**Big Ideas/Key Concepts:**
- Understandings about scientific inquiry and the ability to conduct inquiry that are essential for living in the 21st century
- Society benefits when engineers apply scientific discoveries to design materials and processes that develop into enabling technologies
- Science applies mathematics to investigate questions, solve problems, and communicate findings

**Embedded Inquiry**
- SPI 3221 Inq.1 - select a description or scenario that reevaluates and/or extends a scientific finding
- SPI 3221.inq 2 - Analyze the components of a properly designed scientific investigation
- SPI 3221 Inq. 3 - Determine appropriate tools to gather precise and accurate data
- SPI 3221 Inq. 4 - Evaluate the accuracy and precision of data
- SPI 3221 Inq. 5 - Defend a conclusion based on scientific evidence
- SPI 3221 Inq.6 - Determine why a conclusion is free of bias
- SPI 3221 Inq.7 - Compare conclusions that offer different but acceptable explanations for the same set of data

**Embedded Technology & Engineering**
- SPI 3221.T/E.1 - Distinguish among tools and procedures best suited to conduct a specified scientific inquiry
- SPI 3221. T/E .2 - Evaluate a protocol to determine the degree to which an engineering design process was successfully applied.
- SPI 3221. T/E .3 - Evaluate the overall benefit to cost ratio of a new technology
- SPI 3221. T/E .4 - Use design principles to determine if a new technology will improve the quality of life for an intended audience

**Embedded Mathematics (Checks for Understanding)**
- 9 3221.Math.1 - Use a variety of appropriate notations (e.g., exponential, functional, square root).
- 9 3221.Math.2 - Select and apply appropriate methods for computing with real numbers and evaluate the reasonableness of the results.
- 9 3221.Math.3 - Apply algebraic properties, formulas, and relationships to perform operations on real-world problems (e.g., solve for density, determine the concentration of a solution in a variety of units: ppm, ppb, molarity, molality, and percent composition) calculate heats of reactions and phase changes, and manipulate gas law equations.
- 9 3221.Math.4 - Interpret rates of change from graphical and numerical data (e.g., phase diagrams, solubility graphs, colligative properties, nuclear decay or half-life).
- 9 3221.Math.5 - Analyze graphs to describe the behavior of functions (e.g., concentration of a solution, phase diagrams, solubility graphs, colligative properties, nuclear decay half-life).
## Chemistry, 2nd 4.5 weeks
### 2017-18

- **9 3221.Math.6** Model real-world phenomena using functions and graphs.
- **9 3221.Math.7** Apply and interpret algebraic properties in symbolic manipulation (e.g., density, concentration of a solution, chemical equations, effect of volume, temperature or pressure on behavior of a gas, percent composition of elements in a compound, molar mass, number of moles, and molar volume, amount of products or reactants given mole, molarity, volume at STP or mass amounts, heat loss or gain using mass, temperature change and specific heat, and half-life of an isotope).
- **9 3221.Math.8** Apply and communicate measurement units, concepts and relationships in algebraic problem-solving situations.
- **9 3221.Math.9** Select appropriate units, scales, and measurement tools for problem situations involving proportional reasoning and dimensional analysis.
- **9 3221.Math.10** Select, construct, and analyze appropriate graphical representations for a data set.
- **9 3221.Math.11** Identify and solve different types of stoichiometry problems (e.g., volume at STP to mass, moles to mass, molarity).
- **9 3221.Math.12** Calculate the amount of product expected in an experiment and determine percent yield.
- **9 3221.Math.13** Convert among the quantities of a substance: mass, number of moles, number of particles, molar volume at STP.

<table>
<thead>
<tr>
<th>TN Academic Standards</th>
<th>Student Friendly “I Can” Statements</th>
<th>Prerequisite Knowledge</th>
<th>ACT Readiness</th>
<th>Instructional Time</th>
<th>TN Ready Questions/Resources</th>
<th>ACT Questions/Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPI 3221.1.5</td>
<td>I can represent an electron's location in the quantum mechanical model of an atom in terms of the shape of electron clouds (s and p orbitals in particular), relative energies of orbitals, and the number of electrons possible in the s, p, d, and f orbitals.</td>
<td></td>
<td><strong>I0D01, EM102</strong></td>
<td>4 days</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** I0D01, EM102 represent specific resources or activities related to the learning objectives.
| SPI 3221.3.1 | Analyze ionic and covalent compounds in terms of their formation (electron transfer versus sharing), names, chemical formulas (e.g., molecular: H₂O, C₂O, NH₃; empirical: NaCl, CaBr₂, Al(NO₃)₃), percent composition, and molar masses. | I can explain the formation of anions and cations, and predict the charge of an ion formed by the main-group element. | EM101 | 7 days |
I can employ a table of polyvalent cations and polyatomic ions to name and describe the chemical formula of the ionic compound.

I can identify acids and bases based on their formula.
I can calculate pH and pOH.

<table>
<thead>
<tr>
<th>SPI 3221.3.7 Classify substances as acids or bases based on their formulas and how they react with litmus and phenolphthalein.</th>
<th>3 221.Math.1 Use a variety of appropriate notations (e.g., exponential, functional, square root).</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9 3221.Math.2 Select and apply appropriate methods for computing with real numbers and evaluate the reasonableness of the results.</td>
</tr>
<tr>
<td></td>
<td>9 3221.Math.3 Apply algebraic properties, formulas, and relationships to perform operations</td>
</tr>
<tr>
<td></td>
<td>3 Days</td>
</tr>
</tbody>
</table>
on real-world problems (e.g., solve for density, determine the concentration of a solution in a variety of units: ppm, ppb, molarity, molality, and percent composition) calculate heats of reactions and phase changes, and manipulate gas law equations.

9 3221.Math.8
Apply and communicate measurement units, concepts and relationships in algebraic problem-solving situations.

9 3221.Math.11
Identify and solve different types of stoichiometry problems (e.g., volume at STP to mass, moles to
<p>| SPI 3221.3.2 Determine the reactants, products, and types of different chemical reactions: composition, decomposition, double replacement, single replacement, combustion | I can identify the chemical reactants and products of a chemical reaction. I can identify the types of different chemical reactions. | EM102, IOD01 | 2 days | 3.2 Types of Chemical Reactions Lab (2) 3.2 Cartoon Chemistry Worksheet 3.2 Chemical Reactions Cheat Sheet 3.2 Classification of Chemical Reactions Worksheet (2) 3.2 Demos-Gummy Bear Sacrifice Old Foamy 3.2 Iron Oxidation Lab |</p>
<table>
<thead>
<tr>
<th>SPI 3221.3.4 Balance a chemical equation to determine molar ratios</th>
<th>I can use chemical equations to determine the molar ratio.</th>
<th>Least common multiples, basic algebra</th>
<th>3 days</th>
<th>3.4 Balancing Equations Worksheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 3221.Math.2 Select and apply appropriate methods for computing with real numbers and evaluate the reasonableness of the results.</td>
<td>9 3221.Math.7 Apply and interpret algebraic properties in symbolic manipulation (e.g., density, concentration of a solution, chemical equations, effect of volume, temperature or pressure on behavior of a gas, percent composition of elements in a compound, molar mass, number of</td>
<td>3.4 Writing and Balancing Chemical Equations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPI 3221.3.3</td>
<td>Predict the products of a chemical reaction (e.g., composition and decomposition of binary compounds).</td>
<td>I can use: ...the reactants of a chemical reaction, ...the periodic table patterns, ...an activity series (for single replacement), or</td>
<td>2 days</td>
<td>3.2, 3.3, &amp; 3.4 Reaction Packet</td>
</tr>
</tbody>
</table>
...a set of solubility rules (for double replacement)

I can predict the products of synthesis, decomposition, single displacement, double displacement, combustion and acid/base reactions.