Glen Ridge Board of Education
Science
Chemistry-Honors
Required
Full Year

New Jersey Student Learning Standards

Written by: Robert Booth
**Science Mission Statement:**

The Glen Ridge Public School's science curriculum seeks to inspire scientifically-literate citizens who will be able to participate in a dynamic global community. Our program fosters a spirit of intellectual curiosity and collaborative problem solving that is innovative, experiential, thought-provoking, and developmentally appropriate. Our students will use scientific methodology to evaluate and critique global issues relating to Life Sciences, Physical Sciences, The Sciences of Earth & Space, and Engineering Sciences. Students will be challenged and will be encouraged to take risks and develop critical scientific thinking skills.

**Course Description:**

<table>
<thead>
<tr>
<th>Honors Chemistry</th>
<th>Unit 1: Matter and Measurement</th>
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</thead>
<tbody>
<tr>
<td><strong>Time Allotted (days of instruction):</strong> 15 days</td>
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<tr>
<td><strong>New Jersey Student Learning Standards (NJSLS)</strong></td>
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<tr>
<td>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-PS1-3)</td>
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<td>Use mathematical representations of phenomena to support claims. (HS-PS1-7)</td>
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<td>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 (tradeoffs) may be needed. (secondary to HS-PS1-6)</td>
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<td>Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (HS-PS2-1)</td>
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| ● What are the uses and differences between common pieces of laboratory glassware?  
● What is the difference between precision and accuracy?  
● What purpose does using “significant figures” in calculations involving measurements serve?  
● How are conversion factors used to convert between different units of measurement? | ● Describe the uses of a beaker, graduated cylinder, Erlenmeyer flask, and an analytical balance.  
● Define precision and accuracy, and clearly state how they are different.  
● Identify the number of significant figures in a single measurement.  
● Apply knowledge of significant figures to mathematical operations (addition, subtraction, multiplication, and | ● Observe a series of chemical reactions in the lab and make qualitative observations with the intent of synthesizing a full-length lab report.  
● Experimentally determine the density of an unknown metal using the method of water displacement and graphical analysis in Google Sheets.  
● Manipulate differences in physical properties of individual components in a mixture to separate the mixture and quantify the components. |
- Apply conversion factors to convert between units of the same type of measurement.

### Resources/Materials
- Online Notes: National Math + Science Initiative (NMSI)

### Interdisciplinary Connections
- **MP.2** Reason abstractly and quantitatively. (HS-PS1-5),(HS-PS1-7)
- **MP.4** Model with mathematics. (HS-PS1-4),(HS-PS1-8)
- **HSN-Q.A.1** 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. (HS-PS1-2),(HS-PS1-3),(HS-PS1-4),(HS-PS1-5),(HS-PS1-7),(HS-PS1-8)
- **HSN-Q.A.2** Define appropriate quantities for the purpose of descriptive modeling. (HS-PS1-4),(HS-PS1-7),(HS-PS1-8)
- **HSN-Q.A.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-PS1-2),(HS-PS1-3),(HS-PS1-4),(HS-PS1-5),(HS-PS1-7),(HS-PS1-8)
- **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.
- **WHST.9-12.2** Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
- **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 the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
- **HSF-IF.C.7** Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
- **SL.11-12.5** 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.

### 21st Century Life and Careers
9.3.HL.1 Determine academic subject matter, in addition to high school graduation requirements, necessary for pursuing a health science career.
9.3.ST-SM.2 Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.

### Technology Standards
8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

### Assessments

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**Lab assessments**
- Lab assessments
- Group discussion
- Lab reports
- Section quizzes
- Group presentation

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### Honors Chemistry

#### Unit 2: History of the Atom and Atomic Structure

**Time Allotted (days of instruction):** 14 days

**New Jersey Student Learning Standards (NJSLS)**

- Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1)
- 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-PS1-1),(HS-PS1-2)
- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3),(secondary to HS-PS2-6)
- 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)
Newton’s law of universal gravitation and Coulomb’s law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. (HS-PS2-4)

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. (HSPS3-1),(HS-PS3-2)

When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells. (HS-PS4-4)

Photoelectric materials emit electrons when they absorb light of a high-enough frequency. (HS-PS4-5)

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| ● What three subatomic particles comprise all atoms, and where in the atom are they found?  
● How are the average atomic masses found on the periodic table calculated?  
● How were the different parts of the atom discovered? | ● Define the properties of protons, neutrons, and electrons.  
● Calculate a weighted average using individual isotopes masses and their percent abundance.  
● Describe the process by which the electron was discovered by J.J. Thomson.  
● Describe the process by which the nucleus was discovered by Ernest Rutherford. | ● Use paper chromatography to separate the dyes in a food-coloring mixture.  
● Experimentally determine the mass percent of water in a hydrated compound.  
● Calculate the weighted average mass of different types of beans in a designated container. |

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purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.

*HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

*SL.11-12.5 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.

21st Century Life and Careers

9.3.HL.1 Determine academic subject matter, in addition to high school graduation requirements, necessary for pursuing a health science career.

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Technology Standards

8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

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### Modifications

- Use of Google translate and/or dictionary
- Diagrams/labeling in alternate language
- Provide correction for language errors by modeling, not overt correction
- Verbal testing for written assessments
- Providing texts in native language if possible
- Use of Graphic Organizers; scaffolding
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- Break up multi-step instructions by providing space between questions
- Allow assessments to be typed
- Prompts – mnemonics, graphic organizers, color coding, cue cards, pictures
- Additional response time during

- Interview someone in the field of research and development, academia, engineering, or medicine and write a report on that career
Essential Questions

- How does light emission occur, and how is the corresponding energy of the emission process calculated?
- What is Coulomb’s Law?
- How did the Bohr model of the atom improve upon Rutherford’s nuclear model?

Student Learning Objectives

- Explain particle-wave duality and calculate properties such as energy, frequency, and wavelength of photon emission.
- Explain the relevance of Coulomb’s Law to electronic structure.
- Describe the processes of absorption and emission.

Activities

- Use flame tests to identify an unknown compound.
- Conservation of mass activity
- Experimentally determine the mass percent of oxygen in a sample of magnesium oxide.
## Interdisciplinary Connections

- **MP.2** Reason abstractly and quantitatively. (HS-PS1-5), (HS-PS1-7)
- **MP.4** Model with mathematics. (HS-PS1-4), (HS-PS1-8)
- **HSN-Q.A.1** 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. (HS-PS1-2), (HS-PS1-3), (HS-PS1-4), (HS-PS1-5), (HS-PS1-7), (HS-PS1-8)
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- **HSF-IF.C.7** Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
- **SL.11-12.5** 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.

## 21st Century Life and Careers

- **9.3.HL.1** Determine academic subject matter, in addition to high school graduation requirements, necessary for pursuing a health science career.
- **9.3.ST-SM.2** Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.

## Technology Standards

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## Modifications
### Honors Chemistry

**Unit 4: Periodic Trends**

**Time Allotted (days of instruction): 13 days**

**New Jersey Student Learning Standards (NJSLS)**

- Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1)
- 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-PS1-1), (HS-PS1-2)
- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3), (secondary to HS-PS2-6)
- 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)
- Newton’s law of universal gravitation and Coulomb’s law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. (HS-PS2-4)
- 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. (HPS3-1), (HS-PS3-2)
- When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength
Electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms and cause damage to living cells. (HS-PS4-4)

Photoelectric materials emit electrons when they absorb light of a high-enough frequency. (HS-PS4-5)

### Essential Questions
- How is the periodic table organized with respect to atomic radius, electronegativity, ionization energy, and electron affinity?
- Why are periodic trends heavily influenced by Coulomb’s Law?

### Student Learning Objectives
- Define atomic radius, electronegativity, ionization energy, electron affinity, and ionic radius.
- Compare groups of elements in terms of increasing/decreasing atomic radius, electronegativity, ionization energy, electron affinity, and/or ionic radius.
- Relate each individual periodic trend to Coulomb’s Law.

### Activities
- Research the atomic radius, electronegativity, and ionization energy of the first three rows of elements on the periodic table, and then graph the data using Google Sheets and use the provided data to answer questions.
- Experimentally determine the order of reactivity of a series of common metals.

### Resources/Materials
- Online Notes: National Math + Science Initiative (NMSI)

### Interdisciplinary Connections
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- HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
- SL.11-12.5 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.

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## Unit 5: Compounds and Chemical Nomenclature

### Time Allotted (days of instruction): 14 days

### New Jersey Student Learning Standards (NJSLS)

| 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. (HSPS1-4),(HS-PS1-5) |
| The total amount of energy and matter in closed systems is conserved. (HS-PS1-7) |
| 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) |
| Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6) |
| 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. (HS-PS2-6),(secondary to HS-PS1-1),(secondary to HS-PS1-3) |
| 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. (HSPS3-1),(HS-PS3-2) |
| At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HSPS3-2) (HS-PS3-3) |
| 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) |
| 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). (HS-PS3-4) |

### Essential Questions

| **What are the differences between ionic and covalent compounds in structure and name?** |
| **Why are ionic compounds containing transition metals named differently than ionic compounds without transition metals?** |
| **How can a chemical formula be written from a name?** |

### Student Learning Objectives

| **Provide the chemical formula of a compound from its name.** |
| **Provide the name of a compound from its chemical formula.** |

### Activities

| Polyatomic ion research activity. |
| Experimentally determine the effect of surface area of solid reactants on reaction rate. |
| Summary of nomenclature assignment |

### Resources/Materials

| Online Notes: National Math + Science Initiative (NMSI) |

### Interdisciplinary Connections

| *MP.2 Reason abstractly and quantitatively. (HS-PS1-5),(HS-PS1-7)* |
| *MP.4 Model with mathematics. (HS-PS1-4),(HS-PS1-8)* |
| *HSN-Q.A.1 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. (HS-PS1-2),(HS-PS1-3),(HS-PS1-4),(HS-PS1-5),(HS-PS1-7),(HS-PS1-8)* |
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*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.

*WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

*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 the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.

*HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

*SL.11-12.5 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.

21st Century Life and Careers

9.3.HL.1 Determine academic subject matter, in addition to high school graduation requirements, necessary for pursuing a health science career.

9.3.ST-SM.2 Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.

Technology Standards

8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

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| ● Use of Google translate and/or dictionary  
● Diagrams/labeling in alternate language  
● Provide correction for language errors by modeling, not overt correction  
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● Extended time  
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● Provide notes/study guides  
● Oral and visual instructions  
● At teacher discretion, shorten assignment to | ● Interview someone in the field of research and development, academia, engineering, or medicine and write a report on that career |
### Honors Chemistry

#### Unit 6: The Mole

**Time Allotted (days of instruction):** 15 days

**New Jersey Student Learning Standards (NJSLHS)**

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. (HPS1-4),(HS-PS1-5)

The total amount of energy and matter in closed systems is conserved. (HS-PS1-7)

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)

Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6)

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. (HS-PS2-6),(secondary to HS-PS1-1),(secondary to HS-PS1-3)

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. (HPS3-1),(HS-PS3-2)

At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HPS3-2) (HS-PS3-3)

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)

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). (HS-PS3-4)

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<td>● What is a “mole” in the context of chemistry and measurement?</td>
<td>● Define the term “mole” as it pertains to chemistry.</td>
<td>● Experimentally determine the effect of temperature on reaction rate.</td>
</tr>
<tr>
<td>● What is Avogadro’s Number, and what</td>
<td>● Explain what Avogadro’s Number</td>
<td>● Identify differences in the physical properties of</td>
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</table>

- Use of Graphic Organizers; scaffolding
- Make lessons visual.
- Cooperative and partner activities.
- Give students a job in a group. Monitor that they are participating.
- Focus on mastery of key concepts
- Provide alternative testing site
- Break up multi-step instructions by providing space between questions
- Allow assessments to be typed
- Prompts – mnemonics, graphic organizers, color coding, cue cards, pictures
- Additional response time during discussions/tasks
- Provide frequent breaks/time out opportunities
- Provide immediate reinforcements/consequences
does it signify?
• How can the periodic table be used to convert between grams, moles, and molecules of a substance?

represents.
• Use the periodic table to convert between grams, moles, and molecules of a substance.

metals, nonmetals, and metalloids.

Resources/Materials
• Online Notes: National Math + Science Initiative (NMSI)

Interdisciplinary Connections
*MP.2 Reason abstractly and quantitatively. (HS-PS1-5), (HS-PS1-7)*
*MP.4 Model with mathematics. (HS-PS1-4), (HS-PS1-8)*
*HSN-Q.A.1 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. (HS-PS1-2), (HS-PS1-3), (HS-PS1-4), (HS-PS1-5), (HS-PS1-7), (HS-PS1-8)*
*HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. (HS-PS1-4), (HS-PS1-7), (HS-PS1-8)*
*HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-PS1-2), (HS-PS1-3), (HS-PS1-4), (HS-PS1-5), (HS-PS1-7), (HS-PS1-8)*
*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.*
*WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.*
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*HSF-IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*
*SL.11-12.5 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.*

21st Century Life and Careers
9.3.HL.1 Determine academic subject matter, in addition to high school graduation requirements, necessary for pursuing a health science career.
9.3.ST-SM.2 Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.

Technology Standards
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<td>● Homework check</td>
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<td>● Lecture questions</td>
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- Use of Google translate and/or dictionary
- Diagrams/labeling in alternate language
- Provide correction for language errors by modeling, not overt correction
- Verbal testing for written assessments
- Providing texts in native language if possible
- Use of Graphic Organizers; scaffolding
- Make lessons visual.
- Cooperative and partner activities.
- Give students a job in a group. Monitor that they are participating

- Test/Quiz modifications
- Extended time
- Benchmark larger assignments
- Preferential seating
- Provide notes/study guides
- Oral and visual instructions
- At teacher discretion, shorten assignment to focus on mastery of key concepts
- Provide alternative testing site
- Break up multi-step instructions by providing space between questions
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- Provide frequent breaks/time out opportunities
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- Interview someone in the field of research and development, academia, engineering, or medicine and write a report on that career

---

**Honors Chemistry**

**Unit 7: Chemical Reactions**

**Time Allotted (days of instruction): 12 days**

**New Jersey Student Learning Standards (NJSLS)**

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. (HSPS1-4),(HS-PS1-5)

The total amount of energy and matter in closed systems is conserved. (HS-PS1-7)

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)

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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. (HS-PS2-6),(secondary to HS-PS1-1),(secondary to HS-PS1-3)

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. (HSPS3-1),(HS-PS3-2)

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<td>● What are reactants and products?</td>
<td>● Explain the difference between a reactant and a product.</td>
<td>● Experimentally determine the empirical formula of a compound comprised of magnesium and chlorine.</td>
</tr>
<tr>
<td>● Why does a chemical reaction need to be “balanced?”</td>
<td>● Explain that a chemical reaction must be balanced in order to obey the law of conservation of matter.</td>
<td></td>
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<tr>
<td>● What are the 5 fundamental types of chemical reactions?</td>
<td>● Define and know how to identify synthesis, decomposition, combustion, single replacement, and double replacement reactions.</td>
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<tr>
<td>● How can the chemical formulas of the products be predicted from the identities of the reactants?</td>
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Resources/Materials

- Online Notes: National Math + Science Initiative (NMSI)

Interdisciplinary Connections

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**21st Century Life and Careers**

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- Interview someone in the field of research and development, academia, engineering, or medicine and write a report on that career

*SL.11-12.5 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.*
Time Allotted (days of instruction): 15 days

New Jersey Student Learning Standards (NJSLS)

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. (HSPS1-4),(HS-PS1-5)

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<td>● What is meant by “stoichiometry?”</td>
<td>● Define stoichiometry and relate stoichiometry to everyday life.</td>
<td>● Predict the mass of copper metal that can be precipitated from the reaction between copper (II) chloride solution and aluminum foil.</td>
</tr>
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<td>● How are balanced chemical reactions used to convert between amounts of reactants/products?</td>
<td>● Describe the 3-step process by which stoichiometry is used to convert between amounts of reactants/products.</td>
<td>● Determine the limiting reactant in a reaction between hydrochloric acid and baking soda.</td>
</tr>
<tr>
<td>● What is enthalpy?</td>
<td>● Define “enthalpy.”</td>
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<tr>
<td>● What is the difference between an exothermic process and an endothermic process?</td>
<td>● Identify a chemical reaction as exothermic or endothermic.</td>
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<tr>
<td>● How is stoichiometry used to determine the amount of energy as heat that is absorbed or released by a chemical process?</td>
<td>● Use stoichiometry and the standard enthalpy of a reaction to calculate the amount of energy as heat that is absorbed or released by a reaction.</td>
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Resources/Materials

| Interdisciplinary Connections | *MP.2 Reason abstractly and quantitatively. (HS-PS1-5),(HS-PS1-7)  
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| **21st Century Life and Careers** | 9.3.HL.1 Determine academic subject matter, in addition to high school graduation requirements, necessary for pursuing a health science career.  
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**Honors Chemistry**

**Unit 9: Solutions and Reactions in Aqueous Solution**

**Time Allotted (days of instruction):** 15 days

**New Jersey Student Learning Standards (NJSLS)**

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.

(HSPS1-4),(HS-PS1-5)

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| ● What are the three steps of solution formation?  
● What is enthalpy?  
● Which steps of solution formation are exothermic/endothermic?  
● How can a solution form even when it is enthalpically unfavorable to do so?  
● What is entropy?  
● How are oxidation states of elements in a compound assigned?  
● How is a chemical reaction classified as oxidation-reduction, acid-base, or precipitation?  
● How is the molarity of a solution calculated? | ● Outline the three steps of solution formation, and explain why each step is exothermic or endothermic.  
● Define enthalpy and entropy, and explain the relevance of each term to solution formation.  
● Assign oxidation states to elements in a compound.  
● Identify chemical reactions as acid-base, oxidation-reduction, or precipitation.  
● Use the molarity equation to calculate various solution characteristics. | ● Perform an oxidation-reduction titration of hydrogen peroxide in order to experimentally determine its concentration. |

**Resources/Materials**

- Online Notes: National Math + Science Initiative (NMSI)

**Interdisciplinary Connections**

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- *MP.4 Model with mathematics. (HS-PS1-4),(HS-PS1-8)*
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- Provide frequent breaks/time out
- Interview someone in the field of research and development, academia, engineering, or medicine and write a report on that career
### Honors Chemistry

#### Unit 10: Acids and Bases

**Time Allotted (days of instruction):** 10 days

**New Jersey Student Learning Standards (NJSLS):**

- Use a model to predict the relationships between systems or between components of a system. (HS-PS1-1)
- Use mathematical representations of phenomena to support claims. (HS-PS1-7)
- Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. (HS-PS1-5)
- 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)
- 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 (tradeoffs) may be needed. (secondary to HS-PS1-6)
- Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6)
- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined. (HS-PS2-2)

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| ● What is the difference between strong and weak acids?  
● How is the pH of a weak acid/base mixture calculated at different points in a titration? | ● Explain the difference between strong and weak acids within the context of chemical equilibrium.  
● Explain how the pH of a weak acid/base mixture is calculated at any point in a titration. | ● Use Google Sheets to construct a pH curve for an acid-base titration.  
● Use acid-base titrations to determine the unknown concentration of various store-bought products. |

**Resources/Materials:**

- Online Notes: National Math + Science Initiative (NMSI)

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- Provide frequent breaks/time out opportunities
- Provide immediate reinforcements/consequences

| Time Allotted (days of instruction): 10 days |
| New Jersey Student Learning Standards (NJSLS) |

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. (HSPS1-4),(HS-PS1-5)

The total amount of energy and matter in closed systems is conserved. (HS-PS1-7)

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)

Much of science deals with constructing explanations of how things change and how they remain stable. (HS-PS1-6)

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. (HS-PS2-6),(secondary to HS-PS1-1),(secondary to HS-PS1-3)

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. (HSPS3-1),(HS-PS3-2)

At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HSPS3-2) (HS-PS3-3)

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)

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). (HS-PS3-4)

| Essential Questions | Student Learning Objectives | Activities |
- Define pressure and temperature.
- How are pressure, temperature, volume, and moles of gas related by simple gas laws?
- How is the ideal gas law different from the simple gas laws?
- What is meant by an “ideal” gas?
- How can stoichiometry be applied to gases in chemical reactions?

- Define the terms pressure and temperature.
- Know the simple gas laws by which the four properties of gases are related, and whether a pair of properties exhibits a direct or inverse relationship.
- Use the ideal gas law to calculate a specific property of a gas, given some set of conditions.
- Explain that the word “ideal” provides a model to simplify chemical systems.

**Resources/Materials**

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### Honors Chemistry

**Unit 12: Chemical Bonding and Intermolecular Forces**

**Time Allotted (days of instruction): 7 days**

**New Jersey Student Learning Standards (NJSLS)**

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)

The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (secondary to HS-PS2-6)

Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-4), (HS-PS1-8)

Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. (HS-PS2-6)

### Student Learning Objectives

- Why are valence electrons the only electrons involved in forming chemical bonds?
- What is the process for drawing a Lewis structure for an ionic compound?
- What is the process for drawing a Lewis structure for a covalent compound?
- If there are two Lewis structures drawn for the same molecule, which structure is the most stable?
- What is formal charge?
- What is resonance?
- What is hybridization?
- What is Valence Shell Electron Pair Repulsion (VSEPR) theory, and how is it used to determine three-dimensional molecular geometry?
- Explain, using Coulomb’s Law, why valence electrons, rather than core electrons, are involved in chemical bonding.
- Cite the differences between ionic and covalent compounds with respect to valence electron behavior.
- Draw Lewis structures for a variety of ionic and covalent compounds.
- Use the concepts of formal charge and resonance to determine the most stable Lewis structure for a covalent compound, where multiple Lewis structures are possible.
- Use VSEPR to determine the three-dimensional geometry of a molecule.

### Activities

- Construct molecular models in class using modeling kits and computer simulations.
- Determine the percentage of water in a hydrated compound via experimental methods in lab.
- Explore the meaning and uses of gravimetric analysis for compound determination in lab.

### Resources/Materials

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