<table>
<thead>
<tr>
<th>Unit Plan 1</th>
<th>Quantitative and Structural Aspects of Matter</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 weeks</td>
<td></td>
</tr>
<tr>
<td>Unit Plan 2</td>
<td>The Language of Chemistry and Chemical Quantities</td>
</tr>
<tr>
<td>10 weeks</td>
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<tr>
<td>Unit Plan 3</td>
<td>Chemical Periodicity and Bonding</td>
</tr>
<tr>
<td>10 weeks</td>
<td></td>
</tr>
<tr>
<td>Unit Plan 4</td>
<td>States of Matter</td>
</tr>
<tr>
<td>5 weeks</td>
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<tr>
<td>Unit Plan 5</td>
<td>Aqueous Solutions</td>
</tr>
<tr>
<td>5 weeks</td>
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</tr>
</tbody>
</table>

Date Created: 2/14/11  Date Revised: June 2018  Board Approved on: August 2018
# Unit Overview

10 weeks

(Marking Period 1)

<table>
<thead>
<tr>
<th>Content Area: Chemistry Unit 1</th>
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<tbody>
<tr>
<td><strong>Unit Title:</strong> Quantitative and Structural Aspects of Matter</td>
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<tr>
<td><strong>Target Course/Grade Level:</strong> 10-12</td>
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</tbody>
</table>

**Unit Summary**

This unit is designed to give students a clear understanding of how scientific thought and quantitative skills are applied to the classification of matter.

**Primary interdisciplinary connections:**
Science, Social Studies, Mathematics, Technology, Visual and Performing Arts

Social Studies Standards
Mathematics Standards
Technology Standards
Visual and Performing Art Standards

RST.9-10.4. 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 10-12 texts and topics.

RST.9-10.5. Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).

RST.9-10.7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

**Technology Connections:** Understand and use technology systems, select and use applications effectively and productively, and exhibit digital citizenship by practicing safe, legal, and responsible use of information and technology.

8.2.12.E.1 Demonstrate an understanding of the problem-solving capacity of computers in our world.

8.1.12.F.1 Critical Thinking, Problem Solving, Decision Making Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.
21st Century Themes / Careers including: critical thinking, problem solving, creativity, innovation, collaboration, teamwork and leadership, cross-cultural understanding, global awareness, civic literacy, and interpersonal communication.

9.1.12.A.1 Apply critical thinking and problem-solving strategies during structured learning experiences.
9.4.12A.16 Employ critical thinking skills independently and in teams to solve problems and make decisions, (e.g., analyze, synthesize, and evaluate).
9.4.12A.17 Employ critical thinking and interpersonal skills to resolve conflicts.

Students will also be exposed to Career Ready Practices which describe the career-ready skills that all educators in all content areas should seek to develop in their students. They are practices that have been linked to increase college, career, and life success.

- CRP1. Act as a responsible and contributing citizen and employee.
- CRP2. Apply appropriate academic and technical skills.
- CRP3. Attend to personal health and financial well-being.
- CRP4. Communicate clearly and effectively and with reason.
- CRP5. Consider the environmental, social and economic impacts of decisions.
- CRP6. Demonstrate creativity and innovation.
- CRP7. Employ valid and reliable research strategies.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP9. Model integrity, ethical leadership and effective management.
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- CRP11. Use technology to enhance productivity.
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<th>Code</th>
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<tr>
<td>HS-ETS1-2</td>
<td>Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</td>
</tr>
<tr>
<td>HS-ETS1-3</td>
<td>Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.</td>
</tr>
<tr>
<td>HS-PS1-1</td>
<td>Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms</td>
</tr>
<tr>
<td>HS-PS1-3</td>
<td>Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.</td>
</tr>
<tr>
<td>HS-PS1-8</td>
<td>Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.</td>
</tr>
</tbody>
</table>

**Unit Essential Questions**

- How is chemistry a quantitative and qualitative study of matter?
- Why do we study the atom?
- How has the model for the structure of the atom evolved?

**Disciplinary Core Ideas**

*Students will demonstrate understanding of:*

**ETS1.A: Defining and Delimiting Engineering Problems**

Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (HS-ETS1-1)

Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. (HS-ETS1-1)

**ETS1.B: Developing Possible Solutions**

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

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

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

Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (HS-ETS1-2)

**PS1.A: Structure and Properties of Matter**

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)

A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4)

**PS1.B: Chemical Reactions**

Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond
energies in the set of molecules that are matched by changes in
kinetic energy. (HS-PS1-4),(HS-PS1-5)

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)
The fact that atoms are conserved, together with knowledge of
the chemical properties of the elements involved, can be used
to describe and predict chemical reactions. (HS-PS1-2),(HS-
PS1-7)

**PS1.C: Nuclear Processes**

Nuclear processes, including fusion, fission, and radioactive
decays of unstable nuclei, involve release or absorption of
energy. The total number of neutrons plus protons does not
change in any nuclear process. (HS-PS1-8)

<table>
<thead>
<tr>
<th><strong>Unit Objectives</strong></th>
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</tr>
</thead>
<tbody>
<tr>
<td><em>Students will know...</em></td>
<td><em>Students who demonstrate understanding can...</em></td>
</tr>
<tr>
<td>• Vocabulary and key terms</td>
<td>• Use the metric system</td>
</tr>
<tr>
<td>• Procedures at the core of scientific methodology</td>
<td>• Make temperature conversions</td>
</tr>
<tr>
<td>• Laboratory Safety procedures</td>
<td>• Recognize that density is a physical property and solve density problems</td>
</tr>
<tr>
<td>• Essential laboratory equipment</td>
<td>• Solve problems in scientific notation</td>
</tr>
<tr>
<td>• The difference between qualitative and quantitative measurements</td>
<td>• Distinguish between accuracy and precision</td>
</tr>
<tr>
<td>• How to convert measurements to scientific notation</td>
<td>• Calculate percent error</td>
</tr>
<tr>
<td>• Error analysis</td>
<td>• Use analytical equipment</td>
</tr>
<tr>
<td>• How to classify matter</td>
<td>• Practice safe lab habits</td>
</tr>
<tr>
<td>• How to distinguish between chemical and physical properties</td>
<td>• Define the nature of chemistry, matter, and energy</td>
</tr>
<tr>
<td>• How to distinguish between chemical and physical changes</td>
<td>• Classify matter</td>
</tr>
<tr>
<td>• How to use chemical symbols</td>
<td>• Use chemical symbols</td>
</tr>
<tr>
<td>• The historical development of the atom</td>
<td>• Use the symbols of the elements</td>
</tr>
<tr>
<td>• Atomic Structure</td>
<td>• Recognize changes in matter</td>
</tr>
<tr>
<td></td>
<td>• Describe an atom and its structure</td>
</tr>
<tr>
<td></td>
<td>• Trace the historical development of the atomic model (Dalton, Thomson, Rutherford, and Bohr)</td>
</tr>
<tr>
<td></td>
<td>• Know the significance of isotopes</td>
</tr>
</tbody>
</table>
Formative Assessments
For additional ideas please refer to http://nextgenscience.org/overview-topics
- Observation
- Homework
- Class participation
- Writing Assignments
- Do Now
- Concept map
- Lab reports
- Notebook

Summative Assessments:
For additional ideas please refer to http://nextgenscience.org/overview-topics
- Chapter/Unit Test
- Presentations/Projects
- Laboratory Practicals
- Quarterly Exams
- SGO

Benchmark Assessments:
- Quarterlies
- SGO
- NJS LA-S (Science Assessment)

Alternative Assessment:
- Projects
- Participation
- Modified Assignment

Modifications (ELLs)
- Teacher tutoring
- Peer tutoring
- Cooperative Learning Groups
- Differentiated Instruction
- Response to Intervention (RTI) www.help4teachers.com and www.docstoc.com,
  (search tiered lesson plan template
- Follow all IEP modifications/504 plan

Modifications (Special Education)
- Teacher tutoring
- Peer tutoring
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- Differentiated Instruction
- Response to Intervention (RTI) www.help4teachers.com and www.docstoc.com,
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Modifications (504)
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Follow all IEP modifications/504 plan

Modifications (Gifted and Talented)
• Teacher tutoring
• Peer tutoring
• Cooperative Learning Groups
• Differentiated Instruction

Curriculum development Resources/Instructional Materials/Equipment Needed Teacher Resources:
• Teacher Notes
• Textbook
• Laboratory Manuals and Equipment
• Science Websites

General Chemistry:
http://portal.acs.org/portal/acs/corg/content American Chemical Society
http://www.rsc.org/ royal chemical society
http://www.flinnsci.com/ Flinn Scientific

Testing:
http://www.ets.org/ SAT and ACT
http://apcentral.collegeboard.com/apc/Controller.jsp College Board

Periodic Table:
http://www.americanelements.com/ Periodic Table
http://periodic.lanl.gov/default.htm Periodic Table
http://www.consol.ca/downloads/Periodic_Table.pdf Periodic Table

Educator Websites:
http://www.adriandingleschemistrypages.com/
http://www.chemmybear.com/
http://www.chem.iastate.edu/group/Greenbowe/sections/projectfolder/flashfiles/stoichiometry/acid_base.html

Titration Simulations
http://antoine.frostburg.edu/chem/senese/101/index.shtml General Chemistry
## Unit Overview

10 weeks  
(Marking Period 2)

<table>
<thead>
<tr>
<th>Content Area: Chemistry Unit 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit Title: The Language of Chemistry and Chemical Quantities</td>
</tr>
<tr>
<td>Target Course/Grade Level: 10-12</td>
</tr>
</tbody>
</table>

### Unit Summary
This unit is designed to give students a clear understanding of how scientific thought and quantitative skills are applied to the classification of matter.

### Primary interdisciplinary connections:
Science, Social Studies, Mathematics, Technology, Visual and Performing Arts  
Social Studies Standards  
Mathematics Standards  
Technology Standards  
Visual and Performing Art Standards

- RST.9-10.4. 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 10-12 texts and topics.

- RST.9-10.5. Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).

- RST.9-10.7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

### Technology Connections: Understand and use technology systems, select and use applications effectively and productively, and exhibit digital citizenship by practicing safe, legal, and responsible use of information and technology.

- 8.2.12.E.1 Demonstrate an understanding of the problem-solving capacity of computers in our world.

- 8.1.12.F.1 Critical Thinking, Problem Solving, Decision Making Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.

### 21st Century Themes/ Careers including: critical thinking, problem solving, creativity, innovation, collaboration, teamwork and leadership, cross-cultural understanding, global awareness, civic literacy, and interpersonal communication.
9.1.12.A.1 Apply critical thinking and problem-solving strategies during structured learning experiences.
9.4.12A.16 Employ critical thinking skills independently and in teams to solve problems and make decisions, (e.g., analyze, synthesize, and evaluate).
9.4.12A.17 Employ critical thinking and interpersonal skills to resolve conflicts.

Students will also be exposed to Career Ready Practices which describe the career-ready skills that all educators in all content areas should seek to develop in their students. They are practices that have been linked to increase college, career, and life success.

- CRP1. Act as a responsible and contributing citizen and employee.
- CRP2. Apply appropriate academic and technical skills.
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- CRP9. Model integrity, ethical leadership and effective management.
- CRP10. Plan education and career paths aligned to personal goals.
- CRP11. Use technology to enhance productivity.
- CRP12. Work productively in teams while using cultural global competence

Content Standards
This unit will assimilate the disciplines of the New Jersey Student Learning Standards. This includes the language of chemistry, chemical quantities, and engineering design. Students who demonstrate understanding can:

<table>
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<tr>
<th>Code</th>
<th>Performance Expectation</th>
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<tr>
<td>HS-ETS1-2.</td>
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<tr>
<td>HS-PS1-1</td>
<td>Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.</td>
</tr>
<tr>
<td>HS-PS1-7.</td>
<td>Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.</td>
</tr>
<tr>
<td>HS-PS1-3.</td>
<td>Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.</td>
</tr>
<tr>
<td>HS-PS1-2.</td>
<td>Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.</td>
</tr>
</tbody>
</table>

Unit Essential Questions
- How do chemists use symbols to convey necessary concepts?
- How does the language of chemistry demonstrate systems?

Disciplinary Core Ideas
Students who demonstrate understanding of:
**ETS1.B: Developing Possible Solutions**
When evaluating solutions, it is important to take into account a range of constraints, including cost, safety,
interactions, and patterns of change?
- What affects the patterns of change?
- How is the mole concept the foundation of chemistry?
- How can we determine both qualitative and quantitative changes in the interaction of systems?

reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS-ETS1-3)
Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs. (HS-ETS1-4)

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</tr>
<tr>
<td>Procedures at the core of scientific methodology</td>
<td>• Write formulas for ionic and molecular compounds</td>
</tr>
<tr>
<td>Laboratory Safety procedures</td>
<td>• Calculate percent composition</td>
</tr>
<tr>
<td>Essential laboratory equipment</td>
<td>• Determine empirical and molecular formulas</td>
</tr>
<tr>
<td>The law of conservation of matter and energy</td>
<td>• Write a skeleton equation from a word equation</td>
</tr>
<tr>
<td>How chemical families differ</td>
<td>• Write a balanced equation from a skeleton equation</td>
</tr>
<tr>
<td>Chemical Nomenclature</td>
<td>• Classify reaction types</td>
</tr>
<tr>
<td>Solve % yield problems</td>
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- Differentiated Instruction
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Follow all IEP modifications/504 plan

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- Science Websites

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http://portal.acs.org/portal/acscorg/content American Chemical Society
http://www.rsc.org/ royal chemical society
http://www.flinnsci.com/ Flinn Scientific

Testing:
http://www.ets.org/ SAT and ACT
http://apcentral.collegeboard.com/apc/Controller.jsp College Board

Periodic Table:
http://www.americanelements.com/ Periodic Table
http://periodic.lanl.gov/default.htm Periodic Table
http://www.consol.ca/downloads/Periodic_Table.pdf Periodic Table

Educator Websites:
http://www.adriandingleschemistrypages.com/
http://www.chemmybear.com/
http://www.chem.iastate.edu/group/Greenbowe/sections/projectfolder/flashfiles/stoichiometry/acid_base.html

Titration Simulations
http://antoine.frostburg.edu/chem/senese/101/index.shtml General Chemistry
# Unit Overview

**10 weeks**  
*(Marking Period 3)*

<table>
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<tr>
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<tbody>
<tr>
<td><strong>Unit Title:</strong> Chemical Periodicity and Bonding</td>
</tr>
<tr>
<td><strong>Target Course/Grade Level:</strong> 10-12</td>
</tr>
</tbody>
</table>

## Unit Summary

This unit is designed to give students a clear understanding of the patterns that exist among the various forms of matter and those factors that affect the stability of matter.

### Primary interdisciplinary connections:

- Science, Social Studies, Mathematics, Technology, Visual and Performing Arts
- Social Studies Standards
- Mathematics Standards
- Technology Standards
- Visual and Performing Art Standards

- RST.9-10.4. 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 10-12 texts and topics.
- RST.9-10.5. Analyze the relationships among concepts in a text, including relationships among key terms (e.g., *force*, *friction*, *reaction force*, *energy*).
- RST.9-10.7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

### Technology Connections:

Understand and use technology systems, select and use applications effectively and productively, and exhibit digital citizenship by practicing safe, legal, and responsible use of information and technology.

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- CRP6. Demonstrate creativity and innovation.
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- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP9. Model integrity, ethical leadership and effective management.
- CRP10. Plan education and career paths aligned to personal goals.
- CRP11. Use technology to enhance productivity.
- CRP12. Work productively in teams while using cultural global competence

Content Standards:
This unit will assimilate the disciplines of the New Jersey Student Learning Standards. This includes chemical periodicity, chemical bonding, and engineering design. Students who demonstrate understanding can:

<table>
<thead>
<tr>
<th>Code</th>
<th>Performance Expectation</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS-ETS1-4</td>
<td>Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</td>
</tr>
<tr>
<td>HS-PS1-2</td>
<td>Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.</td>
</tr>
<tr>
<td>HS-PS1-3</td>
<td>Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.</td>
</tr>
<tr>
<td>HS-PS1-4</td>
<td>Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.</td>
</tr>
</tbody>
</table>

Unit Essential Questions
- What patterns exist among the various forms of matter?
- What predictions about matter can be made from the periodic table?
- What affects the stability of matter?

Disciplinary Core Ideas
Students who demonstrate understanding of:

ETS1.B: Developing Possible Solutions
Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive
**Unit Objectives**  
*Students will know...*
- Vocabulary and key terms
- Procedures at the core of scientific methodology
- Laboratory Safety procedures
- Essential laboratory equipment
- Periodic trends
- Reinforce the relationship between periodic trends and electron configuration
- Polarity, electronegativity, and bonding
- Intermolecular attractions

**Unit Objectives**  
*Students who demonstrate understanding can...*
- Write electron configurations for atoms and ions
- Use the periodic table to determine electron configuration
- Predict chemical and physical properties from the periodic table
- Determine valence electrons and predict types of bonding
- Explain intermolecular attractions and how their strength determines physical properties

**Presentation to a client about how a given design will meet his or her needs. (HS-ETS1-4)**

**PS1.A: Structure and Properties of Matter**
The periodic table orders elements horizontally by the number of protons in the atom’s nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-2)
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)*
A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4)

**PS1.B: Chemical Reactions**
Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. (HS-PS1-4),(HS-PS1-5)
The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. (HS-PS1-2),(HS-PS1-7)

**PS2.B: Types of Interactions**
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)*
Formative Assessments

For additional ideas please refer to: http://nextgenscience.org/overview-topics

- Observation
- Homework
- Class participation
- Writing Assignments
- Do Now
- Concept map
- Lab reports
- Notebook

Summative Assessments:
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- Chapter/Unit Test
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- Quarterly Exams
- SGO

Benchmark Assessments:

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- SGO
- NISLA-S (Science Assessment)

Alternative Assessment:

- Projects
- Participation
- Modified Assignment

Modifications (ELLs)

- Teacher tutoring
- Peer tutoring
- Cooperative Learning Groups
- Differentiated Instruction
- Follow all IEP modifications/504 plan

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- Response to Intervention (RTI) [www.help4teachers.com](http://www.help4teachers.com) and [www.docstoc.com](http://www.docstoc.com), (search tiered lesson plan template

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- [http://periodic.lanl.gov/default.htm](http://periodic.lanl.gov/default.htm) Periodic Table
- [http://www.consol.ca/downloads/Periodic_Table.pdf](http://www.consol.ca/downloads/Periodic_Table.pdf) Periodic Table

**Educator Websites:**
## Unit Overview

### 5 weeks

(Marking Period 4)

<table>
<thead>
<tr>
<th>Content Area: Chemistry Unit 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit Title:</strong> States of Matter</td>
</tr>
<tr>
<td><strong>Target Course/Grade Level:</strong> 10-12</td>
</tr>
</tbody>
</table>

### Unit Summary
This unit is designed to give students a clear understanding of how matter and energy drive the universe and how energy causes changes in matter.

### Primary interdisciplinary connections:
- Science, Social Studies, Mathematics, Technology, Visual and Performing Arts
- Social Studies Standards
- Mathematics Standards
- Technology Standards
- Visual and Performing Art Standards

RST.9-10.4. 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 10-12 texts and topics.

RST.9-10.5. Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).

RST.9-10.7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

### Technology Connections:
Understand and use technology systems, select and use applications effectively and productively, and exhibit digital citizenship by practicing safe, legal, and responsible use of information and technology.

8.2.12.E.1 Demonstrate an understanding of the problem-solving capacity of computers in our world.
8.1.12.F.1 Critical Thinking, Problem Solving, Decision Making Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.

### 21st Century Themes/ Careers including:
critical thinking, problem solving, creativity, innovation, collaboration, teamwork and leadership, cross-cultural understanding, global awareness, civic literacy, and interpersonal communication.

9.1.12.A.1 Apply critical thinking and problem-solving strategies during structured learning experiences.
9.4.12A.16 Employ critical thinking skills independently and in teams to solve problems and make decisions, (e.g., analyze, synthesize, and evaluate).
Employ critical thinking and interpersonal skills to resolve conflicts.

Students will also be exposed to Career Ready Practices which describe the career-ready skills that all educators in all content areas should seek to develop in their students. They are practices that have been linked to increase college, career, and life success.

- CRP1. Act as a responsible and contributing citizen and employee.
- CRP2. Apply appropriate academic and technical skills.
- CRP3. Attend to personal health and financial well-being.
- CRP4. Communicate clearly and effectively and with reason.
- CRP5. Consider the environmental, social and economic impacts of decisions.
- CRP6. Demonstrate creativity and innovation.
- CRP7. Employ valid and reliable research strategies.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP9. Model integrity, ethical leadership and effective management.
- CRP10. Plan education and career paths aligned to personal goals.
- CRP11. Use technology to enhance productivity.
- CRP12. Work productively in teams while using cultural global competence

### Learning Targets

#### Content Standards

This unit will assimilate the disciplines of the New Jersey Student Learning Standards. This includes matter and its interactions and engineering design. Students who demonstrate understanding can:

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<tr>
<td>HS-PS1-3.</td>
<td>Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.</td>
</tr>
<tr>
<td>HS-PS3-4.</td>
<td>Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics)</td>
</tr>
<tr>
<td>HS-PS3-2.</td>
<td>Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).</td>
</tr>
<tr>
<td>HS-ETS1-4.</td>
<td>Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.</td>
</tr>
</tbody>
</table>

#### Unit Essential Questions

- How do matter and energy drive the universe?
- How does the kinetic theory describe the relationship between the energy of particles in matter and its temperature?
- How does energy cause (or result from) changes in matter?
- How do the parameters of state determine the nature of matter?

#### Disciplinary Core Ideas

*Students will demonstrate understanding of:

**PS1.A: Structure and Properties of Matter**

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)

**PS2.B: Types of Interactions**

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),(HS-PS2-6)
How do intermolecular attractions determine states of matter?

**PS3.A: Definitions of Energy**

Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system’s total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HS-PS3-1),(HS-PS3-2)

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

These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HS-PS3-2)

**PS3.B: Conservation of Energy and Energy Transfer**

Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1),(HS-PS3-4)

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)

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

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

**ETS1.B: Developing Possible Solutions**

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

**Unit Objectives**

*Students will know...*

- Vocabulary and key terms
- Procedures at the core of scientific methodology
- Laboratory Safety procedures
- Essential laboratory equipment
- The postulates of the kinetic theory
- Units of temperature, volume, and pressure
- How the parameters of state (pressure, temperature, volume and moles) affect matter

*Students who demonstrate understanding can...*

- Explain the relationship between temperature and kinetic energy
- Explain phase changes
- Distinguish between various forms of energy
- Evaluate data using gas law equations
- How intermolecular attractions determine the state of matter
Formative Assessments
For additional ideas please refer to http://nextgenscience.org/overview-topics

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Titration Simulations
### Unit Overview

**5 weeks**

*(Marking Period 4)*

<table>
<thead>
<tr>
<th>Content Area: Chemistry Unit 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit Title:</strong> Aqueous Solutions</td>
</tr>
<tr>
<td><strong>Target Course/Grade Level:</strong> 10-12</td>
</tr>
</tbody>
</table>

**Unit Summary**

This unit is designed to give students a clear understanding of the chemistry of aqueous solutions.

**Primary interdisciplinary connections:**

Science, Social Studies, Mathematics, Technology, Visual and Performing Arts

Social Studies Standards
Mathematics Standards
Technology Standards
Visual and Performing Art Standards

RST.9-10.4. 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 10-12 texts and topics.

RST.9-10.5. Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).

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- CRP11. Use technology to enhance productivity.
- CRP12. Work productively in teams while using cultural global competence

### Learning Targets

#### Content Standards
This unit will assimilate the disciplines of the New Jersey Student Learning Standards. This includes aqueous solutions and engineering design. Students who demonstrate understanding can:

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<td>HS-PS2-6.</td>
<td>Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.</td>
</tr>
<tr>
<td>HS-PS1-1.</td>
<td>Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.</td>
</tr>
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<td>HS-PS3-2.</td>
<td>Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).</td>
</tr>
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<td>HS-PS3-5.</td>
<td>Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.</td>
</tr>
<tr>
<td>HS-ETS1-2.</td>
<td>Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.</td>
</tr>
</tbody>
</table>

#### Unit Essential Questions
- How does the structure of water relate to its unique properties?

#### Disciplinary Core Idea
*Students will demonstrate understanding of:*

**PS1.A: Structure and Properties of Matter**
- How do variables affect a given solution system?
- How do we describe the nature of an aqueous solution?
- How do systems maintain neutrality?

<table>
<thead>
<tr>
<th>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) 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)</th>
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<td><strong>PS2.B: Types of Interactions</strong> 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),(HS-PS2-6)</td>
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<tr>
<td><strong>PS3.C: Relationship Between Energy and Forces</strong> When two objects interacting through a field change relative position, the energy stored in the field is changed. (HS-PS3-5)</td>
</tr>
<tr>
<td><strong>ETS1.C: Optimizing the Design Solution</strong> Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (HS-ETS1-2)</td>
</tr>
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</table>

**Unit Objectives**

*Students will know...*
- Vocabulary and key terms
- Procedures at the core of scientific methodology
- Laboratory Safety procedures
- Essential laboratory equipment

*Unit Objectives*  
*Students who demonstrate understanding can:*
- Discuss the factors that affect rate of solution
- Describe the solvation process
- Calculate concentrations of solutions
- Solve dilution problems
- Identify the properties of acids and bases
<table>
<thead>
<tr>
<th>The unique properties of water</th>
<th>Know the role of pH in solution chemistry</th>
</tr>
</thead>
<tbody>
<tr>
<td>The nature of chemical reactions in an aqueous environment</td>
<td></td>
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http://www.chem.iastate.edu/group/Greenbowe/sections/projectfolder/flashfiles/stoichiometry/acid_base.html

Titration Simulations
http://antoine.frostburg.edu/chem/senese/101/index.shtml General Chemistry
https://phet.colorado.edu/en/simulations/category/new General Chemistry