CARLSTADT-EAST RUTHERFORD REGIONAL HIGH SCHOOL DISTRICT
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AP Chemistry Curriculum Guide

Pacing Guide **AP Chemistry is a full year course that meets on a rotating basis for three (3) 55-minute blocks and one (1) 40-minute block for every five (5) day cycle, as well as an additional 40-minute lab block.**	Based on *Zumdahl and Zumdahl*, 2016 Cengage Chapter 1,2 – Weeks 1,2 Chapter 3 – Weeks 3-5 Chapter 4 – Weeks 6-8 Chapter 5 – Weeks 9-10 Chapter 6 – Weeks 11-12 Chapter 7 – Weeks 13-15 Chapter 8,9 – Weeks 16-18 Chapter 10,11 – Weeks 19-21	Chapter 12 – Weeks 22-23 Chapter 13 – Week 24 Chapter 14 – Week 25 Chapter 15 – Weeks 26-27 Chapter 16 – Week 28-29 Chapter 17 – Weeks 30-31 Chapter 18 – Weeks 32-33 AP REVIEW and AP EXAM – Week 34 Chapters 19-22 – Week 35-39

21st Century Life and Careers Standards: **9.2** Career Awareness	9.2.12.C.1 – Review career goals and determine steps necessary for attainment. 9.2.12.C.3 – Identify transferable career skills and design alternate career plans. 9.2.12.C.4 – Analyze how economic conditions and societal changes influence employment trends and future education.
Technology Standards	8.1.12.A.2 - Produce and edit a multi-page digital document for a commercial or professional audience and present it to peers and/or professionals in that related area for review. 8.1.12.A.3 - Collaborate in online courses, learning communities, social networks or virtual worlds to discuss a resolution to a problem or issue. 8.1.12.F.1 - Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs. 8.2.12.B.1 - Research and analyze the impact of the design constraints (specifications and limits) for a product or technology driven by a cultural, social, economic or political need and publish for review. 8.2.12.B.2 - Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation and maintenance of a chosen product. 8.2.12.B.5 - Research the historical tensions between environmental and economic considerations as driven by human needs and wants in the development of a technological product, and present the competing viewpoints to peers for review. 8.2.12.C.4 - Explain and identify interdependent systems and their functions.
Interdisciplinary Connections	Interdisciplinary connections are built into the New Jersey Student Learning Standards, especially in the sciences. Here are some examples: Mathematics: Using mathematical models, using graphs to present data, interpreting data to reach conclusions, estimating and determining accuracy and precision. English/Language Arts: citing textual evidence to support explanations, integrating and evaluating multiple sources of information, writing explanatory information.

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Differentiation/Accommodations/Modifications

Note: Each district should review the various strategies noted below and determine which are applicable for their population within varied grade levels and languages and make edits where needed.

Gifted and Talented	English Language Learners	Students with Disabilities	Students at Risk of School Failure
(content, process, product and learning environment) **Extension Activities:** • Conduct research and provide presentation of mathematical topics. • Design surveys to generate and analyze data to be used in discussion. • Use of higher level questioning techniques. • Provide assessments at a higher level of thinking.	**Modifications for Classroom:** **Modifications for Homework/Assignments** • Modified assignments. • Extended time for assignment completion as needed. • Use graphing calculator. • Highlight formulas.	*(appropriate accommodations, instructional adaptations, and/or modifications as determined by the IEP or 504 team)* **Modifications for Classroom:** • Ask students to restate information, directions, and assignments. • Repetition and practice. • Model skills / techniques to be mastered. • Extended time to complete class work. • Provide copy of classnotes. • Preferential seating to be mutually determined by the student and teacher. • Students may request books online, on tape/CD, as available and appropriate. • Assign peer helper in the class setting. • Provide regular parent / school communication • Provide oral reminders and check	**Modifications for Classroom:** • Ask students to restate information, directions, and assignments. • Repetition and practice. • Model skills / techniques to be mastered. • Extended time to complete class work. • Provide copy of classnotes. • Preferential seating to be mutually determined by the student and teacher. • Students may request books online, on tape/CD, as available and appropriate. • Assign peer helper in the class setting. • Provide oral reminders and check student work during independent work time. • Assist student with long and short term planning of assignments • Provide regular parent / school communication. • Assign peer helper in the class

		student work during independent work time. • Assist student with long and short term planning of assignments **Modifications for Homework** • Extended time to complete assignments. • Student requires more complex assignments to be broken up and explained in smaller units, with work to be submitted in phases. • Provide the student with clearly stated (written) expectations and grading criteria for assignments. **Modification for Assessments** • Extended time on classroom tests and quizzes. • Student may take / complete tests in an alternate setting as needed. • Restate, reread, and clarify directions/questions. • Distribute study guide for classroom tests. • Establish procedures for accommodations / modifications for assessments.	setting. • Provide oral reminders and check student work during independent work time. • Assist student with long and short term planning of assignments **Modifications for Homework** • Extended time to complete assignments. • Student requires more complex assignments to be broken up and explained in smaller units, with work to be submitted in phases. • Provide the student with clearly stated (written) expectations and grading criteria for assignments. **Modification for Assessments** • Extended time on classroom tests and quizzes. • Student may take / complete tests in an alternate setting as needed. • Restate, reread, and clarify directions/questions. • Distribute study guide for classroom tests. • Establish procedures for accommodations / modifications for assessments.

	CURRICULAR REQUIREMENTS (College Board)	Page(s)
CR1	Students and teachers use a recently published (within the last 10 years) college-level chemistry textbook.	8
CR2	The course is structured around the enduring understandings within the big ideas as described in the AP Chemistry Curriculum Framework.	8
CR3a	The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 1: Structure of matter.	8-21
CR3b	The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 2: Properties of matter-characteristics, states, and forces of attraction.	8-21
CR3c	The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 3: Chemical reactions.	8-21
CR3d	The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 4: Rates of chemical reactions.	8-21
CR3e	The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 5: Thermodynamics.	8-21
CR3f	The course provides students with opportunities outside the laboratory environment to meet the learning objectives within Big Idea 6: Equilibrium.	8-21
CR4	The course provides students with the opportunity to connect their knowledge of chemistry and science to major societal or technological components (e.g., concerns, technological advances, innovations) to help them become scientifically literate citizens.	8-21
CR5a	Students are provided the opportunity to engage in investigative laboratory work integrated throughout the course for a minimum of 25 percent of instructional time.	8
CR5b	Students are provided the opportunity to engage in a minimum of 16 hands-on laboratory experiments integrated throughout the course while using basic laboratory equipment to support the learning objectives listed within the AP Chemistry Curriculum Framework.	8-21
CR6	The laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Chemistry Curriculum Framework. At minimum, six of the required 16 labs are conducted in a guided-inquiry format.	9-21
CR7	The course provides opportunities for students to develop, record, and maintain evidence of their verbal, written, and graphic communication skills through laboratory reports, summaries of literature or scientific investigations, and oral, written, and graphic presentations.	9-21

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Textbooks and Other Curricular Resources [CR1]:

-Zumdahl, Steven and Susan Zumdahl. Chemistry, Ninth Edition. Belmont CA: Cengage Learning, 2014.

-Trout, Laura, et al. *POGIL: Activities for AP Chemistry*. Flinn Scientific, 2015.

-OWLv2 Online Chemistry Homework., www.cengage.com/owlv2.

-The College Board. AP Chemistry Guided Inquiry Experiments: Applying the Science Practices. 2013.

-Flinn Scientific. Advanced Inquiry Labs for AP* Chemistry Lab Manual. 2013. (On CD in PDF format.)

Course Overview:

This Advanced Placement Chemistry course will provide students with the equivalent of a general college chemistry course. This class meets for a total of seven periods per week, 45 minutes each, with two of the days being double periods. During this time, students are engaged in hands-on laboratory work, integrated throughout the course that accounts for more than 25% of the class time. **[CR5a].**

The remaining time is used for lectures, group work using POGIL worksheets, and problem solving sessions using OWL with in-class computers. The content of the course is structured around the six big ideas listed in the AP Chemistry curriculum framework (see course outline below) **[CR2].**

Students will also be given journal articles and news articles throughout the year which have a direct relation to course material. They will be instructed to read the articles and write a brief summary explaining the connections to the chemistry content being covered **[CR4].**

Laboratory Program:

All of the laboratory experiments in this course are hands-on activities developed by Flinn Scientific (AP Advanced Inquiry Labs 1-16) to mirror the recommended labs from the College Board manual. **[CR5a, 5b, 6].** Students work in groups to collect and graph data, make qualitative and quantitative observations, and provide appropriate conclusions to the activities.

Inquiry is emphasized in these experiments, and students are *required* to maintain a laboratory notebook in which they will report the purpose, procedure, all data, data analysis, error analysis, results, and conclusions in the following lab report format: **[CR7].**

Title: Name of the Lab
Purpose: Statement of what they will be learning.
Hypothesis: Educated guess including the student's expected results.
Materials: List of materials, chemicals, and safety equipment.
Method: Summary, recorded in a numbered list, of what was done in the activity.
Observations: Statements describing their observations.
Data: Record of all measurements (often in chart form) with labeling of all units required.
Graphs: If data can be used to create a graph, students use Logger Pro.
Calculations and Analysis: Record of all formulas and units (when appropriate).

Conclusion (RERUN FORMAT)

-Restate–the aim.
-Explain–(briefly) what you did.
-Results–state them, including whether or not your hypothesis was proven.
-Uncertainties–determine percent error for calculations and give reasons for other errors.
-New Information–state something learned in this activity, and find connections to major societal issues currently being discussed or historically important events that can be related to the chemistry topics being covered **[CR4].**

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Unit:	Introduction to AP Chemistry	**NJ Student Learning Standards:**	**DCI:** PS1.A **PE:** PS1-1	**Essential Questions:**	Why is the study of matter and energy important? What makes up the universe? How small is an atom?
Time Frame:	Summer Assignment + 2 weeks	**AP Chemistry Big Idea**	**AP Chemistry Learning Objectives**	**Materials:**	Textbook, Notes, Lab Equipment, Worksheets, Computers
		1.A.1	1.1, 1.17, 2.17, 3.5, 3.6		
Content:	Chapter 1 – Chemical Foundations Chapter 2 – Atoms, Molecules, and Ions			**Student Learning Objectives:**	-Students will learn atomic structure and the history of the development of the atomic theory. -Students will learn to name compounds and ions. -Students will learn how mass spectroscopy is used to determine isotopic abundance.
Engagement *Anticipatory Set*	Bozeman Science – http://www.bozemanscience.com/ap-chem-001-molecules-elements - Bozeman Science – http://www.bozemanscience.com/ap-chem-009-mass-spectrometry - PHET Simulation – http://phet.colorado.edu/en/simulation/legacy/build-a-molecule -				
Exploration *Student Inquiry*	Flinn POGIL – Mass Spectroscopy OWL Assignment for Chapters 1 and 2				
Explanation *Concepts and Practices*	Unit Conversions Practice - http://joneslhs.weebly.com/ - NMSI – 01 - Chemical Foundations.pdf – Zumdahl Chapter 1 and 2 Presentation and selected chapter questions				
Elaboration *Extension Activity*	Introduction and Safety Lab Physical and Chemical Changes Lab				
Evaluation *Assessments*	**Formative** POGIL Results Chapter and Practice AP Questions			**Summative** Chapter 1-2 Assessment Lab Report	

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<table>
<tr><td>Unit:</td><td>Stoichiometry</td><td>NJ Student Learning Standards:</td><td>DCI: PS1.A, PS1.B, PS2.B
PE: PS1-1, PS1-2, PS1-4, PS1-6, PS1-7</td><td>Essential Questions:</td><td>How small is an atom?
How can we measure the amount of matter in a sample?
How can we predict the amounts of products from a given reaction?</td></tr>
<tr><td rowspan="2">Time Frame:</td><td rowspan="2">3 weeks</td><td>AP Chemistry Big Idea</td><td>AP Chemistry Learning Objectives</td><td rowspan="2">Materials:</td><td rowspan="2">Textbook, Notes, Lab Equipment, Worksheets, Computers</td></tr>
<tr><td>1.A.2, 1.A.3, 3.A.2, 3.C.1</td><td>1.1-1.4, 1.14, 1.17-1.19 3.1, 3.3, 3.4, 3.6</td></tr>
<tr><td>Content:</td><td colspan="3">Chapter 3 – Stoichiometry</td><td>Student Learning Objectives:</td><td>-Students will use the mole as a quantitative model for chemical composition.
-Students will apply the law of conservation of mass to chemical equations and use particulate diagrams to illustrate how matter is conserved.</td></tr>
<tr><td>Engagement
Anticipatory Set</td><td colspan="5">Article – Understanding your local water quality report
Bozeman Science – http://www.bozemanscience.com/ap-chem-003-the-mole -
Bozeman Science – http://www.bozemanscience.com/ap-chem-012-conservation-of-atoms -
PHET Simulation – http://phet.colorado.edu/en/simulation/reactants-products-and-leftovers -</td></tr>
<tr><td>Exploration
Student Inquiry</td><td colspan="5">Flinn POGIL – Empirical Formulas
Flinn POGIL – Net Ionic Equations
OWL Assignment for Chapter 3</td></tr>
<tr><td>Explanation
Concepts and Practices</td><td colspan="5">NMSI - 02 - Stoichiometry.pdf –
Zumdahl Chapter 3 Presentation and selected chapter questions</td></tr>
<tr><td>Elaboration
Extension Activity</td><td colspan="5">Guided Inquiry: Gravimetric Analysis of Calcium and Hard Water Lab</td></tr>
<tr><td>Evaluation
Assessments</td><td colspan="3">Formative
POGIL Results
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<tr><td>Unit:</td><td>Solution Stoichiometry and Chemical Analysis</td><td>NJ Student Learning Standards:</td><td>DCI: PS1.A, PS1.B, PS3.D, ESS2.D, LS2.B
PE: PS1-2, PS1-6, PS1-7, ESS2-6, LS2-4, LS2-5</td><td>Essential Questions:</td><td>Why is water such a ubiquitous compound in nature?
How do we know when a chemical change occurs?</td></tr>
<tr><td rowspan="2">Time Frame:</td><td rowspan="2">3 weeks</td><td>AP Chemistry Big Idea</td><td>AP Chemistry Learning Objectives</td><td rowspan="2">Materials:</td><td rowspan="2">Textbook, Notes, Lab Equipment, Worksheets, Computers</td></tr>
<tr><td>1.E.1, 1.E.2, 3.A.1, 3.B.1, 3.B.2, 3.B.3</td><td>1.4, 1.17-18, 2.8, 2.9, 2.14 3.1-3.4, 3.8-3.10</td></tr>
<tr><td>Content:</td><td colspan="3">Chapter 4 – Solution Stoichiometry & Chemical Analysis</td><td>Student Learning Objectives:</td><td>-Students will write balanced net ionic equations for precipitation, neutralization, and redox reactions.
-Students will calculate limiting and excess reactants.</td></tr>
<tr><td>Engagement
Anticipatory Set</td><td colspan="5">Article – ACS: 12 Principles of Green Chemistry
Bozeman Science – http://www.bozemanscience.com/ap-chem-002-chemical-analysis -
Bozeman Science – http://www.bozemanscience.com/ap-chem-028-stoichiometry -
Bozeman Science – http://www.bozemanscience.com/ap-chem-027-chemical-equations -
PHET Simulation – http://phet.colorado.edu/en/simulation/legacy/sugar-and-salt-solutions -
PHET Simulation – http://phet.colorado.edu/en/simulation/concentration -</td></tr>
<tr><td>Exploration
Student Inquiry</td><td colspan="5">Flinn POGIL – Combustion Analysis
OWL Assignment for Chapter 4</td></tr>
<tr><td>Explanation
Concepts and Practices</td><td colspan="5">NMSI - 02 - Stoichiometry.pdf –
Zumdahl Chapter 4 Presentation and selected chapter questions</td></tr>
<tr><td>Elaboration
Extension Activity</td><td colspan="5">Acidity of Beverages Lab
Guided Inquiry: Green Chemistry Analysis of a Mixture</td></tr>
<tr><td>Evaluation
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<tr><td>Unit:</td><td>Gases</td><td>NJ Student Learning Standards:</td><td>DCI's: PS1.A, PS2.B, PS3.A, PS3.B, PS3.C, PS3.D
PE's: PS1-3, PS2-4, PS2-6, PS3-2, PS3-4, PS3-5</td><td>Essential Questions:</td><td>Why do all ideal gases behave the same under the same conditions?
What is the difference between an ideal gas and a real gas?
How does the Kinetic-Molecular Theory explain the behavior of molecules under a variety of conditions?</td></tr>
<tr><td rowspan="2">Time Frame:</td><td rowspan="2">2 weeks</td><td>AP Chemistry Big Idea</td><td>AP Chemistry Learning Objectives</td><td rowspan="2">Materials:</td><td rowspan="2">Textbook, Notes, Lab Equipment, Worksheets, Computers</td></tr>
<tr><td>2.A.2</td><td>1.3, 1.4, 2.4-2.6
2.12, 2.15, 3.4, 5.2</td></tr>
<tr><td>Content:</td><td colspan="3">Chapter 5 – Gases</td><td>Student Learning Objectives:</td><td>Students will model gas behavior using pressure, temperature, and volume.
Students will use the kinetic-molecular theory to explain properties of atoms and molecules.</td></tr>
<tr><td>Engagement
Anticipatory Set</td><td colspan="5">Bozeman Science – http://www.bozemanscience.com/ap-chem-014-gases -
PHET Simulation – http://phet.colorado.edu/en/simulation/legacy/gas-properties -</td></tr>
<tr><td>Exploration
Student Inquiry</td><td colspan="5">Flinn POGIL – Partial Pressure of Gases
Flinn POGIL – Deviations from the Ideal Gas Law
Flinn POGIL – Maxwell-Boltzmann Distributions
OWL Assignment for Chapter 5</td></tr>
<tr><td>Explanation
Concepts and Practices</td><td colspan="5">NMSI - 05 - Gases.pdf –
Zumdahl Chapter 5 Presentation and selected chapter questions</td></tr>
<tr><td>Elaboration
Extension Activity</td><td colspan="5">Determining the Molar Volume of a Gas Lab</td></tr>
<tr><td>Evaluation
Assessments</td><td colspan="3">Formative
POGIL Results
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<tr><td>Unit:</td><td>Thermochemistry</td><td>NJ Student Learning Standards:</td><td>DCI: PS1.A, PS1.B, PS3.A, PS3.B, PS3.D
PE: PS1-4, PS3-1, PS3-2, PS3-3, PS3-4</td><td>Essential Questions:</td><td>-How is energy transferred from one substance to another in chemical and physical systems?
-Why do energy changes accompany chemical changes?</td></tr>
<tr><td rowspan="2">Time Frame:</td><td rowspan="2">2 weeks</td><td>AP Chemistry Big Idea</td><td>AP Chemistry Learning Objectives</td><td rowspan="2">Materials:</td><td rowspan="2">Textbook, Notes, Lab Equipment, Worksheets, Computers</td></tr>
<tr><td>3.C.2, 5.A.1, 5.A.2, 5.B.1, 5.C.2</td><td>3.11, 5.3-5.7</td></tr>
<tr><td>Content:</td><td colspan="3">Chapter 6 - Thermochemistry</td><td>Student Learning Objectives:</td><td>-Students will model how energy is transferred between molecules in chemical systems.
-Students will show how the Law of Conservation of Energy applies to chemical systems.</td></tr>
<tr><td>Engagement
Anticipatory Set</td><td colspan="5">Article – Why are fossil fuels so difficult to replace?
Bozeman Science – http://www.bozemanscience.com/ap-chemistry/ - 046, 047, 048, 049, 050, 051, 053</td></tr>
<tr><td>Exploration
Student Inquiry</td><td colspan="5">Flinn POGIL – Calorimetry
Flinn POGIL – Bond Energy
OWL Assignment for Chapter 6</td></tr>
<tr><td>Explanation
Concepts and Practices</td><td colspan="5">NMSI - 06 - Thermochemistry.pdf –
Zumdahl Chapter 6 Presentation and selected chapter questions</td></tr>
<tr><td>Elaboration
Extension Activity</td><td colspan="5">Guided Inquiry: Designing a Hand Warmer Lab</td></tr>
<tr><td>Evaluation
Assessments</td><td colspan="3">Formative
POGIL Results
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Chapter 6 Assessment plus 1-5 Review
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<tr><td>Unit:</td><td>Atomic Structure and Periodicity</td><td>NJ Student Learning Standards:</td><td>DCI: PS1.A, PS1.B, PS2.B
PE: PS1-1, PS1-3, PS1-2, PS2-4</td><td>Essential Questions:</td><td>What are the fundamental building blocks of matter?
How are matter and energy interchangeable?
Why is the periodic table a useful tool to study chemistry?</td></tr>
<tr><td rowspan="2">Time Frame:</td><td rowspan="2">3 weeks</td><td>AP Chemistry Big Idea</td><td>AP Chemistry Learning Objectives</td><td rowspan="2">Materials:</td><td rowspan="2">Textbook, Notes, Lab Equipment, Worksheets, Computers</td></tr>
<tr><td>1.B.2, 1.C.1, 1.D.1</td><td>1.5-1.10, 1.12, 1.13, 1.15</td></tr>
<tr><td>Content:</td><td colspan="3">Chapter 7 – Atomic Structure and Periodicity</td><td>Student Learning Objectives:</td><td>-Students will use models of atomic structure to predict properties of elements.
-Students will use the periodic table to predict physical and chemical properties.</td></tr>
<tr><td>Engagement
Anticipatory Set</td><td colspan="5">Bozeman Science – http://www.bozemanscience.com/ap-chemistry/ - 5, 6, 7, 8, 10
PHET Simulation – http://phet.colorado.edu/en/simulation/build-an-atom -
PHET Simulation – http://phet.colorado.edu/en/simulation/isotopes-and-atomic-mass -
PHET Simulation – http://phet.colorado.edu/en/simulation/legacy/hydrogen-atom -
PHET Simulation – http://phet.colorado.edu/en/simulation/legacy/photoelectric -</td></tr>
<tr><td>Exploration
Student Inquiry</td><td colspan="5">Flinn POGIL – Advanced Periodic Trends
Flinn POGIL – Photoelectron Spectroscopy
OWL Assignment for Chapter 7</td></tr>
<tr><td>Explanation
Concepts and Practices</td><td colspan="5">NMSI - 07 - Atomic Structure and Periodicity.pdf –
Zumdahl Chapter 7 Presentation and selected chapter questions</td></tr>
<tr><td>Elaboration
Extension Activity</td><td colspan="5">Percent Copper in Brass Lab
Analysis of Food Dyes in Beverages Lab</td></tr>
<tr><td>Evaluation
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<tr><td>Unit:</td><td>Chemical Bonding</td><td>NJ Student Learning Standards:</td><td>DCI's: PS1.A, PS1.B, PS2.B, PS3.C, PS3.A, PS3.C
PE's: PS3-5, PS1-1, PS1-3, PS1-4, PS2-4, PS2-6, PS3-5</td><td>Essential Questions:</td><td>-Why do atoms combine to form larger clusters of atoms?
-How can we use atomic models to predict reactions?
-How do atomic properties change when atoms gain, lose or share electrons?</td></tr>
<tr><td>Time Frame:</td><td>3 weeks</td><td>AP Chemistry Big Idea
2.C.1-4, 2.D.1-4</td><td>AP Chemistry Learning Objectives
1.7, 1.8, 1.15, 2.1, 2.17, 2.18, 2.21, 2.23, 2.24, 5.1, 5.8</td><td>Materials:</td><td>Textbook, Notes, Lab Equipment, Worksheets, Computers</td></tr>
<tr><td>Content:</td><td colspan="3">Chapter 8 – Bonding: General Concepts
Chapter 9 – Covalent Bonding: Orbitals</td><td>Student Learning Objectives:</td><td>-Students will model chemical bonding using Lewis structures, hybrid orbitals, and molecular orbitals.
-Students will model covalent, ionic, and metallic bonds.</td></tr>
<tr><td>Engagement
Anticipatory Set</td><td colspan="5">Bozeman Science – http://www.bozemanscience.com/ap-chemistry/ - 19-22
PHET Simulation – http://phet.colorado.edu/en/simulation/legacy/molecule-polarity -
PHET Simulation – http://phet.colorado.edu/en/simulation/molecule-shapes -
PHET Simulation – http://phet.colorado.edu/en/simulation/legacy/atomic-interactions -</td></tr>
<tr><td>Exploration
Student Inquiry</td><td colspan="5">Flinn POGIL – Types of Bonds
Flinn POGIL – Polar and Nonpolar Molecules
Flinn POGIL – Properties of Covalent Bonds
OWL Assignment for Chapter 8 and 9</td></tr>
<tr><td>Explanation
Concepts and Practices</td><td colspan="5">NMSI - 08 - Bonding: General Concepts.pdf –
NMSI - 09 - Covalent Bonding Orbitals.pdf -
Zumdahl Chapter 8 and 9 Presentation and selected chapter questions</td></tr>
<tr><td>Elaboration
Extension Activity</td><td colspan="5">Guided Inquiry: Qualitative Analysis and Chemical Bonding Lab
Molecular Modeling Lab</td></tr>
<tr><td>Evaluation
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Chapter and AP Practice Questions</td><td colspan="2">Summative
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<tr><td>Unit:</td><td>Liquids, Solids, and Solutions</td><td>NJ Student Learning Standards:</td><td>DCI: PS1.A, PS1.B, PS2.B, PS3.A, PS3.C, LS1.C
PE: PS1-1, PS1-2, PS1-3, PS1-4, PS2-4, PS2-6, PS3-2, PS3-5, LS1-6</td><td>Essential Questions:</td><td>How do atoms and molecules interact with each other?
How does the Kinetic-Molecular Theory explain the behavior of molecules under a variety of conditions?
Why are molecules attracted to or repelled by each other?</td></tr>
<tr><td rowspan="2">Time Frame:</td><td rowspan="2">3 weeks</td><td>AP Chemistry Big Idea</td><td>AP Chemistry Learning Objectives</td><td rowspan="2">Materials:</td><td rowspan="2">Textbook, Notes, Lab Equipment, Worksheets, Computers</td></tr>
<tr><td>2.A.1, 2.A.3, 2.B.1, 2.B.2, 2.B.3, 5.D.1, 5.D.2, 5.D.3</td><td>1.11, 2.1, 2.3, 2.8, 2.9, 2.11, 2.13, 2.14-2.16, 2.19, 2.20 2.22-2.32, 5.6, 5.9-5.11, 6.24</td></tr>
<tr><td>Content:</td><td colspan="3">Chapter 10 – Liquids and Solids
Chapter 11 – Properties of Solutions</td><td>Student Learning Objectives:</td><td>-Students will learn about the properties of mixtures.
-Students will model molecular interactions.</td></tr>
<tr><td>Engagement
Anticipatory Set</td><td colspan="5">Analysis of Sports Drinks Labels
Bozeman Science – http://www.bozemanscience.com/ap-chemistry/ - 13-18, 23-26
PHET Simulation – http://phet.colorado.edu/en/simulation/legacy/states-of-matter -
PHET Simulation – http://phet.colorado.edu/en/simulation/legacy/atomic-interactions -
PHET Simulation – http://phet.colorado.edu/en/simulation/concentration -
PHET Simulation – http://phet.colorado.edu/en/simulation/molarity -</td></tr>
<tr><td>Exploration
Student Inquiry</td><td colspan="3">Flinn POGIL – Heats of Formation
Flinn POGIL – Lattice Energy
OWL Assignment for Chapter 10 and 11</td><td colspan="2">Flinn POGIL – Alloys
Flinn POGIL – Types of Solids</td></tr>
<tr><td>Explanation
Concepts and Practices</td><td colspan="5">NMSI – 10 - IMFs, Solids, Liquids.pdf -
NMSI – 11 - Solutions.pdf -
Zumdahl Chapter 10 and 11 Presentation and selected chapter questions</td></tr>
<tr><td>Elaboration
Extension Activity</td><td colspan="5">Separation of a Dye Mixture Using Chromatography Lab</td></tr>
<tr><td>Evaluation
Assessments</td><td colspan="3">Formative
POGIL Results
Chapter and AP Practice Questions</td><td colspan="2">Summative
Chapter 10 and 11 Assessment plus 7-9 Review
Lab Report</td></tr>
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<table>
<tr><td>Unit:</td><td>Chemical Kinetics</td><td>NJ Student Learning Standards:</td><td>DCI: PS1.A, PS1.B, PS3.A, PS3.C
PE: PS1-4, PS1-5, PS3-2, PS3-5</td><td>Essential Questions:</td><td>How can the rate of reaction be determined?
How can we speed up the rate of chemical reactions?
Why don’t reactions occur with every molecular collision?</td></tr>
<tr><td rowspan="2">Time Frame:</td><td rowspan="2">2 weeks</td><td>AP Chemistry Big Idea</td><td>AP Chemistry Learning Objectives</td><td rowspan="2">Materials:</td><td rowspan="2">Textbook, Notes, Lab Equipment, Worksheets, Computers</td></tr>
<tr><td>4.A.1-3, 4.B.1-3, 4.C.1-3, 4.D.1,2</td><td>4.1-4.9</td></tr>
<tr><td>Content:</td><td colspan="3">Chapter 12 – Chemical Kinetics</td><td>Student Learning Objectives:</td><td>-Students will learn how to calculate the rate of reaction.
-Students will learn how activation energy and collision theory are used to hypothesize a reaction mechanism.</td></tr>
<tr><td>Engagement
Anticipatory Set</td><td colspan="5">Bozeman Science – http://www.bozemanscience.com/ap-chemistry/ - 35-45
PHET Simulation – http://phet.colorado.edu/en/simulation/legacy/reactions-and-rates -</td></tr>
<tr><td>Exploration
Student Inquiry</td><td colspan="5">Flinn POGIL – Rates of Reaction
Flinn POGIL – Method of Initial Rates
OWL Assignment for Chapter 12</td></tr>
<tr><td>Explanation
Concepts and Practices</td><td colspan="5">NMSI - 12 - Chemical Kinetics.pdf –
NMSI - Arrhenius Made Easy.pdf -
Zumdahl Chapter 12 Presentation and selected chapter questions</td></tr>
<tr><td>Elaboration
Extension Activity</td><td colspan="5">Guided Inquiry: Rate of Decomposition of Calcium Carbonate Lab
Kinetics of Crystal Violet Fading Lab</td></tr>
<tr><td>Evaluation
Assessments</td><td colspan="3">Formative
POGIL Results
Chapter and AP Practice Questions</td><td colspan="2">Summative
Chapter 12 Assessment
Lab Report</td></tr>
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<table>
<tr><td>Unit:</td><td>Chemical Equilibrium</td><td>NJ Student Learning Standards:</td><td>DCI: PS1.A, PS1.B, PS3.B, PS3.D

PE: PS1-2, PS1-6, PS3-4</td><td>Essential Questions:</td><td>Why don’t some reactions go to completion?
If reactions are reversible, how can we define what reactants and products are?</td></tr>
<tr><td>Time Frame:</td><td>1 week</td><td>AP Chemistry Big Idea</td><td>AP Chemistry Learning Objectives</td><td>Materials:</td><td>Textbook, Notes, Lab Equipment, Worksheets, Computers</td></tr>
<tr><td></td><td></td><td>6.A.1-4, 6.B.1,2</td><td>6.1-6.10</td><td></td><td></td></tr>
<tr><td>Content:</td><td colspan="3">Chapter 13 – Chemical Equilibrium</td><td>Student Learning Objectives:</td><td>-Students will calculate reaction quotients and equilibrium constants from given concentrations.
-Students will model reversible reactions and explain how different variables can affect equilibrium concentrations.</td></tr>
<tr><td>Engagement
Anticipatory Set</td><td colspan="5">Bozeman Science – http://www.bozemanscience.com/ap-chemistry/ - 62-67
PHET Simulation – http://phet.colorado.edu/en/simulation/legacy/reversible-reactions -</td></tr>
<tr><td>Exploration
Student Inquiry</td><td colspan="5">Flinn POGIL – Reaction Quotient
OWL Assignment for Chapter 13</td></tr>
<tr><td>Explanation
Concepts and Practices</td><td colspan="5">NMSI – 13 - General Equilibrium.pdf -
Zumdahl Chapter 13 Presentation and selected chapter questions</td></tr>
<tr><td>Elaboration
Extension Activity</td><td colspan="5">Guided Inquiry: Applications of LeChâtelier's Principle (using $CoCl_2$) Lab</td></tr>
<tr><td>Evaluation
Assessments</td><td colspan="3">Formative
POGIL Results
Chapter and AP Practice Questions</td><td colspan="2">Summative
Chapter 13 Assessment
Lab Report</td></tr>
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<table>
<tr><td>Unit:</td><td>Acid-Base Equilibrium</td><td>NJ Student Learning Standards:</td><td>DCI: PS1.A, PS1.B, PS3.B, PS3.D
PE: PS1-2, PS1-6, PS3-4</td><td>Essential Questions:</td><td>Why don’t some reactions go to completion?
If reactions are reversible, how can we define what reactants and products are?
Why is water such an important substance to study?</td></tr>
<tr><td rowspan="2">Time Frame:</td><td rowspan="2">3 weeks</td><td>AP Chemistry Big Idea</td><td>AP Chemistry Learning Objectives</td><td rowspan="2">Materials:</td><td rowspan="2">Textbook, Notes, Lab Equipment, Worksheets, Computers</td></tr>
<tr><td>6.A.1-4, 6.B.1,2</td><td>2.1, 2.2, 3.7, 6.1, 6.11-6.16</td></tr>
<tr><td>Content:</td><td colspan="3">Chapter 14 – Acids and Bases
Chapter 15 – Acid-Base Equilibria</td><td>Student Learning Objectives:</td><td>Students will model acid-base reactions and predict products and final concentrations.
Students will calculate pH and pOH.</td></tr>
<tr><td>Engagement
Anticipatory Set</td><td colspan="5">Bozeman Science – http://www.bozemanscience.com/ap-chem-068-equilibrium-reasoning -
Bozeman Science – http://www.bozemanscience.com/ap-chem-069-ph -
PHET Simulation – http://phet.colorado.edu/en/simulation/acid-base-solutions -
PHET Simulation – http://phet.colorado.edu/en/simulation/ph-scale -</td></tr>
<tr><td>Exploration
Student Inquiry</td><td colspan="3">Flinn POGIL – Strong vs. Weak Acids
Flinn POGIL – Calculating pH
Flinn POGIL – Common Ion in Acid Ionization
Flinn POGIL – Buffers</td><td colspan="2">Flinn POGIL – Strength of Acids
Flinn POGIL – Titration Curves
OWL Assignment for Chapters 14 and 15</td></tr>
<tr><td>Explanation
Concepts and Practices</td><td colspan="5">NMSI – 15 - AcidsBases.pdf –
NMSI – 15 - Buffers Made Easy.pdf –
NMSI – 15 - Demystifying Titration Curves.pdf -
Zumdahl Chapter 14 and 15 Presentation and selected chapter questions</td></tr>
<tr><td>Elaboration
Extension Activity</td><td colspan="5">Buffers in Household Products Lab
Properties of Buffer Solutions Lab</td></tr>
<tr><td>Evaluation
Assessments</td><td colspan="3">Formative
POGIL Results
Chapter and AP Practice Questions</td><td colspan="2">Summative
Chapter 14 and 15 Assessment
Lab Report</td></tr>
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<table>
<tr><td>Unit:</td><td>Solubility and Complex Ion Equilibrium</td><td>NJ Student Learning Standards:</td><td>DCI: PS1.A, PS1.B, PS3.B, PS3.D
PE: PS1-2, PS1-6, PS3-4</td><td>Essential Questions:</td><td>Why don’t some reactions go to completion?
If reactions are reversible, how can we explain what reactants and products are?
Why is water such an important substance to study?</td></tr>
<tr><td rowspan="2">Time Frame:</td><td rowspan="2">2 weeks</td><td>AP Chemistry Big Idea</td><td>AP Chemistry Learning Objectives</td><td rowspan="2">Materials:</td><td rowspan="2">Textbook, Notes, Lab Equipment, Worksheets, Computers</td></tr>
<tr><td>6.A.1-4, 6.B.1,2</td><td>1.20, 3.3, 6.1, 6.12-6.23</td></tr>
<tr><td>Content:</td><td colspan="3">Chapter 16 – Solubility and Complex Ion Equilibria</td><td>Student Learning Objectives:</td><td>Students will model solubility reactions for a variety of ionic and covalent substances.
Students will determine solubility concentrations after adding substances to water.</td></tr>
<tr><td>Engagement
Anticipatory Set</td><td colspan="5">Bozeman Science – http://www.bozemanscience.com/ap-chem-070-solubility -
PHET Simulation - http://phet.colorado.edu/en/simulation/legacy/soluble-salts -
PHET Simulation - http://phet.colorado.edu/en/simulation/concentration -</td></tr>
<tr><td>Exploration
Student Inquiry</td><td colspan="5">Flinn POGIL – Common Ion Effect on Solubility
Flinn POGIL – Fractional Precipitation
OWL Assignment for Chapter 16</td></tr>
<tr><td>Explanation
Concepts and Practices</td><td colspan="5">NMSI – 16 - Solubility Equilibria.pdf -
Zumdahl Chapter 16 Presentation and selected chapter questions</td></tr>
<tr><td>Elaboration
Extension Activity</td><td colspan="5">Ksp of Calcium Hydroxide</td></tr>
<tr><td>Evaluation
Assessments</td><td colspan="3">Formative
POGIL Results
Chapter and AP Practice Questions</td><td colspan="2">Summative
Chapter 16 Assessment plus 12-15 Review
Lab Report</td></tr>
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<table>
<tr><td>Unit:</td><td>Entropy and Free Energy</td><td>NJ Student Learning Standards:</td><td>DCI: PS3.A, PS3.B, PS3.D
PE: PS3-1, PS3-2, PS3-4</td><td>Essential Questions:</td><td>Why don’t all chemical collisions result in a reaction?
Why do molecules become less ordered over time?</td></tr>
<tr><td rowspan="2">Time Frame:</td><td rowspan="2">2 weeks</td><td>AP Chemistry Big Idea</td><td>AP Chemistry Learning Objectives</td><td rowspan="2">Materials:</td><td rowspan="2">Textbook, Notes, Lab Equipment, Worksheets, Computers</td></tr>
<tr><td>5.E.1-5, 6.D.1</td><td>2.15, 5.3, 5.12-5.18, 6.25</td></tr>
<tr><td>Content:</td><td colspan="3">Chapter 17 – Spontaneity, Entropy, and Free Energy</td><td>Student Learning Objectives:</td><td>-Students will learn how entropy and enthalpy provide the driving force behind chemical reactions.
-Students will calculate free energy using Gibbs equation.</td></tr>
<tr><td>Engagement
Anticipatory Set</td><td colspan="5">Bozeman Science – http://www.bozemanscience.com/ap-chem-071-the-magnitude-of-the-equilibrium-constant -
Bozeman Science – http://www.bozemanscience.com/ap-chemistry/ - 57-61</td></tr>
<tr><td>Exploration
Student Inquiry</td><td colspan="5">Flinn POGIL – Free Energy
Flinn POGIL – Work, Equilibrium, and Free Energy
OWL Assignment for Chapter 17</td></tr>
<tr><td>Explanation
Concepts and Practices</td><td colspan="5">NMSI - 17 - Thermodynamics.pdf -
Zumdahl Chapter 17 Presentation and selected chapter questions</td></tr>
<tr><td>Elaboration
Extension Activity</td><td colspan="5">Delta G Demonstration (concentrated HCl and $NaHCO_3$)</td></tr>
<tr><td>Evaluation
Assessments</td><td colspan="3">Formative
POGIL Results
Chapter and AP Practice Questions</td><td colspan="2">Summative
Chapter 17 Assessment
Lab Report</td></tr>
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<table>
<tr><td>Unit:</td><td>Electrochemistry</td><td>NJ Student Learning Standards:</td><td>DCI: PS3.A, PS3.B, PS3.C, PS3.D
PE: PS3-1, PS3-3, PS3-5</td><td>Essential Questions:</td><td>-How can we use chemical reactions to create electrical energy that can power portable devices?
-Why do we have to recharge these devices regularly?
-Why do some metals rust, yet others do not?</td></tr>
<tr><td rowspan="2">Time Frame:</td><td rowspan="2">2 weeks</td><td>AP Chemistry Big Idea</td><td>AP Chemistry Learning Objectives</td><td rowspan="2">Materials:</td><td rowspan="2">Textbook, Notes, Lab Equipment, Worksheets, Computers</td></tr>
<tr><td>3.C.3</td><td>3.2, 3.8, 3.12, 3.13, 5.15, 6.1</td></tr>
<tr><td>Content:</td><td colspan="3">Chapter 18 – Electrochemistry</td><td>Student Learning Objectives:</td><td>-Students will balance electron transfer reactions and determine which substances are oxidized and reduced.
-Students will learn how to calculate cell voltages for galvanic and electrolytic chemical cells.</td></tr>
<tr><td>Engagement
Anticipatory Set</td><td colspan="5">Bozeman Science – http://www.bozemanscience.com/ap-chem-034-electrochemistry -</td></tr>
<tr><td>Exploration
Student Inquiry</td><td colspan="5">Flinn POGIL – Electrochemical Cell Voltage
Flinn POGIL – Faraday’s Law
OWL Assignment for Chapter 18</td></tr>
<tr><td>Explanation
Concepts and Practices</td><td colspan="5">NMSI - 18 - Electrochemistry.pdf -
Zumdahl Chapter 18 Presentation and selected chapter questions</td></tr>
<tr><td>Elaboration
Extension Activity</td><td colspan="5">Analysis of Hydrogen Peroxide Lab
Separating a Synthetic Pain Relief Mixture Lab</td></tr>
<tr><td>Evaluation
Assessments</td><td colspan="3">Formative
POGIL Results
Chapter and AP Practice Questions</td><td colspan="2">Summative
Chapter 18 Assessment
Lab Report</td></tr>
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<table>
<tr><td>Unit:</td><td>AP Chemistry Review</td><td>NJ Student Learning Standards:</td><td>All Standards</td><td>Essential Questions:</td><td></td></tr>
<tr><td rowspan="2">Time Frame:</td><td rowspan="2">1 week</td><td>AP Chemistry Big Idea</td><td>AP Chemistry Learning Objectives</td><td rowspan="2">Materials:</td><td rowspan="2">Past AP Chemistry Exams</td></tr>
<tr><td>All Standards</td><td>All Standards</td></tr>
<tr><td>Content:</td><td colspan="3">AP Chemistry Exam Review</td><td>Student Learning Objectives:</td><td>Students will prepare for the AP Chemistry Exam given during the first week of May.</td></tr>
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<table>
<tr><td>Unit:</td><td>After the Exam</td><td>NJ Student Learning Standards:</td><td>DCI: LS1.A
PE: LS1-6</td><td>Essential Questions:</td><td>How can we apply chemistry to other sciences and to everyday life?
How can we use chemistry to explain phenomena?</td></tr>
<tr><td rowspan="2">Time Frame:</td><td rowspan="2">4 weeks</td><td>AP Chemistry Big Idea</td><td>AP Chemistry Learning Objectives</td><td rowspan="2">Materials:</td><td rowspan="2">Textbook, Notes, Lab Equipment, Worksheets, Computers</td></tr>
<tr><td>All Standards</td><td>All Standards</td></tr>
<tr><td>Content:</td><td colspan="3">Chapter 19 – The Nucleus: A Chemist’s View
Chapter 20 – The Representative Elements
Chapter 21 – Transition Metals and Coordination Chemistry
Chapter 22 – Organic and Biological Molecules</td><td>Student Learning Objectives:</td><td>Students will learn about nuclear power.
Students will learn about the uses of different elements.
Students will learn about organic molecules.</td></tr>
<tr><td>Engagement</td><td colspan="5">Students will choose two of the chapters and complete a project about them.</td></tr>
<tr><td>Exploration</td><td colspan="5">Students will use their textbooks and the internet to compile information for their project.</td></tr>
<tr><td>Explanation</td><td colspan="5">Students will create informational packets and presentations, related to their chosen chapters, to give to other students</td></tr>
<tr><td>Elaboration</td><td colspan="5">Half-Life Simulation Lab
Carbon Dating Activity
Synthesis of a Coordination Compound Lab
Synthesis of Esters Lab</td></tr>
<tr><td>Evaluation</td><td colspan="3">Formative
Daily Work</td><td colspan="2">Summative
Final Project
Lab Reports</td></tr>
</table>