<table>
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<th>1st Quarter</th>
<th>Task Analysis</th>
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<th>Vocabulary</th>
<th>Sample Formative Assessment Questions/Sample Essential Questions</th>
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<td><strong>State Standard/Objective</strong></td>
<td><strong>Skill Statements and Content limits for State EOC</strong></td>
<td><strong>Vocabulary</strong></td>
<td><strong>Suggested Resources</strong></td>
<td></td>
</tr>
<tr>
<td>1.6.1 Demonstrate an understanding of the scientific method.</td>
<td>Memorize the steps of the scientific method. Validate the usefulness of the scientific method. Analyze how certain experiments follow the scientific method. <strong>Skill Statements:</strong> • Recognize that science is information about the natural world collected in a measurable and repeatable process. • Identify that explanations are based on observations, evidence, and testing. • Identify a testable hypothesis. • Use logic and analysis to predict the most reasonable explanation for a set of observations and/or data. • Identify the different factors involved in a scientific experiment (control, dependent, and independent variables). <strong>Content Limits:</strong> Limit to content in the Chemistry Content Standards.</td>
<td><strong>Prior</strong> • hypothesis • theory • observation • control • data • experiment • conclusion • variable</td>
<td>Why are controls important in scientific studies? Compare and contrast a hypothesis, a theory, and a law. Essential Question: How can the scientific method be useful in my own life? <strong>RESOURCES:</strong> District Adopted Chemistry Textbook: World of Chemistry ©2007 by Zumdahl/Zumdahl/DeCoste (WOC) and POGIL Activities for High School Chemistry ©2012 edited by Laura Trout (POGIL)</td>
<td></td>
</tr>
<tr>
<td>1.6.2 Select and use appropriate scientific equipment, materials and techniques.</td>
<td>Recognize the basic laboratory equipment or materials Demonstrate proper usage of laboratory equipment or.</td>
<td><strong>Prior</strong> • thermometer • metric ruler • hot plate • balance • beaker</td>
<td>Name the following pieces of lab ware. (Paste picture onto test or provide them with actual lab equipment)</td>
<td></td>
</tr>
</tbody>
</table>

**RST 11-12.1** Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. **RST 11-12.2** Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. **RST 11-12.4** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics. **RST 11-12.5** Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas. **RST 11-12.6** Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved. **RST 11-12.7** Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
Select the appropriate equipment/materials to use to perform specific tasks.

Skill Statement:
- Choose the appropriate set of tools and/or technologies for conducting a specific investigation.

Content Limits:
Use laboratory equipment including a graduated cylinder, burette, pipette, Erlenmeyer flask, thermometer, balance, beaker, metric ruler, and other equipment generally used in a chemistry laboratory.

WHST 11-12.2a-e. Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
WHST 11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
WHST 11-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
WHST 11-12.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
WHST 11-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
WHST 11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of

5.1.1 Demonstrate the ability to work safely and effectively in a chemistry laboratory.

List the safety rules.
Discuss the importance of safety rules.
Identify the location of safety equipment.
Explain how and when to use the safety equipment.
Demonstrate how to work safely in the laboratory.

RST 11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

Prior
- Goggles
- Gloves
- apron
- fire extinguisher

Explicit
- fume hood
- eye wash
- safety shower

Introductory

Essential Question: What is the best tool or technique to use for a particular task and how can I find out how to do it?

RESOURCES:
- WOC Lab Manual

- POGIL: Safety First
- WOC lab manual
<table>
<thead>
<tr>
<th>Topic</th>
<th>Description</th>
<th>Prior</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2.2 Create and interpret graphs of data.</td>
<td>Create graphs from supplied data. Collect data to create graphs. Distinguish between different graphs. Interpret graphs. <strong>Skill Statements:</strong> - Recognize the appropriate graphical representation for a given set of experimental data. - Interpret graphed data and draw appropriate conclusions, including recognizing inverse and proportional relationships. - Make predictions based on graphed data. <strong>Content Limits:</strong> Given a set of data related to the Chemistry Content Standards, choose the proper method to graph a given set of data (i.e., a bar, line, or circle graph or a scatter plot). Appropriate data sets could include solubility curve, mass vs. volume graphs (density), phase and energy diagrams, heating curves, titration curves (strong acid/strong base), and gas laws graphs. <strong>RST 11-12.7</strong> Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. <strong>Prior</strong> - independent variable - dependent variable - x-axis - y-axis - line graph - bar graph - pie graphs - slope</td>
<td><strong>Make a line graph from the following data. Test tube #1 at 40°C reacted in 21 seconds. Test tube #2 at 10°C reacted in 50 seconds. Test tube #3 at 30°C reacted in 32 seconds, and test tube #4 at 20°C reacted in 39 seconds. Properly label all components of the graph.</strong></td>
<td><strong>RESOURCES:</strong> POGIL: Fundamentals of Experimental Design and Organizing Data</td>
</tr>
<tr>
<td>1.8.2 Communicate scientific investigations and information clearly.</td>
<td>Recognize and read a formal lab report. Paraphrase a laboratory procedure. Write a lab report. <strong>RST 11-12.2</strong> Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. <strong>WHST 11-12.2a-e.</strong> Write informative/explanatory texts, including the</td>
<td><strong>Write a lab report.</strong></td>
<td><strong>RESOURCES:</strong> Write Tools</td>
</tr>
<tr>
<td>Skill Statements:</td>
<td>Prior</td>
<td>Essential Question: What is the coldest possible temperature and what does that mean?</td>
<td></td>
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<tr>
<td>-------------------</td>
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<td>----------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Evaluate a lab report.</td>
<td>• abstract</td>
<td>WOC Ch.2 section 1 States of Matter, Ch 10 section 1 Energy, Temperature and Heat, Ch 13 Gases POGIL: Gas Variables</td>
<td></td>
</tr>
<tr>
<td>Predict particle activity associated with temperature change. Skill Statements:</td>
<td>• kinetic energy</td>
<td>A substance has atoms which are vibrating but not flowing past each other. What phase of matter is the substance in?</td>
<td></td>
</tr>
<tr>
<td>• Explain how the kinetic molecular theory explains the properties of ideal gases.</td>
<td>• solid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Explain and apply the postulates that describe the behavior of molecules in a gas.</td>
<td>• liquid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Recognize how the kinetic molecular theory led to the concept of absolute zero.</td>
<td>• gas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Using a given experimental scenario or set of data, describe the change in behavior of particles involved.</td>
<td>• constant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Content Limits: Experimental scenarios and/or data should be limited to temperature, pressure, and volume changes for ideal gases and basic concepts involving diffusion of a gas. There is a limit of two variables being addressed at one time.</td>
<td>• Kelvin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2.3 Explain and interpret the key concepts of the kinetic molecular theory.</td>
<td>Explicit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Explain the kinetic molecular theory. Compare and contrast the molecular arrangement for each state of matter.</td>
<td>Introductory</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2.1 Describe the Kinetic Molecular Theory as it applies to phases of matter.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assessed in the classroom, not assessed on the chemistry EOC assessment.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>narration of historical events, scientific procedures/ experiments, or technical processes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RST 11-12.6 Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Skill Statements:**
- Compare the kinetic energy, distance, and forces of attraction between solid, liquid, and gas molecules of the same material.
- Identify the states of matter in a phase diagram.
- Explain how variables such as pressure and temperature can affect the state of matter of a substance.
- Identify a substance as a solid, liquid, or gas based on shape, volume, and compressibility.
- Calculate the pressure, volume, number of moles, or temperature of an ideal gas.

**Content Limits:**
Provide equations for the gas laws (i.e., ideal gas law, Boyle’s law, Charles’ law, and the combined gas laws).

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**2.1.4 Distinguish and classify all matter into appropriate categories.**

- Define atom, element, compound, molecule, pure substance, heterogeneous mixture, and homogeneous mixture.

**Skill Statements:**
- Identify examples of elements, compounds, and mixtures.
- Compare elements, compounds, and mixtures.

**Content Limits:**
Terminology may include element, compound, homogeneous mixture, heterogeneous mixture, and solution. Items should use visual representations and should

**RST 11-12.5** Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.

**WHST12.2a** Introduce a topic and 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.

**WHST12.2b** Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and

**Prior**
- Atom
- Element
- Compound
- molecule
- pure substance
- heterogeneous mixture
- homogeneous mixture

**Explicit**

**Introductory**
- colloid
- suspension

---

**Essential Question.** How does the nature of the particles (structure) affect their behavior (function)?

**RESOURCES:** WOC Ch.2 section 1 States of Matter, Ch 10 section 1 Energy, Temperature and Heat, Ch 13 Gases POGIL: Gas Variables

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**Essential Question:** What is the fundamental difference between different kinds of materials?

**RESOURCES:** WOC Ch. 2, POGIL, Classification of Matter
not require students to recognize specific materials (e.g., vinegar, milk, orange juice).

Classify different examples of matter.

examples appropriate to the audience’s knowledge of the topic.

1.3.1 Identify, compare and contrast physical and chemical properties and changes and appropriate computations.

| RST 11-12.5 Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas. |
|---|---|
| Prior |
| • Physical property |
| • Chemical property |
| Explicit |
| • physical change |
| • chemical change |
| Introductory |
| • intensive |
| • extensive |

Circle which of the following are physical changes: Cars rusting, wood burning, ice melting, cutting diamonds, dry ice subliming.

Essential Question: How do the changes of matter (chemical and physical) affect my daily life?

What is the difference between the two types of changes?

RESOURCES: WOC Ch. 2 Matter Section 2 A Physical and Chemical Properties and Changes
Methods of separation may include filtration, electrolysis, and evaporation. Physical properties may include color, mass, density, volume, conductivity, temperature, freezing/melting point, boiling point, and magnetism. Chemical properties may include reactivity, pH, flammability, and corrosion (oxidation/reduction).

2.3.3 Differentiate between exothermic and endothermic chemical reactions during chemical or physical changes.

<table>
<thead>
<tr>
<th>Skill Statements:</th>
<th>Prior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define exothermic and endothermic reactions.</td>
<td>temperature</td>
</tr>
<tr>
<td>Identify chemical reactions and phase changes as endothermic and exothermic.</td>
<td>endothermic</td>
</tr>
<tr>
<td><strong>Skill Statements:</strong></td>
<td>exothermic</td>
</tr>
<tr>
<td>• Classify a chemical or physical change as endothermic or exothermic based on an enthalpy diagram, or the change in temperature for a given process.</td>
<td>heat energy</td>
</tr>
<tr>
<td><strong>Content Limits:</strong></td>
<td>system</td>
</tr>
<tr>
<td>Provide two temperatures (initial and final), a temperature-time graph, or an enthalpy diagram.</td>
<td>surroundings</td>
</tr>
</tbody>
</table>

**Introductory**

Two solutions are added to a beaker and the beaker feels hot to the touch. Is this an exothermic or endothermic reaction?

**Essential Question:** What is heat? How is heat involved in endothermic and exothermic reactions?

**RESOURCES:** WOC Ch 10 Energy, section 3 Energy and Chemical Reactions

1.3.2 Perform computations using scientific notation, the metric system and dimensional analysis.

<table>
<thead>
<tr>
<th><strong>Skill Statements:</strong></th>
<th>Prior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify a number in scientific notation.</td>
<td>exponent</td>
</tr>
<tr>
<td>Convert between standard and scientific notation by hand and with a calculator.</td>
<td>milli</td>
</tr>
<tr>
<td>Perform mathematical operations using scientific notation.</td>
<td>centi</td>
</tr>
<tr>
<td>Measure and record using the metric system. Convert measurements within the metric system.</td>
<td>deci</td>
</tr>
<tr>
<td><strong>Explicit</strong></td>
<td>kilo</td>
</tr>
<tr>
<td>• scientific notation</td>
<td>scientific notation</td>
</tr>
<tr>
<td>• conversion factors</td>
<td>conversion factors</td>
</tr>
<tr>
<td><strong>Introductory</strong></td>
<td>SI base units</td>
</tr>
</tbody>
</table>

**Answer this problem using scientific notation** $(5 \times 10^6) \times (6 \times 10^2)$.

**Convert 85 km/hr to m/s.**

**Essential Question:** What is a method I can learn to solve real-life problems that involve many different units?

If metric are easier, why doesn’t the United States use the metric system?
1.3.3 Compute measurement uncertainty to include precision, accuracy and the rules for significant digits.

<table>
<thead>
<tr>
<th>Define precision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define accuracy</td>
</tr>
<tr>
<td>Recognize precise and accurate measurements</td>
</tr>
<tr>
<td>Compare and contrast precision and accuracy.</td>
</tr>
<tr>
<td>Define the term “significant digit”.</td>
</tr>
<tr>
<td>Recognize significant digits in a number.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Prior</th>
</tr>
</thead>
<tbody>
<tr>
<td>placeholder decimal place nonzero digit</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Explicit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precision</td>
</tr>
<tr>
<td>Accuracy</td>
</tr>
<tr>
<td>significant digits</td>
</tr>
<tr>
<td>uncertainty</td>
</tr>
</tbody>
</table>

RESOURCES: WOC Ch 5 Measurements and Calculations
Express measurements using the correct number of significant digits.

Use correct significant digits in calculations.

**Skill Statements:**
- Accurately read measurements on common laboratory equipment including one uncertain (estimated) digit.
- Select the appropriate instrument for certain measurements.
- Identify the level of precision that can be obtained from different laboratory equipment.
- Know the difference between precision and accuracy (i.e., determine whether a set of experimental data is precise and/or accurate).
- Know the rules for significant figures and use these rules while doing calculations based on experimental data using different laboratory equipment.

**Content Limits:**
Be able to use the following laboratory tools: graduated cylinder, burette, pipette, thermometer, balance, beaker, and metric ruler. Use a given formula and/or set of data for required calculations. Provide an accepted value for precision and accuracy measurements. Students will not be asked to read measurements on a common piece of laboratory equipment and also do a calculation in the same item.

**Introductory**

**RESOURCES:** WOC Ch 5, POGIL: Significant Digits and Measurement and Significant Zeros
| 5.2.1 Assess the role of chemistry in enabling technological advances. | List technology that was developed by chemists.  
State career fields that use chemistry.  
Explore the role of chemistry in the development of specific technology.  
**Skill Statements:**  
- Explain how important discoveries in chemistry have led to technological advances.  
- Explain how technological advances have led to important discoveries in chemistry.  
**Content Limits:**  
Examples could include the production of semiconductors (cell-phones, computers), research on the atom (nuclear imaging, nuclear energy, smoke detectors), development of cathode ray tubes (television), and discovery of organic chemical reactions (plastics, polymers, pharmaceuticals).  
Technological advances could include the scanning electron microscope, spectroscope, various sensors, and the ability to harness electricity. | **RST.11-12.2** Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.  
**WHST.11-12.9** Draw evidence from informational texts to support analysis, reflection, and research. | Describe how chemistry is involved in a technology of your choice (ex. iPod, phone, Tool from CSI etc.)  
**Essential Question:** How did the discovery of the chemical dye "Mauve" change the world?  
**RESOURCES:** Garfield, Simon, *Mauve: How One Man Invented a Color That Changed the World* |
Examples could include nuclear waste, acid rain, hazardous vs. non-hazardous waste, pollution, biodiesel, petroleum products, recycling, nuclear energy, the pharmaceutical industry, or fossil fuel (oil, coal, and gas) production.

**Introductory**
- hydrogen fuel cells
- atom economy
- Carbon footprint

**RESOURCES:** American Chemical Society, Chematters Magazine http://www.acs.org/content/acs/en/education.html

<table>
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<tr>
<th>2nd Quarter</th>
<th>State Standard/Objective</th>
<th>Task Analysis</th>
</tr>
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<tbody>
<tr>
<td>1.1.1 Use the periodic table to predict physical and chemical properties.</td>
<td>Predict reactivity, density, electronegativity, and other trends of the periodic table.</td>
<td>RST 11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.</td>
</tr>
<tr>
<td>1.1.1 Use the periodic table to predict physical and chemical properties.</td>
<td>Predict most common ion charge based on group</td>
<td>RST 11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.</td>
</tr>
<tr>
<td>1.1.1 Use the periodic table to predict physical and chemical properties.</td>
<td>Predict metallic character</td>
<td>RST 11-12.5 Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.</td>
</tr>
<tr>
<td>1.1.1 Use the periodic table to predict physical and chemical properties.</td>
<td>Use periodic trends to predict physical and chemical properties of an element.</td>
<td>RST 11-12.6 Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.</td>
</tr>
<tr>
<td>1.1.1 Use the periodic table to predict physical and chemical properties.</td>
<td>Identify the group to which a specific element belongs within the periodic table using the element’s characteristic chemical properties and/or periodic trends.</td>
<td>RST 11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.</td>
</tr>
<tr>
<td>1.1.1 Use the periodic table to predict physical and chemical properties.</td>
<td>Use the periodic table to identify metals, nonmetals, and metalloids (semimetals) and to describe their properties.</td>
<td>RST 11-12.10 By the end of grade 12, read and comprehend science/technical texts in the grades 11–12 text complexity band independently and proficiently.</td>
</tr>
<tr>
<td>1.1.1 Use the periodic table to predict physical and chemical properties.</td>
<td>Predict an element’s properties based on its location in the periodic table.</td>
<td>WHST 11-12.1 Write arguments focused on discipline-specific content.</td>
</tr>
<tr>
<td>1.1.1 Use the periodic table to predict physical and chemical properties.</td>
<td>Content Limits: Elements will be limited to main group elements. Properties assessed will be limited to reactivity, valence electrons, atomic radius, electronegativity, ionization energy (first), shielding</td>
<td>WHST 11-12.2a-e. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.</td>
</tr>
<tr>
<td>1.1.1 Use the periodic table to predict physical and chemical properties.</td>
<td></td>
<td>WHST 11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</td>
</tr>
<tr>
<td>1.1.1 Use the periodic table to predict physical and chemical properties.</td>
<td>Prior</td>
<td>Which element (given a selection of elements) is more dense? Which has the highest electronegativity? Which is least stable or most reactive?</td>
</tr>
<tr>
<td>1.1.1 Use the periodic table to predict physical and chemical properties.</td>
<td>Explicit</td>
<td>Essential Question: Why is the periodic chart considered the most valuable tool a chemist has?</td>
</tr>
<tr>
<td>1.1.1 Use the periodic table to predict physical and chemical properties.</td>
<td>Introductory</td>
<td>RESOURCES: WOC Ch.3 Section 4 Using the Periodic Table POGIL: Cracking the Periodic Table Code, Periodic Trends</td>
</tr>
</tbody>
</table>
| 1.2.1 Describe the historical development of the periodic table. | Explain Mendeleev’s and Mosely’s contribution to the development of the periodic table.  
**Skill Statements:**  
- Describe how models change over time with new scientific understanding.  
- Explain why changes to past models of the periodic table were made, resulting in the current model of the periodic table.  
**Content Limits:**  
Items should focus on the nature of experimentation and changes in understanding over time rather than specific steps and individuals involved in the development of the periodic table. Test items will include any additional contextual information needed to answer the question (e.g., a step in | Prior  
- periodic  

| **RST 11-12.1** Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.  
**RST 11-12.4** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.  

| Explain how Mendeleev was able to predict the properties of undiscovered elements using his periodic table  
Is the periodic table still useful today? How so?  
What refinements have we made to Mendeleev’s table?  
Essential Question: Why is it important to publish scientific work?  
RESOURCES: American Institute of Physics,  
http://www.aip.org/history/curie/periodic.htm |
| 1.7.1 Explain how a series of historically related and documented experiments led to the current model and structure of the atom. | • Describe the major contributions of specific scientists to the atomic theory. *Assessed in the classroom, not assessed on the chemistry EOC assessment.* | • Nucleus  
• Atom  
• Electron  
• Proton  
• neutron | Describe Rutherford’s experiment?  
Essential Question: What is the smallest particle of a substance that retains the properties of that substance?  
RESOURCES: WOC  3.3 The Structure of the Atom |
| --- | --- | --- | --- |
| 2.3.1 Explain and calculate the changes in heat energy that occur during chemical reactions and phase changes. | • Read and record temperature and mass measurements.  
• Calculate the change in heat energy.  
• Explain the reasons for temperature change of a system | • Exothermic  
• Endothermic  
• Heat of fusion  
• Heat of vaporization  
• Specific heat capacity | Calculate the heat required to take 10 g of ice at -20°C to steam at 125°C.  
Is the reaction of Mg + HCl endothermic and exothermic and how can you tell?  
Essential Question: Why do I feel cold when I am wet on a hot day? Why does ice cool things down so fast?  
RESOURCES: WOC Ch. 10 |
| 2.4.1 Interpret the classic historical experiments that were | • Describe the experimental designs and conclusions of specific experiments to the development | • Rutherford’s experiment  
• Cathode ray tube | Explain how Rutherford’s results proved that the atom was mostly empty space and had a positively charged nucleus |
used to identify the components of an atom and its structure.

Skill Statements:
- Recognize that historical models have led to a better understanding of the atom.
- Explain how models of the atom helped represent concepts that could not be validated by direct observations.
- Given graphical representations and/or descriptive writing of experiments, identify the resulting key conclusions about the structure of atoms.
- Identify experiments throughout history that led to the current model of the atom.

Content Limits:
Experiments throughout history include Thomson’s cathode ray tube, Rutherford’s gold foil experiment, and Bohr’s hydrogen spectrum.

<table>
<thead>
<tr>
<th>2.4.2 Deduce the number of protons, neutrons and electrons for an atom or ion.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Use the atomic number on the periodic table to find the number of protons of an atom or ion.</td>
<td>• Isotope</td>
</tr>
<tr>
<td>• Use the atomic number and charge to determine the number of electrons for an atom or ion.</td>
<td>Ion</td>
</tr>
<tr>
<td>• Use the atomic number and mass number to determine the number of neutrons in an atom or ion.</td>
<td>Atomic number</td>
</tr>
<tr>
<td>Skill Statements:</td>
<td>Atomic mass</td>
</tr>
<tr>
<td>• Describe how isotopes of the same element differ in the number of neutrons while the numbers of</td>
<td>nuclide</td>
</tr>
<tr>
<td></td>
<td>Calculate the number of protons and neutrons and electrons of a Ca$^{+2}$ ion with a mass number of 40</td>
</tr>
<tr>
<td></td>
<td>Essential Questions: What are the basic building blocks that everything is made of?</td>
</tr>
<tr>
<td></td>
<td>RESOURCES: WOC Ch. 3. Elements, Atoms and Ions</td>
</tr>
</tbody>
</table>
protons and electrons remain constant.

- Describe how the number of electrons differs from the number of protons in ions.
- Given an isotope symbol, including mass number and atomic number, identify the number of protons, neutrons, and electrons in an atom.
- Given the formula for a monatomic ion, determine the number of protons and electrons.

**Content Limits:**
Terms used may include atomic number, mass number, and atomic mass. Include a periodic table when necessary for determining the mass number and atomic number of an element.

2.4.3 Describe the relationship between the structure of atoms and light absorption and emission.

- Explain how the wavelengths of light emitted by an atom provide information about electron energy levels.

**Skill Statements:**
- Describe how electrons absorb energy and move to higher energy levels and release energy in the form of electromagnetic radiation (light) at specific wavelengths when they move back to lower energy levels.
- Explain how every atom can be identified by its own unique atomic emission or absorption spectrum.
- Describe how energy can only be emitted or absorbed in discrete energy quanta because different energy levels within an atom are

<table>
<thead>
<tr>
<th>Ground state</th>
<th>Excited state</th>
<th>Electromagnetic spectrum</th>
<th>photon</th>
</tr>
</thead>
</table>

Which color of light would be produced by the largest energy drop of an electron?

**Essential Question:** What causes the colors of fireworks or neon lights? How do we determine the composition of distant stars?

**RESOURCES:** WOC CH. 11
POGIL  Electron Energy and Light
associated with specific quanta of energy.

**Content Limits:**
Limit to elements commonly used in a laboratory. Students will not be expected to perform or identify calculations or calculation setups within this objective.

<table>
<thead>
<tr>
<th>2.4.4 Determine and illustrate electron arrangements of elements using electron configurations and orbital energy diagrams.</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Know that there are seven energy levels where electrons can be found.</td>
</tr>
<tr>
<td>• List which sublevels (s, p, d, f) are in each energy level.</td>
</tr>
<tr>
<td>• Show the number of orbitals and maximum number of electrons in each sublevel.</td>
</tr>
<tr>
<td>• Illustrate the location of electrons of specific atoms using electron configuration and orbital energy diagrams.</td>
</tr>
</tbody>
</table>

**Skill Statements:**
- Determine the electron configuration for an element based on its position in the periodic table.
- Identify an atom by observing its ground state orbital energy diagram.
- Select the correct orbital diagram for an element using the rules established for orbital energy diagrams.

**Content Limits:**
Limit to the first 36 elements in the periodic table excluding the ground state electron configuration or orbital energy diagram for chromium (Cr) or copper (Cu).

<table>
<thead>
<tr>
<th>What element would have the ground state electron configuration of 1s²2s²2p⁶?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Essential Question: Why does the periodic table have such an unusual shape?</td>
</tr>
</tbody>
</table>

**RESOURCES:** WOC Ch 11 Modern Atomic Theory

3rd Quarter
<table>
<thead>
<tr>
<th>State Standard/Objective</th>
<th>Task Analysis</th>
<th>Energy levels</th>
<th>Lewis Dot Diagrams</th>
<th>Ionic bond</th>
<th>Covalent bond</th>
<th>Energy levels</th>
<th>Lewis Dot Diagrams</th>
<th>Ionic bond</th>
<th>Covalent bond</th>
</tr>
</thead>
</table>
| 2.1.1 Explain and understand how electrons are involved in the formation of chemical bonds using the octet rule and Lewis dot diagrams. | • Define valence electrons.  
• Determine the number of valence electrons using the periodic table.  
• Draw Lewis dot diagrams for various elements.  
• Explain the octet rule.  
• Define ionic bonds.  
• Define covalent bonds.  
• Demonstrate how covalent bonds form using Lewis dot diagrams.  
• Demonstrate how ionic bonds form using Lewis dot diagrams. | Energy levels | Lewis Dot Diagrams | Ionic bond | Covalent bond | What type of bond is involved in the following: H₂O, NaCl, O₂ | Essential Question: What holds atoms together in compounds? |

**Skill Statements:**  
- Identify the correct Lewis structure for an element, binary ionic compound, or simple covalent compound including double and/or triple bonds.  
- Describe how valence electrons behave in chemical bonds.  
- Compare ionic and covalent bonds.  
- Explain why elements form ions.

**Content Limits:**  
Include only compounds where atoms follow the octet rule. Covalent compounds can include up to three carbon atoms. Use representative elements to explain why elements form ions. Provide a list of the elements or a periodic table. Do not use polyatomic cations or anions.

| 2.1.2 Predict the polarity of chemical bonds using electronegativity. | • Understand the concept of electronegativity.  
• Use the trends for electronegativity on the periodic table to predict polarity. | Polar |  
Which molecule is the most polar, HCl or CO₂ and why? | Essential Question: Why does water have so many strange properties? |
- Given two elements and their placement on the periodic table, predict whether the bond between the two elements is ionic or covalent.
- Given an electronegativity table, predict whether the bond between two nonmetal elements is polar covalent or nonpolar covalent based on the electronegativity difference.
- Order a list of covalent bonds according to their polarity.

**Content Limits:**
For questions involving polar vs. nonpolar bonds, item distractors containing ionic bonds may not be used. Electronegativity differences of < 0.5 should be used for nonpolar covalent bonds. Electronegativity differences of 0.5 – 1.7 should be used for polar covalent bonds.

### 2.1.3 Predict physical properties of compounds based upon the attractive forces between atoms and molecules.

- Use molecular shapes to predict attraction between molecules.
  - Identify hydrogen bonding
  - Predict intermolecular physical properties (e.g. capillary action, surface tension).

**Skill Statements:**
- Identify intermolecular forces including hydrogen bonding, dipole-dipole attraction, and London dispersion (van der Waals) forces.
- Given a list of compounds, predict which has the greatest melting or boiling point based on their intermolecular forces.

- Vapor pressure
- Volatile
- Viscous
- Boiling point
- Dipole-dipole
- Dispersion forces
- Hydrogen bonding

Which substance has the lowest boiling point and why? CO₂ or H₂O

Essential Question: Why are some substances such as rubbing alcohol or gasoline volatile while other substances such as motor oil are viscous?

### RESOURCES:
WOC Ch 12 Chemical Bonding
POGIL Periodic Trends
WOC Ch 14 Liquids and Solids
1.8.1 Correctly write symbols, formulas and names for common elements, ions and compounds.

- Find elements on the periodic table.
- Recognize the symbols for common elements. Recognize charge from periodic chart location
  - Recognize the symbol for an ion.
  - Construct formulas for compounds.

**Skill Statements:**
- Use the periodic table to derive symbols for the names of the representative and familiar transition metal elements.
- Given the International Union of Pure and Applied Chemistry (IUPAC) name of an ionic or covalent compound, correctly write the formula for the compound.
- Given the formula for a compound, correctly write the IUPAC name of the ionic or covalent compound.

**Content Limits:** Students will be provided with the names of the elements, a list of

**RST 11-12.4** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.

- Cation
- Anion
- Polyatomic ion
- Monatomic ion
- Molecular compound
- Type II metal

Name or write formulas for: MgCl₂, CO₂, calcium oxide, sulfur trioxide.

Essential Question: Should dihydrogen monoxide be banned?

**RESOURCES:**
- WOC Ch. 4 Nomenclature
- POGIL: Naming Ionic Compounds, Polyatomic Ions, Naming Molecular Compounds, Naming Acids
common ions, a list of numerical prefixes and their meanings, and the charges of all cations and anions within the item as necessary. Confine element symbols to the representative and familiar transition metal elements.

1.3.4 Perform calculations related to the conversion of grams to moles to particles, atoms, molecules and volume.

<table>
<thead>
<tr>
<th>Skill Statements:</th>
<th>Content Limits:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Define moles.</td>
<td>Conversion problems will be one to two steps (e.g., grams to moles to atoms/molecules). Compounds and formulas should be provided in the stem of the question. Students should be given molecular masses in problems involving gram to other unit conversions. Molar mass calculations should not be combined with conversion problems. All volumes must be at standard temperature and pressure (STP).</td>
</tr>
<tr>
<td>• Explain the usefulness of moles.</td>
<td></td>
</tr>
<tr>
<td>• Calculate molar mass.</td>
<td></td>
</tr>
<tr>
<td>• Memorize Avogadro's number.</td>
<td></td>
</tr>
<tr>
<td>• Determine the number of atoms, molecules, or particles in a certain number of moles.</td>
<td></td>
</tr>
<tr>
<td>• Calculate the number of atoms in a certain number of grams in a specific substance and vice versa.</td>
<td></td>
</tr>
<tr>
<td>• Know the standard molar volume.</td>
<td></td>
</tr>
<tr>
<td>• Calculate between moles and liters using the standard molar volume.</td>
<td></td>
</tr>
</tbody>
</table>

Skill Statements:
• Perform stoichiometric calculations involving a compound or a single element.
• Calculate the molar mass of a compound.
• Recognize the correct setup for a conversion

Content Limits:
Conversion problems will be one to two steps (e.g., grams to moles to atoms/molecules). Compounds and formulas should be provided in the stem of the question. Students should be given molecular masses in problems involving gram to other unit conversions. Molar mass calculations should not be combined with conversion problems. All volumes must be at standard temperature and pressure (STP).

- Mole
- Avogadro's number
- Standard molar volume

How many moles are in 15 grams of water?

How many liters, at STP are in 15 g of hydrogen gas?

Essential Question: What is the link between the invisible world of atoms and molecules to the practical world we live in?

RESOURCES: WOC Ch 9 Chemical Quantities

POGIL Relative Mass and the Mole
<table>
<thead>
<tr>
<th>4th Quarter</th>
<th></th>
</tr>
</thead>
</table>
• Perform an activity using a chemical equation and examine if the equation follows the Law of Conservation of Mass and the Law of Definite Proportions.  
**Skill Statements:**  
• Identify an example of the law of definite proportions where a chemical compound always has exactly the same proportion of elements by mass.  
• Identify an example of the law of multiple proportions where the masses of one element which combine with a fixed mass of the second element are in a ratio of whole numbers.  
**Content Limits:**  
Limit material assessed to the law of definite proportions and the law of multiple proportions. Use simple compounds and avoid multiple polyatomic anions or cations in a formula.  
  |
| 2.3.2 Demonstrate the conservation of matter by balancing chemical equations. | • Define the law of conservation of matter.  
• Use coefficients to balance chemical equations.  
• Defend how balancing equations is in accordance with the law of conservation of matter.  
**Skill Statements:**  
• Balance a chemical equation.  
• Recognize that matter is conserved during chemical reactions.  
  | • products  
• reactants  
• coefficients  
• subscripts  
• yields

Write and balance the formula equation for: hydrogen gas reacts with oxygen gas to produce water vapor

**Essential Question:** How does oxygen and hydrogen combine to make H₂O? Why 2 H to 1 O?

WOC  Ch. 7 Chemical Reactions  
POGIL  Mole Ratios  

Same as above
- Verify the law of conservation of matter by showing that the mass of the products in a specific example is equal to the mass of the reactants.

**Content Limits:**
Chemical equations should be limited to basic equations, and coefficients should not be fractions or too large (no double digits). The equations should not total more than five elements/compounds as reactants and products. Do not include redox reactions in chemical equations.

### 2.5.2 Classify, write and balance chemical equations for common types of chemical reactions and predict the products.

- Label the parts of a chemical equation.
- Translate word equations into chemical equations and vice versa.
- Balance chemical equations by counting the total number of each type of atom for both reactants and products, then inserting coefficients.
- Recognize the different types of chemical reactions.
- Predict the products from various reactants for the different types of chemical reactions.

**Skill Statements:**
- Identify the types of chemical reactions.
- Translate a chemical equation from words to formula, or formula to words.
- Predict the products of a chemical equation.

**Content Limits:**
Identify types of chemical reactions including: synthesis/formation/combination reactions, decomposition reactions, single displacement, double displacement, combustion reactions.

Identify from a list of reactions a decomposition reaction.

**Essential Question:** How do we classify things?

**RESOURCES:** WOC Ch 7 Chemical Reactions and Ch 8 Reactions in Aqueous Solutions

POGIL: Types of Chemical Reactions
replacement/displacement reactions, double replacement/displacement reactions, oxidation-reduction (redox) reactions and combustion reactions (for hydrocarbons). Predict the products of double replacement, single replacement, and combustion reactions only.

For the second skill statement, do not use acid names or hydrocarbons when translating between words and formulas.

Items will include a list of common ions, as needed.

2.5.3 Describe the factors that influence the rates of chemical reactions.

| Skill Statements: | • Discuss the factors that influence the rates of chemical reactions. |
| Content Limits: | • Identify the factors that can change the rate of a chemical reaction. |
| | • Describe how a catalyst increases the rate of a chemical reaction. |
| | • Equilibrium catalyst |
| | Explain the effect of heat on the decomposition of H₂O₂ |
| Essential Questions: | What can affect the speed of a chemical reaction? |
| Resources: | WOC Ch 17.1 Reaction Rates |

1.3.5 Analyze and solve reaction stoichiometry problems.

| Skill Statements: | • Balance an equation. • Understand mole ratios of molecules in a chemical equation. • Convert moles to grams and grams to moles. • Solve stoichiometry problems |
| | • Stoichiometry |
| | How many grams of sodium chloride can be produced from 15 g of baking soda reacting with unlimited hydrochloric acid? |
| Essential Question: | How do I know how much chemical to use? |
| 1.3.6 Express concentrations of solutions in various ways including molarity. | • Perform stoichiometric calculations involving a balanced chemical equation.  
• Identify the limiting reactant for a given reaction.  
• Recognize the correct setup for a stoichiometry calculation.  
• Calculate theoretical yield and percent yield for a chemical reaction.  
| **Content Limits:** A balanced equation and molar masses should be included in the item. Calculations may include grams/moles/volume of reactant to grams/moles/volume of product. | | RESOURCES: WOC Ch. 9 Chemical Quantities  
POGIL: Mole Ratios, Limiting and Excess Reactants |
| 1.3.7 Interpret how the presence of solute particles affect the properties of a solution and be able to do calculations involving colligative properties. | • Define molarity.  
• Calculate molarity values of solutions.  
| **Skill Statements:**  
• Calculate the molarity of a solution.  
• Recognize various ways to calculate percent concentration including mass percent (%).  
| **Content Limits:** Given the mass of solute and volume of the solution, find the molarity of the solution. Given the mass of the solute and mass of the solution, find the concentration in mass percent (%). The molar mass will be provided. Use the molarity to do dilution of solution calculations. | • Molarity  
• Molality  
• Normality  
• Mass percent  
| What is the molarity of 12.5 g of sodium chloride dissolved in 350 ml of solution?  
Essential Question: Why is solution concentration important for IV solutions?  
RESOURCES: WOC Ch 15 Solutions  
POGIL: Molarity |
| | • Define colligative properties.  
• Use calculations to solve boiling point elevation and freezing point depression.  
| **Skill Statements:** | Colligative properties  
| What is the freezing point of 150 kg of water that has 155 g of NaCl dissolved in it? |
• Know the properties of a solution that are affected by changes in the concentration of the solute.
• Recognize how solute particles change the freezing point or boiling point of a solution.

**Content Limits:**
Limit the properties being tested to the boiling point and freezing point of the solution. Recognize whether the boiling point or the freezing point increases or decreases with the addition of a solute or solvent. Problems involving calculations of colligative properties may include a graphical representation. Limit calculations to finding the freezing point depression or boiling point elevation for solutions containing only nonelectrolytes. Nonelectrolytes and electrolytes can be used but only in the context of finding the highest/lowest melting/boiling point of a solution.

1.3.8 Analyze quantitative relationships involved in acid/base chemistry including pH.

- Memorize the pH scale
- Determine whether a solution is acidic or basic based on the pH scale, Predict the pH of a variety of substances
- Calculate the pH from [H+] and [OH-].

**Skill Statements:**
- Given the concentration of an acid or base, calculate/identify the pH.
- Given the pH, calculate/identify the concentration of an acid or base.
- Given the pH of a solution, identify a substance as acidic, basic, or neutral.

• pH
• logarithm

What would be the approximate pH of the following: pure water, HCl, NaOH, soap, lemon juice

What pH is given to acids? Bases? Neutral substances?

Calculate the pH of a solution with a H+ of 1.8 x 10^-4

Essential Question: How do acids and bases affect my daily life? Why is it important to know if something is acidic or basic?

RESOURCES: WOC 16 Acids and Bases, POGIL Calculating pH
• Relate the concentration of hydrogen ions (H⁺) to the pH.

• Demonstrate knowledge that a low pH means a high H⁺/low OH⁻ concentration and a high pH means a low H⁺/high OH⁻ concentration based on a logarithmic relationship (factors of 10).

Content Limits:
Given the formula for finding the pH, calculate the pH of a solution. Limit questions to strong acids and bases. Do not require students to use the log key on a calculator. Concentrations should be expressed as a 1 × 10 raised to a negative whole number power. Molar concentrations must be given. The pH must be represented as a whole number.

1.2.4 Distinguish the common theories defining acids and bases.

• Compare and contrast the different theories of acids and bases (e.g. Arrhenius Acids and Bases, Lewis Acids and Bases, Brønsted-Lowry Acids and Bases).

• Classify compounds as acids or bases using the different theories.

Skill Statement:
• Compare the common theories of acids and bases.

Content Limits:
Given a description of the Brønsted-Lowry and Arrhenius theories of acids and bases, recognize major differences and/or similarities between the theories. Identify common examples of Brønsted-Lowry and Arrhenius acids and bases. Do not test Lewis acids or bases.

• Identify a neutralization reaction.

• Predict the products of a neutralization reaction.

• Acid-base neutralization

• Titration

Write an equation for an acid base neutralization reaction.
<table>
<thead>
<tr>
<th>2.1.5 Explain the relationship and reactions of acids, bases, and salts.</th>
<th>Skill Statements:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predict the products of an acid-base reaction.</td>
<td></td>
</tr>
<tr>
<td>Identify characteristic properties of acids, bases, and salts.</td>
<td></td>
</tr>
<tr>
<td>Do calculations involving monoprotic strong acid-strong base titrations using the formula ( M_1V_1 = M_2V_2 ).</td>
<td></td>
</tr>
<tr>
<td>Explain how acids and bases neutralize each other to form a salt and water.</td>
<td></td>
</tr>
</tbody>
</table>

**Content Limits:**
The equation \( M_1V_1 = M_2V_2 \) must be provided in the item when students are required to perform calculations for titrations. Titrations questions will only include strong monoprotic acids and alkali metal hydroxides.

<table>
<thead>
<tr>
<th>2.1.6 Explain the role of dissociation and ionization in producing strong, weak, and nonelectrolytes.</th>
<th>Skill Statements:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define strong and weak electrolytes, and nonelectrolytes.</td>
<td></td>
</tr>
<tr>
<td>Explain how dissociation and ionization produce electrolytes.</td>
<td></td>
</tr>
</tbody>
</table>

**Skill Statements:**
- Explain how electrolytes conduct electricity.
- Distinguish between compounds that will dissociate in water and ones that will not and explain why.
- Identify the equation for the complete dissociation of a simple ionic compound.

**Content Limits:**
Items will include only electrolytes and nonelectrolytes, but will not require the student to distinguish between weak or strong electrolytes. Use compounds that

<table>
<thead>
<tr>
<th>Acid-base indicator</th>
<th>Essential Question: What happens when you mix an acid and a base?</th>
</tr>
</thead>
</table>

**RESOURCES:** Same as above

<table>
<thead>
<tr>
<th>Ionization</th>
<th>Dissociation</th>
<th>Electrolyte</th>
<th>Which compound will ionize, NaCl, H(_2)O, or PbCl(_2)?</th>
</tr>
</thead>
</table>

**Essential Question:** Pure water should not conduct electricity so why shouldn’t I dry my hair in the bathtub?

**RESOURCES:** WOC Ch 8 Reactions in Aqueous Solutions
students are familiar with in a laboratory context