### Graduation Competency: HS5

Students will understand and analyze forces, mass, motion, and interactions through scientific processes and practices.

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<th>Cross-Cutting Concepts</th>
<th>Number of Weeks</th>
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</table>
| **SPS8. Obtain, evaluate, and communicate information to explain the relationships among force, mass, and motion.** | - Obtaining, evaluating, and communicating information  
- Planning and carrying out investigations  
- Constructing explanations and designing solutions  
- Analyzing and interpreting data  
- Using mathematics and computational thinking | - Cause and effect  
- Systems and system models  
- Scale, Proportion and Quantity  
- Stability and Change  
- Patterns | 5 weeks  
Motion and Forces  
July 31 – Sept 1 |
| a. Plan and carry out an investigation to analyze the motion of an object using mathematical and graphical models. | (Clarification statement: Mathematical and graphical models could include distance, displacement, speed, velocity, time and acceleration.) | | |
| b. Construct an explanation based on experimental evidence to support the claims presented in Newton’s three laws of motion. | (Clarification statement: Evidence could demonstrate relationships among force, mass, velocity, and acceleration.) | | |
| c. Analyze and interpret data to identify the relationship between mass and gravitational force for falling objects. | | | |
| d. Use mathematics and computational thinking to identify the relationships between work, mechanical advantage, and simple machines. | | | |
Graduation Competency: **HS6**  Students will understand and analyze energy and the characteristics of waves as demonstrated through the integration of scientific practices.

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| SPS7. Obtain, evaluate, and communicate information to explain transformations and flow of energy within a system. | • Obtaining, evaluating and communicating information  
• Constructing explanations and designing solutions  
• Planning and carrying out investigations  
• Asking questions and identifying problems  
• Analyzing and interpreting data | • Systems and Systems Models  
• Energy and Matter  
• Structure and Function  
• Patterns | 4 weeks  
Energy  
Sept 5 – Oct 6 |
| a. Construct explanations for energy transformations within a system. (Clarification statement: Types of energy to be addressed include chemical, mechanical, electromagnetic, light, sound, thermal, electrical, and nuclear.) | | | |
| b. Plan and carry out investigations to describe how molecular motion relates to thermal energy changes in terms of conduction, convection, and radiation. | | | |
| c. Analyze and interpret specific heat data to justify the selection of a material for a practical application (e.g., insulators and cooking vessels). | | | |
| d. Analyze and interpret data to explain the flow of energy during phase changes using heating/cooling curves. | | | |
Graduation Competency: **HS6** Students will understand and analyze energy and the characteristics of waves as demonstrated through the integration of scientific practices.

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<tr>
<td><strong>SPS9. Obtain, evaluate, and communicate information to explain the properties of waves.</strong></td>
<td></td>
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<td>4 weeks</td>
</tr>
<tr>
<td>a. Analyze and interpret data to identify the relationships among wavelength, frequency, and energy in electromagnetic waves and amplitude and energy in mechanical waves.</td>
<td>• Obtaining, evaluating and communicating information</td>
<td>• Scale, Proportion and Quantity</td>
<td>Waves</td>
</tr>
<tr>
<td>b. Ask questions to compare and contrast the characteristics of electromagnetic and mechanical waves.</td>
<td>• Analyzing and interpreting data</td>
<td>• Energy and Matter</td>
<td>Oct 10 – Nov 3</td>
</tr>
<tr>
<td>c. Develop models based on experimental evidence that illustrate the phenomena of reflection, refraction, interference, and diffraction.</td>
<td>• Asking questions and defining problems</td>
<td>• Patterns</td>
<td></td>
</tr>
<tr>
<td>d. Analyze and interpret data to explain how different media affect the speed of sound and light waves.</td>
<td>• Developing and using models</td>
<td>• Cause and Effect</td>
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</tr>
<tr>
<td>e. Develop and use models to explain the changes in sound waves associated with the Doppler Effect.</td>
<td></td>
<td>• Systems and System Models</td>
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Graduation Competency: **HS6** Students will understand and analyze energy and the characteristics of waves as demonstrated through the integration of scientific practices.

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| SPS10. Obtain, evaluate, and communicate information to explain the properties of and relationships between electricity and magnetism. | • Obtaining, evaluating and communicating information  
• Using mathematics and computational thinking  
• Developing and using models  
• Planning and carrying out investigations | • Scale, Proportion and Quantity  
• Cause and Effect  
• Structure and Function | 4 weeks  
Electricity and Magnetism  
Nov 8 – Dec 8  
Midterm Review and Test  
Dec 11 – Dec 15 |
**Graduation Competency: HS7** Students will understand and analyze the structure and properties of atoms and matter through scientific processes and practices.

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| **SPS5. Obtain, evaluate, and communicate information to compare and contrast the phases of matter as they relate to atomic and molecular motion.** | • Obtaining, evaluating and communicating information  
• Asking questions and defining problems  
• Planning and carrying out investigations | • Energy and Matter  
• Patterns  
• Cause and Effect  
• Systems and System Models | 1 week, 3 days  
Matter  
Jan 9 – Jan 19 |

a. Ask questions to compare and contrast models depicting the particle arrangement and motion in solids, liquids, gases, and plasmas.

b. Plan and carry out investigations to identify the relationships among temperature, pressure, volume, and density of gases in closed systems.

(Clarification statement: Using specific Gas laws to perform calculations is beyond the scope of this standard; emphasis should focus on the conceptual understanding of the behavior of gases rather than calculations.)
**Graduation Competency: HS7**  Students will understand and analyze the structure and properties of atoms and matter through scientific processes and practices.

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| **SPS1. Obtain, evaluate, and communicate information from the Periodic Table to explain the relative properties of elements based on patterns of atomic structure.** | • Obtaining, evaluating and communicating information  
• Developing and using models  
• Analyzing and interpreting data                                                               | • Patterns  
• Scale, Proportion and Quantity  
• Matter and Energy                                                                         | 2 weeks  
Atoms and Periodic Table  
Jan 22 – Feb 2 |
| a. Develop and use models to compare and contrast the structure of atoms, ions and isotopes.  
(Clarification statement: Properties include atomic number, atomic mass and the location and charge of subatomic particles.) |                                                                                                       |                                   |                             |
| b. Analyze and interpret data to determine trends of the following:  
• Number of valence electrons  
• Types of ions formed by main group elements  
• Location and properties of metals, nonmetals, and metalloids  
• Phases at room temperature |                                                                                                       |                                   |                             |
| c. Use the Periodic Table as a model to predict the above properties of main group elements. |                                                                                                       |                                   |                             |
**Graduation Competency HS8:** Students will understand and analyze reactions and interactions of matter through scientific processes and practices.

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| **SPS2. Obtain, evaluate, and communicate information to explain how atoms bond to form stable compounds.** | • Obtaining, evaluating and communicating information  
• Analyzing and interpreting data  
• Developing and using models | • Structure and Function  
• Stability and Change  
• Patterns | 2 weeks  
Chemical Bonding  
Feb 5 – Feb 16 |
| a. Analyze and interpret data to predict properties of ionic and covalent compounds.  
( Clarification statement: Properties are limited to types of bonds formed, elemental composition, melting point, boiling point, and conductivity. ) |  |  |  |
| b. Develop and use models to predict formulas for stable, binary ionic compounds based on balance of charges. |  |  |  |
| c. Use the International Union of Pure and Applied Chemistry (IUPAC) nomenclature for translating between chemical names and chemical formulas.  
( Clarification statement: Limited to binary covalent and binary ionic, containing main group elements, compounds but excludes polyatomic ions. ) |  |  |  |
**Graduation Competency HS8:** Students will understand and analyze reactions and interactions of matter through scientific processes and practices.

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| SPS3. Obtain, evaluate, and communicate information to support the Law of Conservation of Matter. | - Obtaining, evaluating and communicating information  
- Planning and carrying out investigations  
- Developing and using models | - Energy and Matter  
- Cause and Effect  
- Scale, Proportion and Quantity  
- Patterns | 2 weeks, 3 days  
Chemical Reactions  
Feb 27 – Mar 16 |
| a. Plan and carry out investigations to generate evidence supporting the claim that mass is conserved during a chemical reaction.  
(Clarification statement: Limited to synthesis, decomposition, single replacement, and double replacement reactions.) | | | |
| b. Develop and use a model of a chemical equation to illustrate how the total number of atoms is conserved during a chemical reaction.  
(Clarification statement: Limited to chemical equations that include binary ionic and covalent compounds and will not include equations containing polyatomic ions.) | | | |
**Graduation Competency HS8:** Students will understand and analyze reactions and interactions of matter through scientific processes and practices.

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<td>SPS6. Obtain, evaluate, and communicate information to explain the properties of solutions.</td>
<td>- Obtaining, evaluating and communication information</td>
<td>- Cause and Effect</td>
<td>3 weeks</td>
</tr>
<tr>
<td>a. Develop and use models to explain the properties (solute/solvent, conductivity, and concentration) of solutions.</td>
<td>- Developing and using models</td>
<td>- Stability and Change</td>
<td>Acids, Bases and Solutions</td>
</tr>
<tr>
<td>b. Plan and carry out investigations to determine how temperature, surface area, and agitation affect the rate solutes dissolve in a specific solvent.</td>
<td>- Analyzing and interpreting data</td>
<td>- Patterns</td>
<td>Mar 19 – Mar 30</td>
</tr>
<tr>
<td>c. Analyze and interpret data from a solubility curve to determine the effect of temperature on solubility.</td>
<td>- Planning and carrying out investigations</td>
<td>- Scale, Proportion and Quantity</td>
<td>Apr 9 – Apr 13</td>
</tr>
<tr>
<td>d. Obtain and communicate information to explain the relationship between the structure and properties (e.g., pH, and color change in the presence of an indicator) of acids and bases.</td>
<td></td>
<td>- Structure and Function</td>
<td></td>
</tr>
<tr>
<td>(Clarification statement: Limited to only the structure of simple acids and bases (e.g., HCl and NaOH) that demonstrates the presence of an H+ or OH-.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. Plan and carry out investigations to detect patterns in order to classify common household substances as acidic, basic, or neutral.</td>
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| SPS4. Obtain, evaluate, and communicate information to explain the changes in nuclear structure as a result of fission, fusion and radioactive decay. | • Obtaining, evaluating and communicating information  
• Developing and using models  
• Using mathematics and computational thinking  
• Constructing arguments from evidence | • Structure and Function  
• Cause and Effect  
• Patterns  
• Stability and Change  
• Energy and Matter | 2 weeks |
| a. Develop a model that illustrates how the nucleus changes as a result of fission and fusion. | | | Nuclear Chemistry  
Apr 16 – Apr 27 |
| b. Use mathematics and computational thinking to explain the process of half-life as it relates to radioactive decay. | | | Flex Weeks and Milestones Testing  
Apr 30 – May 18 |
| (Clarification statement: Limited to calculations that include whole half-lives.) | | | Final Projects and Exams  
May 21 – May 25 |
| c. Construct arguments based on evidence about the applications, benefits, and problems of nuclear energy as an alternative energy source. | | | |