VL.11–12.3</b></li> </ul>  | Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 11–12 reading and content, including technical meanings, choosing flexibly from a range of strategies. |
| <ul style="list-style-type: none"> <li>● <b>RL.PP.11–12.5</b></li> </ul> | Evaluate perspectives/lenses from two or more texts on related topics and justify the more cogent viewpoint (e.g., different accounts of the same event or issue, use of different media                  |

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|  | or formats).  |
|  | <b>Math Standards</b>   |
| <ul style="list-style-type: none"> <li>● <b>HSN-Q.A.1</b></li> </ul> | Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. |
| <ul style="list-style-type: none"> <li>● <b>HSN-Q.A.3</b></li> </ul> | Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.   |

### Computer Science & Design Thinking

#### **8.1 Computer Science**

- 8.1.5.DA.1: Collect, organize, and display data in order to highlight relationships or support a claim.

#### **8.2 Design Thinking**

- 8.2.5.ED.2: Collaborate with peers to collect information, brainstorm to solve a problem, and evaluate all possible solutions to provide the best results with supporting sketches or models.
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### Career Readiness, Life Literacies & Key Skills

#### **9.1 Personal Financial Literacy**

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- 9.1.8.FI.4: Analyze the interest rates and fees associated with financial products.
- 9.1.8.FP.7: Identify the techniques and effects of deceptive advertising.

#### **9.4 Life Literacies & Key Skills**

- 9.4.5.CT.3: Describe how digital tools and technology may be used to solve problems.
- 9.4.8.TL.3: Select appropriate tools to organize and present information digitally.

### **Evidence of Student Learning**

#### **Formative Tasks:**

- Oral Questioning
- Student Conference
- Self-Assessment
- Hand Signals
- Communicators
- Graphic Organizers
- Teacher Observation

#### **Alternative Assessments:**

- Teacher-Created Projects
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- Completion of webquests
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- Online assessment activities example:
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| <ul style="list-style-type: none"> <li>● DOL</li> <li>● Quiz Classwork</li> <li>● NJSLA Released questions</li> <li>● Problem of the Day</li> </ul> | <ul style="list-style-type: none"> <li>○ Quizizz</li> </ul>  |
| <b>Summative Assessments:</b> <ul style="list-style-type: none"> <li>● Unit Tests</li> <li>● Midterm Exam</li> <li>● Final Exam</li> </ul>          | <b>Benchmark Assessments:</b> <ul style="list-style-type: none"> <li>● Quarterly Benchmarks</li> <li>● Beginning/End of Year Assessment</li> <li>● Unit Common Assessment</li> </ul> |

**Knowledge & Skills**

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| <p><b>Enduring Understandings:</b></p> <ul style="list-style-type: none"> <li>● The periodic table organizes elements in ways that reflect repeating patterns in atomic structure, particularly the arrangement of electrons in the outermost energy levels.<br/>An element’s position on the periodic table can be used to predict its chemical and physical properties.</li> <li>● The behavior of atoms is governed by electrical forces that arise from interactions between charged particles.</li> <li>● Differences in electrical forces between particles help explain why substances exhibit different bulk properties such as conductivity, melting point, and solubility.</li> <li>● Evidence gathered from investigations of bulk materials can be used to infer particle-level structures and interactions.</li> <li>● Atomic-scale interactions determine how particles bond and arrange themselves within substances.</li> <li>● Scientific models such as the periodic table provide powerful tools for predicting patterns and relationships in matter.</li> <li>● Understanding matter requires connecting observable properties to invisible particle interactions through evidence-based reasoning and experimentation.</li> </ul> | <p><b>Essential Questions:</b></p> <ul style="list-style-type: none"> <li>● 1. How can you classify matter?</li> <li>● 2. How do intramolecular forces determine properties of matter?</li> <li>● 3. How do the properties of molecular compounds relate to the molecular structure?</li> <li>● 4. What are the differences between covalent and ionic bonding?</li> <li>● 5. What is the electrostatic nature of ionic attractions?</li> </ul> |
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| <p><b>Content</b><br/><i>Students will know...</i></p> <ul style="list-style-type: none"> <li>● The macroscopic physical properties of materials can be explained by the intermolecular forces</li> </ul> | <p><b>Skills</b><br/><i>Students will be able to ...</i></p> <ul style="list-style-type: none"> <li>● Distinguish between atoms, molecules, and compounds at the particle level.</li> <li>● Create and/or evaluate molecules of pure substances.</li> </ul> |
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among particles

- The structure and properties of compounds arise from the periodic properties and bonding patterns of the constituent atoms.

- *Create and/or evaluate models of mixtures.*
- *Interpret the results of an experiment involving the separation of a mixture.*
- *Relate the total and partial pressure of a gas mixture to the number of particles and their proportions.*
- *Create and/or evaluate a claim about the types of forces that are overcome during the melting, boiling, and/or dissolving of substances.*

### Core Instructional & Supplemental Materials

**Suggested Activities/Resources:**

- Lab Safety
- Quizizz
- Kahoot
- Card sort: Identify characteristics of polar compounds.
- Practice Performance Task: Properties of Limonene
- Card Sort: Ionic and Covalent Nomenclature:
- Online simulation: Basic Atomic Structure Including Electron Shells
- Card Sort: identify patterns in the periodic table.
- Performance Task: Ionic and Covalent Compounds

**Supplemental resources:**

- Pre-AP Teachers Resources Unit 1 and 2
- [www.explorellearning.com](http://www.explorellearning.com)
- [www.cK-12.org](http://www.cK-12.org)
  - Free Online Textbooks, Flashcards, Adaptive Practice, Real World Examples, Simulations
- [Race & Social Justice Teacher Resources](#)
- [Period Table](#)

### Suggested Accommodations

**English Language Learners:**

- Multi-Sensory Instruction
- Flexible Grouping
- Small Group Instruction
- Peer Buddies
- Graphic Organizers
- Chunking Information
- Scaffolded Questioning
- Manipulatives/Concrete Models
- Build Background/Vocabulary
- Math Word Wall/Word Bank
- Gradual Release Model
- Visual Cues
- Visual Models
- Technology Integration
- Hands-On/Experiential Activities
- Native language support when possible
- Sheltered English Instructional Strategies

- Provide additional time

**Special Education/Students with Disabilities:**

- Extra help opportunities provided
- Credit Recovery
- Allow use of a calculator, when appropriate
- Modified length and time frame of assignments
- Alternate assessments with extended time
- Provide guided notes and study guides as needed
- Preferential Seating
- Extra Practice
- Directions repeated, clarified, and reworded
- Breakdown task into manageable units
- Differentiated instruction
- Use of manipulatives
- Math tool paper available
- Cooperative learning groups
- Supplemental books
- Repeat, reword or clarify directions
- Small group instruction as needed
- Instructional technology as needed/required
- Effective teacher questioning; ranging from fact recall to higher order critical thinking questions

**504 Plans:**

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**Gifted and Talented:**

- Cooperative Learning Groups
- Enriched Assignments
- Tiered Assignments

- Word Problems
- NJSLA questions
- Model Curriculum Questions
- Inquiry Based Project
- Interest Based/Choice Activities

**Students at Risk of Failure:**

- Extended Time
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- Math Word Wall/Word Bank
- Modified Assignments
- Gradual Release Model
- Preferential Seating
- Brain Breaks
- Visual Cues
- Visual Models
- Technology Integration
- Assistive Technology
- Credit Recovery

**Economically Disadvantaged:**

- Pre-teach vocabulary using visuals and gestures
- Chunk texts
- Summarize as you go
- Preview lessons
- Graphic organizers
- Highlight key words
- Sentence starters
- Prompting and cueing
- Activate schema
- Build background knowledge

**Culturally Diverse:**

- Create pictures, posters, art, books, maps, flags, etc to hang in the classroom.
- Create an emotionally positive classroom climate.
- Bring in guest speakers
- Create effective communication
- Model and teach cultural respect
- Build relationships with students by interviewing students to understand their background

Lakewood School District Curriculum Guide

|                           |  |
|---------------------------|--|
| <b>Grade: High School</b> | <b>Content Area: Science - Chemistry</b> |
|---------------------------|--|

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|--|--|
| <b>Unit 3: Chemical Quantities</b>                           | <b>38 days</b>   |
| <a href="#"><u>New Jersey Learning Standards-Science</u></a> |  |
| <b>HS-PS1-7</b>  | Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.  |
| <b>HS-ETS1-4</b>   | Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. |

| Science and Engineering Practices  | Discipline Core Ideas/Unit Enduring Understandings   | Crosscutting Concepts  |
|--|--|--|
| <p><b>Developing and Using Models</b><br/>Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.</p> <p>Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-4)</p> <p><b>Using Mathematics and Computational Thinking</b><br/>Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.</p> | <p><b>PS1.A: Structure and Properties of Matter</b><br/>The periodic table orders elements horizontally by the number of protons in the atom’s nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-2) (Note: This Disciplinary Core Idea is also addressed by HS-PS1-1.)</p> <p>A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4)</p> <p><b>PS1.B: Chemical Reactions</b><br/>Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. (HS-PS1-4),(HS-PS1-5)</p> <p>In many situations, a dynamic and</p> | <p><b>Patterns</b><br/>Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-2),(HS-PS1-5)</p> <p><b>Energy and Matter</b><br/>The total amount of energy and matter in closed systems are conserved. (HS-PS1-7)<br/>Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-PS1-4)</p> <p><b>Stability and Change</b><br/>Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6)</p> |

|  |   |  |
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| <p>Use mathematical representations of phenomena to support claims. (HS-PS1-7)</p> <p><b>Constructing Explanations and Designing Solutions</b><br/>Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.</p> <p>Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. (HS-PS1-5)</p> <p>Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-PS1-2)</p> <p>Refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-PS1-6)</p> | <p>condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. (HS-PS1-6)</p> <p>The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. (HS-PS1-2),(HS-PS1-7)</p> <p><b>ETS1.C: Optimizing the Design Solution</b><br/>Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (secondary to HS-PS1-6)</p> <p><b>PS3.A: Definitions of Energy</b><br/>Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HS-PS3-1), (HS-PS3-2)</p> <p>At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HS-PS3-2) (HS-PS3-3)</p> <p>These relationships are better understood at the microscopic scale, at which all of the different</p> |  |
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| <b>Grade: High School</b> | <b>Content Area: Science - Chemistry</b> |
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|  | <p>manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HS-PS3-2)</p> |  |
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### Social and Emotional Learning Standards

|                                    |   |
|------------------------------------|---|
| <b>Self-Awareness</b>              | <ul style="list-style-type: none"> <li>Recognize one’s personal traits, strengths, and limitations</li> <li>Recognize the importance of self-confidence in handling daily tasks and challenges</li> </ul>   |
| <b>Self-Management</b>             | <ul style="list-style-type: none"> <li>Recognize the skills needed to establish and achieve personal and educational goals</li> <li>Identify and apply ways to persevere or overcome barriers through alternative methods to achieve one’s goals</li> </ul> |
| <b>Social Awareness</b>            | <ul style="list-style-type: none"> <li>Demonstrate an understanding of the need for mutual respect when viewpoints differ</li> </ul>  |
| <b>Responsible Decision-Making</b> | <ul style="list-style-type: none"> <li>Develop, implement and model effective problem solving and critical thinking skills</li> </ul>   |

### Interdisciplinary Connections

|  |  |
|--|--|
| <b>ELA Standards</b>   |  |
| <ul style="list-style-type: none"> <li><b>W.IW.11–12.2</b></li> </ul>  | Introduce a topic; organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. |
| <ul style="list-style-type: none"> <li><b>SL.PI.11–12.4</b></li> </ul> | Present information, findings and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.   |
| <b>Math Standards</b>  |  |
| <ul style="list-style-type: none"> <li><b>HSN-Q.A.1</b></li> </ul>     | Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.  |
| <ul style="list-style-type: none"> <li><b>MP.4</b></li> </ul>          | Model with mathematics.  |

## Lakewood School District Curriculum Guide

Grade: High School

Content Area: Science - Chemistry

### Computer Science & Design Thinking

#### **8.1 Computer Science**

- 8.1.5.DA.1: Collect, organize, and display data in order to highlight relationships or support a claim.

#### **8.2 Design Thinking**

- 8.2.5.ED.2: Collaborate with peers to collect information, brainstorm to solve a problem, and evaluate all possible solutions to provide the best results with supporting sketches or models.
- 8.2.5.ED.3: Follow step by step directions to assemble a product or solve a problem, using appropriate tools to accomplish the task.
- 8.2.8.ED.3: Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).

### Career Readiness, Life Literacies & Key Skills

#### **9.1 Personal Financial Literacy**

- 9.1.5.EG.1: Explain and give examples of what is meant by the term “tax.”
- 9.1.8.FI.4: Analyze the interest rates and fees associated with financial products.
- 9.1.8.FP.7: Identify the techniques and effects of deceptive advertising.

#### **9.4 Life Literacies & Key Skills**

- 9.4.5.CT.3: Describe how digital tools and technology may be used to solve problems.
- 9.4.8.TL.3: Select appropriate tools to organize and present information digitally.

### **Evidence of Student Learning**

#### **Formative Tasks:**

- Oral Questioning
- Student Conference
- Self-Assessment
- Hand Signals
- Communicators
- Graphic Organizers
- Teacher Observation
- DOL
- Quiz Classwork
- NJSLA Released questions
- Problem of the Day

#### **Alternative Assessments:**

- Teacher-Created Projects
- <https://www.khanacademy.org/>
- Completion of webquests
- On-Line Laboratory activities
- Online assessment activities example:
  - Kahoot
  - Quizizz

#### **Summative Assessments:**

- Unit Tests
- Midterm Exam
- Final Exam

#### **Benchmark Assessments:**

- Quarterly Benchmarks
- Beginning/End of Year Assessment
- Unit Common Assessment

# Lakewood School District Curriculum Guide

**Grade: High School**

**Content Area: Science - Chemistry**

## Knowledge & Skills

### Enduring Understandings:

- The periodic table organizes elements in ways that reflect repeating patterns in atomic structure, particularly the arrangement of electrons in the outermost energy levels.
- An element's position on the periodic table can be used to predict its chemical and physical properties.
- The behavior of atoms is governed by electrical forces that arise from interactions between charged particles.  
Differences in electrical forces between particles help explain why substances exhibit different bulk properties such as conductivity, melting point, and solubility.
- Evidence gathered from investigations of bulk materials can be used to infer particle-level structures and interactions.
- Atomic-scale interactions determine how particles bond and arrange themselves within substances.
- Scientific models such as the periodic table provide powerful tools for predicting patterns and relationships in matter.  
Understanding matter requires connecting observable properties to invisible particle interactions through evidence-based reasoning and experimentation.

### Essential Questions:

- How are Avogadro's Number and the mole related?
- Why are moles used when counting particles?
- How is the concept of relative mass related to the Periodic Table?
- How are moles calculated for gases?
- What is the relationship between the number of gas particles and pressure, volume, and temperature.
- How is a word equation that describes the combination of 2 substances written using symbols.
- Why do chemists write chemical and word equations?
- What 2 ways are chemical transformations (chemical changes) represented by modeling?
- Explain the application of balancing equations to the Law of Conservation of Mass.
- How do you know when a chemical equation is balanced?
- How are the amounts of reactants consumed and products formed during a chemical transformation quantified?
- Why is it important to identify and calculate limiting reactants?
- How are theoretical and actual yields calculated using balanced chemical equations and the mole?

### Content

*Students will know...*

- *A large number of particles of a substance is needed to measure the physical properties of that substance.*
  - a. A mole of a substance contains Avogadro's number ( $6.02 \times 10^{23}$ ) of particles.*
- *The molar mass of an element listed on the periodic table is the mass, in grams, of a mole of atoms of that element.*
- *The ideal gas law describes the mathematical relationship between pressure, volume, number of gas particles, and temperature.*

### Skills

*Students will be able to ...*

- *Explain the relationship between the mass of a substance, the number of particles of that substance, and the number of moles of that substance.*
- *Use the mole concept to calculate the mass, number of particles, or number of moles of a given substance.*
- *Explain the relationships between macroscopic properties of gas samples.*
- *Perform calculations using the ideal gas law.*
- *Create and/or evaluate models based on the ideal gas law.*

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*a. Two samples of gas with the same pressure, volume, and temperature have the same number of particles.*

*b. The mass of the particles can be computed from atomic masses.*

*c. Because macroscopic samples of a gas contain many particles, moles are useful units for counting particles.*

- *All chemical transformations involve the rearrangement of atoms to form new combinations.*

*a. Since the atoms are not created or destroyed, the total numbers of each atom must remain constant.*

*b. Chemical transformations can be modeled by balanced chemical equations and particulate representations.*

- *A balanced chemical reaction equation, combined with the mole concept, can be used to quantify the amounts of reactants consumed and products formed during a chemical transformation.*
- *The limiting reactant is the reactant that is completely consumed during a chemical reaction. The limiting reactant determines the amount of product formed.*
- *A balanced chemical reaction equation, combined with the mole concept, can be used to calculate the theoretical and percent yield of a reaction.*

- *Create and/or evaluate models of chemical transformations.*
- *Explain the relationship between the quantity of reactants consumed and the quantity of products formed in a chemical transformation.*
- *Perform stoichiometric calculations involving the quantity of reactants and products in a chemical system.*
- *Create and/or evaluate models of a reaction mixture before and/or after a reaction has occurred, including situations with a limiting reactant.*
- *Calculate the theoretical yield and/or percent yield of a chemical reaction.*

### Core Instructional & Supplemental Materials

**Suggested Activities/Resources:**

- Lab Safety
- Quizizz
- Kahoot
- Lab- Molar Mass
- Performance Task - Molar Challenges
- Learning Checkpoint 1
- Lab: Determining “R”
- Lab: Chemical Reactions
- Lab: Determining Percent Yield

**Supplemental resources:**

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  - Free Online Textbooks, Flashcards, Adaptive Practice, Real World Examples, Simulations
- [Race & Social Justice Teacher Resources](#)
- [Chemical Reactions](#)

### Suggested Accommodations

**English Language Learners:**

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## Lakewood School District Curriculum Guide

**Grade: High School**

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- Pre-teach vocabulary using visuals and gestures
- Chunk texts
- Summarize as you go

## Lakewood School District Curriculum Guide

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- Preview lessons
- Graphic organizers
- Highlight key words
- Sentence starters
- Prompting and cueing
- Activate schema
- Build background knowledge

**Culturally Diverse:**

- Create pictures, posters, art, books, maps, flags, etc to hang in the classroom.
- Create an emotionally positive classroom climate.
- Bring in guest speakers
- Create effective communication
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- Build relationships with students by interviewing students to understand their background

| <b>Unit 4: Chemical Transformations</b>                      |   | <b>58 days</b> |
|--|---|----------------|
| <u><a href="#">New Jersey Learning Standards-Science</a></u> |   |                |
| <b>HS-PS1-2</b>  | Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.  |                |
| <b>HS-PS1-4</b>  | Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.   |                |
| <b>HS-PS1-5</b>  | Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs  |                |
| <b>HS-PS1-6</b>  | Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.  |                |
| <b>HS-PS1-7</b>  | Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.   |                |
| <b>HS-PS3-1</b>  | Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.  |                |
| <b>HS-PS3-2</b>  | Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).                                       |                |
| <b>HS-PS3-3</b>  | Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.   |                |
| <b>HS-PS3-4</b>  | Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics). |                |
| <b>HS-ETS1-4</b>   | Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.  |                |

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| <b>Science and Engineering Practices</b>  | <b>Discipline Core Ideas/Unit Enduring Understandings</b>   | <b>Crosscutting Concepts</b>  |
|---|---|---|
| <p><b>Planning and Carrying Out Investigations</b><br/>                     Planning and carrying out investigations to answer questions or test solutions to problems in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models. Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS3-4)</p> <p><b>Developing and Using Models</b><br/>                     Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-4)</p> <p><b>Using Mathematics and Computational Thinking</b></p> | <p><b>PS1.A: Structure and Properties of Matter</b><br/>                     The periodic table orders elements horizontally by the number of protons in the atom’s nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-2) (Note: This Disciplinary Core Idea is also addressed by HS-PS1-1.)</p> <p>A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4)</p> <p><b>PS1.B: Chemical Reactions</b><br/>                     Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. (HS-PS1-4),(HS-PS1-5)</p> <p>In many situations, a dynamic and condition-dependent balance between a reaction and the reverse reaction determines the numbers of all types of molecules present. (HS-PS1-6)</p> <p>The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical</p> | <p><b>Patterns</b><br/>                     Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-2),(HS-PS1-5)</p> <p><b>Energy and Matter</b><br/>                     The total amount of energy and matter in closed systems are conserved. (HS-PS1-7)</p> <p>Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-PS1-4)</p> <p><b>Stability and Change</b><br/>                     Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6)</p> <p><b>Cause and Effect</b><br/>                     Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. (HS-PS3-5)</p> <p><b>Systems and System Models</b><br/>                     When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (HS-PS3-4)</p> <p>Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. (HS-PS3-1)</p> <p><b>Structure and Function</b><br/>                     Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and</p> |

|  |   |  |
|--|---|--|
| <p>Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.</p> <p>Use mathematical representations of phenomena to support claims. (HS-PS1-7)</p> <p><b>Constructing Explanations and Designing Solutions</b><br/>Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.</p> <p>Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. (HS-PS1-5)</p> <p>Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world</p> | <p>reactions. (HS-PS1-2), (HS-PS1-7)</p> <p><b>PS2.B: Types of Interactions</b><br/>Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (secondary to HS-PS1-1),(secondary to HS-PS1-3)</p> <p><b>PS3.B: Conservation of Energy and Energy Transfer</b><br/>Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. (HS-PS3-1)<br/>Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1), (HS-PS3-4)</p> <p>Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. (HS-PS3-1)</p> <p>The availability of energy limits what can occur in any system. (HS-PS3-1)</p> <p>Uncontrolled systems always evolve toward more stable states—that is, toward more uniform energy distribution (e.g., water flows downhill, objects</p> | <p>connections of components to reveal its function and/or solve a problem. (HS-PS2-6)</p> <p><b>Connections to Nature of Science</b></p> <p><b>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</b><br/>Science assumes the universe is a vast single system in which basic laws are consistent. (HS-PS1-7)</p> |
|--|---|--|

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operate today as they did in the past and will continue to do so in the future. (HS-PS1-2)

Refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-PS1-6)

**Obtaining, Evaluating, and Communicating Information**

Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-PS2-6)

hotter than their surrounding environment cools down). (HS-PS3-4)

**PS3.D: Energy in Chemical Processes**

Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. (HS-PS3-3), (HS-PS3-4)

**ETS1.B: Developing Possible Solutions**

When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3)

Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. (HS-ETS1-4)

**ETS1.C: Optimizing the Design Solution**

Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (secondary to HS-PS1-6)

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|  | <p><b>PS3.A: Definitions of Energy</b><br/>           Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HS-PS3-1), (HS-PS3-2)</p> <p>At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HS-PS3-2) (HS-PS3-3)</p> <p>These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HS-PS3-2)</p> |  |
|--|--|--|

### Social and Emotional Learning Standards

|                         |   |
|-------------------------|---|
| <b>Self-Awareness</b>   | <ul style="list-style-type: none"> <li>● Recognize one's personal traits, strengths, and limitations</li> <li>● Recognize the importance of self-confidence in handling daily tasks and challenges</li> </ul>   |
| <b>Self-Management</b>  | <ul style="list-style-type: none"> <li>● Recognize the skills needed to establish and achieve personal and educational goals</li> <li>● Identify and apply ways to persevere or overcome barriers through alternative methods to achieve one's goals</li> </ul> |
| <b>Social Awareness</b> | <ul style="list-style-type: none"> <li>● Demonstrate an understanding of the need for mutual respect when viewpoints differ</li> </ul>  |

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|                                    |   |
|------------------------------------|---|
| <b>Responsible Decision-Making</b> | <ul style="list-style-type: none"> <li>• Develop, implement and model effective problem solving and critical thinking skills</li> </ul> |
|------------------------------------|---|

| <u>Interdisciplinary Connections</u>                                     |  |
|--|--|
| <b>ELA Standards</b>   |  |
| <ul style="list-style-type: none"> <li>• <b>SL.UM.11–12.5</b></li> </ul> | Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.  |
| <ul style="list-style-type: none"> <li>• <b>W.WP.11–12.4</b></li> </ul>  | Develop and strengthen writing as needed by planning, revising, editing, rewriting, trying a new approach; sustaining effort to complete complex writing tasks; tracking and reflecting on personal writing progress (e.g., using portfolios, journals, conferencing); or consulting a style manual (such as MLA or APA Style), focusing on addressing what is most significant for a specific purpose and audience. |
| <b>Math Standards</b>  |  |
| <ul style="list-style-type: none"> <li>• <b>HSN-Q.A.1</b></li> </ul>     | Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.  |
| <ul style="list-style-type: none"> <li>• <b>MP.4</b></li> </ul>          | Model with mathematics.  |

| <u>Computer Science &amp; Design Thinking</u>  |
|--|
| <p><b>8.1 Computer Science</b></p> <ul style="list-style-type: none"> <li>• 8.1.5.DA.1: Collect, organize, and display data in order to highlight relationships or support a claim.</li> </ul>   |
| <p><b>8.2 Design Thinking</b></p> <ul style="list-style-type: none"> <li>• 8.2.5.ED.2: Collaborate with peers to collect information, brainstorm to solve a problem, and evaluate all possible solutions to provide the best results with supporting sketches or models.</li> <li>• 8.2.5.ED.3: Follow step by step directions to assemble a product or solve a problem, using appropriate tools to accomplish the task.</li> <li>• 8.2.8.ED.3: Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).</li> </ul> |

| <u>Career Readiness, Life Literacies &amp; Key Skills</u>   |
|---|
| <p><b>9.1 Personal Financial Literacy</b></p> <ul style="list-style-type: none"> <li>• 9.1.5.EG.1: Explain and give examples of what is meant by the term “tax.”</li> <li>• 9.1.8.FI.4: Analyze the interest rates and fees associated with financial products.</li> <li>• 9.1.8.FP.7: Identify the techniques and effects of deceptive advertising.</li> </ul> |

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### 9.4 Life Literacies & Key Skills

- 9.4.5.CT.3: Describe how digital tools and technology may be used to solve problems.
- 9.4.8.TL.3: Select appropriate tools to organize and present information digitally.

### Evidence of Student Learning

#### **Formative Tasks:**

- Oral Questioning
- Student Conference
- Self-Assessment
- Hand Signals
- Communicators
- Graphic Organizers
- Teacher Observation
- DOL
- Quiz Classwork
- NJSLA Released questions
- Problem of the Day

#### **Alternative Assessments:**

- Teacher-Created Projects
- <https://www.khanacademy.org/>
- Completion of webquests
- On-Line Laboratory activities
- Online assessment activities example:
  - Kahoot
  - Quizizz

#### **Summative Assessments:**

- Unit Tests
- Midterm Exam
- Final Exam

#### **Benchmark Assessments:**

- Quarterly Benchmarks
- Beginning/End of Year Assessment
- Unit Common Assessment

### Knowledge & Skills

#### **Enduring Understandings:**

- Chemical reactions occur as a result of interactions between valence electrons, and periodic trends help predict how and why substances react.
- The outcome of a chemical reaction depends on the breaking and forming of bonds, which involves the transfer, absorption, or release of energy.
- Changes in temperature and concentration affect reaction rates by altering the frequency and energy of particle collisions.
- Chemical systems reach equilibrium when opposing processes occur at equal rates, and changing system conditions can shift equilibrium to favor different outcomes.
- Matter is conserved during chemical reactions, and mathematical representations can be used to

#### **Essential Questions:**

- How do you identify a precipitation reaction using net ionic equations and the solubility chart?
- What 3 ways can precipitation reactions be modeled?
- How is Molarity used to quantify the concentration of a solution?
- How does Gravimetric analysis determine the amount of a substance in an aqueous solution?
- What happens to electrons in redox reactions?
- How do you determine oxidation states?
- How can you determine whether a redox reaction will occur between two species?
- What 3 ways can Redox reactions can be modeled?
- How are acids and bases classified?
- What is the pH of a solution?
- What occurs during acid-base reactions?
- What 3 ways can acid-base reactions be modeled?

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show that atoms and mass are neither created nor destroyed.

- Energy within chemical and physical systems can be modeled, tracked, and calculated to explain changes in system components.
- Macroscopic energy phenomena can be explained by particle motion and relative position, linking observable behavior to microscopic interactions. Scientific modeling, computation, and engineering design allow solutions to be tested and refined for complex, real-world problems involving energy transfer and system constraints.

- What occurs during endo- and exothermic reactions?
- How is calorimetry used to quantify energy changes in a reaction?
- What effect does the relative strength of bonds in reactants and products have on the energy change in a reaction?
- How is the rate of a chemical reaction measured? / How do we measure the speed of a reaction?
- What factors affect frequency of collisions? / What factors will affect the rate of a reaction?
- What role does temperature have in the effectiveness of collisions?
- What is meant by dynamic equilibrium?
- How does equilibrium respond to changes in conditions?

**Content**

*Students will know...*

- Solubility, electron transfer, and proton transfer are driving forces in chemical reactions.
  - Precipitation reactions may occur when two aqueous solutions are mixed, because some ionic compounds are insoluble in water and therefore precipitate out of solution.
  - Precipitation reactions can be modeled by molecular equations, net ionic equations, and particulate representations.
  - Molarity is one way to quantify the concentration of a solution. It describes the number of dissolved particles in a unit volume of that solution.
  - Gravimetric analysis is a quantitative method for determining the amount of a substance by selectively precipitating the substance from an aqueous solution.
  - Electrons are transferred between reactants in oxidation–reduction (redox) reactions.
- a. Substances lose electrons in the process of oxidation and gain electrons in the process of reduction.
- b. Oxidation numbers are useful for determining if electrons are transferred in a chemical reaction.
- c. Electrons are conserved in redox reactions.
- An activity series lists elements in order of decreasing ease of oxidation and can be used to determine whether a redox reaction will occur between

**Skills**

*Students will be able to ...*

- Recognize and classify reactions as one of three main types: precipitation, oxidation/reduction, acid/base.
- Predict the products of a precipitation reaction given reactants and solubility rules, and write net ionic chemical equations.
- Create and/or evaluate models of precipitation reactions.
- Create and/or evaluate models that represent the concentration of a solution.
- Perform calculations relating to the molarity of solutions.
- Predict the amount of solid produced in a precipitation reaction using gravimetric analysis based on the concentrations of the starting solutions.
- Evaluate the results of a gravimetric analysis.
- Identify a reaction as an oxidation–reduction reaction based on the change in oxidation numbers of reacting substances.
- Create and/or evaluate a claim about which reacting species is oxidized or reduced in an oxidation–reduction reaction.
- Predict whether a redox reaction will occur between two reactants using an activity series.
- Create and/or evaluate an activity series from experimental measurements
- Create and/or evaluate models of redox reactions.
- Translate an observed chemical change into a balanced chemical equation and justify the choice of equation type (molecular, ionic, or net ionic) in terms of utility for the given circumstances.

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two species.

- Redox reactions can be modeled by molecular equations, net ionic equations, and particulate representations.
  - Acids and bases are described as either strong or weak based on the degree to which they dissociate in aqueous solution.
  - The pH of a solution is a measure of the molarity of  $\text{H}_3\text{O}^+$  (or  $\text{H}^+$ ) in the solution.
  - Acid–base reactions involve the transfer of a hydrogen ion from the acid to the base. Strong acid–base reactions produce water and an aqueous ionic compound. In a neutralization reaction, protons are transferred from an acid to a base.
  - Acid–base reactions can be modeled by molecular equations, net ionic equations, and particulate representations.
  - Temperature change during a reaction is the result of energy transfer during the process of breaking and forming bonds.
- a. Bond breaking is always an endothermic process and bond formation is always an exothermic process.
- b. Calorimetry can be used to quantify energy changes in a reaction.
- The relative strength of bonds in reactants and products determines the energy change in a reaction. Bond energy tables and Lewis diagrams provide a way to estimate these changes quantitatively for a wide variety of chemical reactions.
  - The rate of a chemical reaction can be measured by determining how quickly reactants are transformed into products.
- a. The reaction rate is related to the frequency and success of collisions between reactant species and the proportion of effective collisions.
- b. The frequency of collisions increases with the concentration of gases or dissolved species and with the surface area of a solid.
- c. The proportion of effective collisions increases directly as temperature increases.
- The equilibrium of a chemical reaction is affected by a number of factors. The concentration of

- Create and/or evaluate models of strong and weak acids and bases.
- Distinguish between strong and weak acids in terms of degree of dissociation in aqueous solution.
- Evaluate a claim about whether a compound is a strong or weak acid or base.
- Explain the relationship between the hydrogen ion concentration and the pH of a solution.
- Calculate the pH of a solution.
- Predict the products of a reaction between a strong acid and a strong base
- Create and/or evaluate models of a reaction between a strong acid and a strong base.
- Create and/or evaluate a claim about whether a reaction is endothermic or exothermic from experimental observations.
- Explain the relationship between the measured change in temperature of a solution and the energy transferred by a chemical reaction.
- Calculate energy changes in chemical reactions from calorimetry data.
- Create and/or evaluate a claim about the energy transferred as a result of a chemical reaction based on bond energies.
- Construct and/or evaluate particulate representations that illustrate how changes in concentration, temperature, or surface area of reactants alter the rate of a chemical reaction.
- Explain how experimental changes in the rate of a reaction are related to changes in the concentration, temperature, or surface area of the reactants.
- Explain how experimental changes in concentration are related to production of products.

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products can be increased by adding reactants or removing products.

### Core Instructional & Supplemental Materials

#### Suggested Activities/Resources:

- Lab Safety
- Quizizz
- Kahoot
- Introduction to Precipitation Reactions (resource handout)  
<https://www.youtube.com/watch?v=aMU1RaRuLS>  
o (8:30-11:40)
- Student Activity 4.1.A Precipitations Reaction Lab with 4.1.B Precipitations Reaction Lab Mat
- CK-12: Molarity:  
<https://flexbooks.ck12.org/cbook/ck-12-chemistry-flexbook-2.0/section/16.9>
- PHET simulation  
[https://phet.colorado.edu/sims/html/molarity/latest/molarity\\_en.html](https://phet.colorado.edu/sims/html/molarity/latest/molarity_en.html)
- Lab: Gravimetric Analysis - Lead in Water
- <http://www.chemcollective.org/chem/ubc/exp01/index.php>
- Gravimetric Analysis—  
[https://chem.libretexts.org/Bookshelves/Ancillary\\_Materials/Laboratory\\_Experiments/Wet\\_Lab\\_Experiments/General\\_Chemistry\\_Labs/Online\\_Chemistry\\_Lab\\_Manual/Chem\\_11\\_Experiments/07%3A\\_Gravimetric\\_Analysis\\_\(Experiment\)](https://chem.libretexts.org/Bookshelves/Ancillary_Materials/Laboratory_Experiments/Wet_Lab_Experiments/General_Chemistry_Labs/Online_Chemistry_Lab_Manual/Chem_11_Experiments/07%3A_Gravimetric_Analysis_(Experiment))
- CK-12
  - 22.1 Oxygen in Reactions
  - 22.2 RedOx Reactions and Ionic Compounds
  - 22.6 Assigning Oxidation Numbers
  - CK-12 Acids
  - CK-12 Bases
  - CK-12 Arrhenius Acids
  - CK-12 Arrhenius Bases
  - CK-12 Bronsted-Lowry Acid & Base
  - CK-12 Bronsted-Lowry Acid & Base Reactions
  - CK-12 pH Scale
  - CK-12 Calculating pH/pOH
  - CK-12 Exothermic Reaction
  - CK-12 Endothermic Reaction
  - CK-12 Exothermic and Endothermic

#### Supplemental resources:

- Pre-AP Teachers Resources Unit 1 and 2
- [www.explorellearning.com](http://www.explorellearning.com)
- [www.ck-12.org](http://www.ck-12.org)
  - Free Online Textbooks, Flashcards, Adaptive Practice, Real World Examples, Simulations
- [Race & Social Justice Teacher Resources](#)

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Processes

- CK-12 Specific Heat Calculations
- CK-12 Reaction Rates
- CK-12 Factors Affecting Reaction Rates
- CK-12 Collision Theory
- CK-12 Reversible Reaction
- CK-12 Chemical Equilibrium
- CK-12 Le Chatelier's Principle
- Student Activity 4.3.A Flaking Away
- Student Activity 4.4.A A Rusty Nail - Iron and Copper Redox Reaction
- Student Activity 4.4.B Using Redox to Clean Silver
- Performance Task: Reactions of Copper and Aluminum
- Student Activity 4.6.A Classifying Chemical Reactions
- Student Activity 4.6.B Additional Practice Classifying
- Gizmo: Reaction Energy Activity A and B
- <https://www.explorelarning.com/index.cfm?method=cResource.dspView&ResourceID=1065>
- Gizmo: Reaction Energy Activity C
- <https://www.explorelarning.com/index.cfm?method=cResource.dspView&ResourceID=1065>
- Applications of Chemical Transformations
- Kinetics Simulation:
- <https://teachchemistry.org/classroom-resources/reaction-rates-simulation> OR <https://phet.colorado.edu/sims/cheerpj/reactions-and-rates/latest/reactions-and-rates.html?simulation=reactions-and-rates>
- Lab NJCTL Equilibrium Virtual Lab.doc

### Suggested Accommodations

**English Language Learners:**

- Multi-Sensory Instruction
- Flexible Grouping
- Small Group Instruction
- Peer Buddies
- Graphic Organizers
- Chunking Information
- Scaffolded Questioning
- Manipulatives/Concrete Models
- Build Background/Vocabulary
- Math Word Wall/Word Bank
- Gradual Release Model

- Visual Cues
- Visual Models
- Technology Integration
- Hands-On/Experiential Activities
- Native language support when possible
- Sheltered English Instructional Strategies
- Provide additional time

**Special Education/Students with Disabilities:**

- Extra help opportunities provided
- Credit Recovery
- Allow use of a calculator, when appropriate
- Modified length and time frame of assignments
- Alternate assessments with extended time
- Provide guided notes and study guides as needed
- Preferential Seating
- Extra Practice
- Directions repeated, clarified, and reworded
- Breakdown task into manageable units
- Differentiated instruction
- Use of manipulatives
- Math tool paper available
- Cooperative learning groups
- Supplemental books
- Repeat, reword or clarify directions
- Small group instruction as needed
- Instructional technology as needed/required
- Effective teacher questioning; ranging from fact recall to higher order critical thinking questions

**504 Plans:**

- Extra help opportunities provided
- Credit Recovery
- Allow use of a calculator, when appropriate
- Modified length and time frame of assignments
- Alternate assessments with extended time
- Provide guided notes and study guides as needed
- Preferential Seating
- Extra Practice
- Directions repeated, clarified, and reworded
- Breakdown task into manageable units
- Differentiated instruction
- Use of manipulatives
- Math tool paper available
- Cooperative learning groups
- Supplemental books
- Repeat, reword or clarify directions
- Small group instruction as needed
- Instructional technology as needed/required

- Effective teacher questioning; ranging from fact recall to higher order critical thinking questions

**Gifted and Talented:**

- Cooperative Learning Groups
- Enriched Assignments
- Tiered Assignments
- Word Problems
- NJSLA questions
- Model Curriculum Questions
- Inquiry Based Project
- Interest Based/Choice Activities

**Students at Risk of Failure:**

- Extended Time
- Multi-Sensory Instruction
- Flexible Grouping
- Small Group Instruction
- Peer Buddies
- Graphic Organizers
- Chunking Information
- Scaffolded Questioning
- Tiered Activities
- Manipulatives/Concrete Models
- Build Background/Vocabulary
- Math Word Wall/Word Bank
- Modified Assignments
- Gradual Release Model
- Preferential Seating
- Brain Breaks
- Visual Cues
- Visual Models
- Technology Integration
- Assistive Technology
- Credit Recovery

**Economically Disadvantaged:**

- Pre-teach vocabulary using visuals and gestures
- Chunk texts
- Summarize as you go
- Preview lessons
- Graphic organizers
- Highlight key words
- Sentence starters
- Prompting and cueing
- Activate schema
- Build background knowledge

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### **Culturally Diverse:**

- Create pictures, posters, art, books, maps, flags, etc to hang in the classroom.
- Create an emotionally positive classroom climate.
- Bring in guest speakers
- Create effective communication
- Model and teach cultural respect
- Build relationships with students by interviewing students to understand their background