

BERKELEY HEIGHTS PUBLIC SCHOOLS
BERKELEY HEIGHTS, NEW JERSEY

**GOVERNOR LIVINGSTON HIGH SCHOOL
SCIENCE DEPARTMENT**

CHEMISTRY HONORS

#0445

Curriculum Guide

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This curriculum may be modified through varying techniques,
strategies, and materials, as per an individual student's
Individualized Educational Plan (IEP).

Approved by the Berkeley Heights Board of Education
at the regular meeting held on _____.

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***Note: New Jersey Core Curriculum Content Standards can also be viewed at
www.state.nj.us**

PHILOSOPHY/RATIONALE

Chemistry Honors (#445) is designed to develop scientifically literate citizens who can use technology to investigate and explain the world around them. Using the scientific approach of observing, hypothesizing, testing, and analyzing, students explore the properties of matter and energy. While acquiring laboratory techniques, alone or in groups, students develop workplace skills to prepare them for the future. Students communicate their acquired knowledge through oral, written, or physical means of expression.

The curriculum introduces the scientific method, the acquiring of data using the Systeme Internationale of standard measurement and the presentation of this information. Students are made aware of how mathematics is a valuable tool for scientific inquiry. In conjunction with learning the International Union of Pure and Applied Chemists (IUPAC) system of nomenclature, students can appreciate the ease and rationale for using these approaches. With this background, students acquire knowledge of the elements and their stoichiometry when forming compounds. Students delve into the concepts of bonding, thermodynamics, states of matter, atomic theory, periodicity, rates of reactions, acidity, and redox reactions, which are all integral to a fundamental knowledge of chemistry.

Chemistry Honors is intended for students in grade 10 or 11. The prerequisite for the course is successful completion of Biology. Six (6) credits are earned for successful completion of this two-semester course. The New Jersey Core Curriculum Content Standards for Science and the New Jersey Core Curriculum Content Standards for Workplace Readiness have been integrated throughout the curriculum

COURSE PROFICIENCIES

COURSE OBJECTIVES

1. To promote scientific literacy.
2. To assist students in developing thinking processes for solving scientific problems.
3. To help students develop an appreciation for the theoretical and mathematical aspects of chemistry.
4. To help students to become familiar with basic laboratory procedures.
5. To suggest how chemistry relates to student's everyday lives.

STUDENT PROFICIENCIES

The student will be able to:

1. Recognize how knowledge obtained for the study of chemistry can be applied in your life. 9.1/B9; 9.2/A3, F1-5
2. Explain why communication is an important aspect of obtaining scientific knowledge. 5.1/A1-4; 8.1/A2, B6,13; 9.1/B2
3. Describe the function of the scientific method and be able to apply in analyzing a problem. 5.1/A1, B1,2, C1; 8.1/B10, B12
4. Use SI units to express quantities and numbers when constructing tables and graphs to organize data, with density as an example. 5.3/A1, B1, D1
5. Determine density by interpreting graph and obtained data. 5.3/A1
6. Observe how chemical and physical properties of matter can be used to distinguish elements and compounds. 5.6/A6
7. Distinguish between elements and compounds on the submicroscopic level using the atomic model. 5.6/A3,4
8. Summarize information about the elements and their properties from the periodic table emphasizing the relationship to the formulas of ionic compounds. 5.6/A3-5
9. Explain the difference between exothermic and endothermic reactions from balanced equations, using the concepts of kinetic and potential energy. 5.6/B2; 5.7/B1
10. Calculate percent composition by mass and empirical formulas of compounds using the concepts of moles, mole mass, and molarity. 5.3/A1
11. Recognize significant digits in a recorded measurement and determine the number of significant digits in a calculated value. 5.3/A1
12. Calculate the percent yield of a product using the ratio of experimental mass produced to theoretical mass predicted. 5.3/A1
13. Predict gas behavior in terms of pressure, volume, moles, and temperature using Avogadro's Principle and Charles's, Dalton's, Boyle's, Guy-Lussac, and Graham's Laws in addition to the Ideal Gas Law. 5.2/B1; 5.6/A6, B1

STUDENT PROFICIENCIES (continued)

14. Describe the early evolution of the atomic model, emphasizing the role of technology in developing the models of Dalton, Thomson, Rutherford, and Bohr. (5.2/B1-3; 5.6/A1,8; 8.2/A3)
15. Apply the concepts of radioisotopes, fusion, fission and nuclear decay to understand a half-life, including how to predict the age of a fossil and determine nuclear waste hazards. (5.2/A1; 5.7/A5; 5.8/D1; 5.10/B2)
16. Compare and contrast regions of the electromagnetic spectrum, relating them to the wave probability model of the atom and orbital theory. (5.3/D1; 5.6/A8; 5.7/A4)
17. Interpret Mendeleev's first and Moseley's modern periodic tables descriptions of metals, nonmetals, and metalloids in terms of electron configuration, valence electrons, ionization energies, and atomic size. (5.6/A2,3,5,8; 5.8/C2)
18. Use Lewis diagrams and molecular models to describe and predict patterns and behavior of ionic, polar, and non-polar molecules. (5.6/A4; 5.7/A6)
19. Describe how intermolecular forces influence the states of matter and other properties such as vapor pressure, surface tension, and three-dimensional submicroscopic structure formations. (5.6/A7; 5.7/A4)
20. Relate properties of solutions in terms of solubility, emphasizing the role of concentration in altering physical properties and reaction rates. (5.6/B1)
21. Use calorimetry, specific heat, Hess's Law, and Gibbs free energy equation to identify thermodynamic energy flow. (5.7/B1,2)
22. Explain that reaction rates and equilibrium in terms of kinetic theory and that both are affected by the nature of the reactants, concentration, pressure, temperature, and the presence of a catalyst, emphasizing LeChatelier's principle. (5.6/B1)
23. Use Bronsted-Lowry definitions to describe acids and bases in terms of pH, dissociation constants, and equilibrium, including the titration as a technique to identify neutralization reactions and buffering ability. (5.6/B1; 9.2/A1, F3)
24. Describe voltaic cells in terms of oxidation-reduction equations and agents and use this information in describing electrochemical concepts of voltage, current, electrolysis, and corrosion. (5.6/A3,4)
25. Identify and describe organic molecules and their functional groups in terms of the IUPAC system to differentiate types of organic. (5.5/A1)

STUDENT PROFICIENCIES (continued)

26. Compare and contrast basic biological molecules to describe simple biological reactions.
(5.5/A1; 5.6/A7)

METHODS OF EVALUATION

Methods of evaluation that are used in Chemistry Honors include but are not limited to:

1. Tests.
2. Quizzes.
3. Assignments.
4. Class Participation.
5. Special Assignments.
6. Laboratory Reports.
7. Mid-year and Final Examinations.

SCOPE AND SEQUENCE
COURSE OUTLINE/STUDENT OBJECTIVES

The student will be able to:

N.J. Core Curriculum Standards	Indicators	Course Outline/Student Objectives *(see note at end of outline)
5.1 5.3 8.1 9.1 9.2	A1-4 B1,2 C1 A1 B1 D1 A2 A3 B9 F1-5	I. An Introduction to Chemistry A. Apply the Scientific Method to Solve Problems B. Use the Metric System for Data Collection and Analysis C. Write Formal Laboratory Reports D. Use Scientific Notation to Analyze Data E. Use Dimensional Analysis for Unit Conversions F. Identify Uncertainty in Measured Quantities G. Distinguish Between Accuracy and Precision H. Report and Manipulate Data Using the Correct Number of Significant Digits I. Graph Analyzed Data Effectively J. Use the Bunsen Burner K. Weigh Materials Using Various Balances L. Measure Volumes and Calculate Densities M. Recognize and Locate Safety Equipment in Laboratory N. Recognize and Eliminate Safety Hazards in the Laboratory O. Recognize and Use Common Laboratory Glassware and Hardware
5.6	A3,4,6	II. Concepts of Matter A. Describe the Properties of Elements and Compound B. Recognize and Describe Pure Substances C. Name Compounds and Write Formulas D. Define, Identify, and Prepare Solutions E. Separate Mixtures by Various Techniques F. Employ the Mole Concept to Solve Problems G. Define & Solve Problems Involving Molar Volume H. Explain the Significance and Utility of Avogadro's Number I. Work with Empirical Formulas J. Compute Percent Composition
5.3 5.6	A1 A6	III. Stoichiometry A. Represent Chemical Reactions Symbolically B. Balance Equations C. Perform Mass-Mass Computations D. Solve Mass-Volume Problems E. Solve Volume-Volume Problems

		<p>III. Stoichiometry (continued)</p> <p>F. Distinguish Between Composition, Decomposition, Replacement, and Ionic Reactions</p>
<p>5.2</p> <p>5.6</p>	<p>B1</p> <p>A6</p> <p>B1</p>	<p>IV. Gases and the Gas Laws</p> <p>A. Explain Gas Behavior in Terms of the Kinetic Molecular Theory</p> <p>B. Explain the Origin of Pressure of a Contained Gas</p> <p>C. Manipulate the Various Pressure Units Commonly Employed by Chemists</p> <p>D. Read a Barometer and Explain How it Works</p> <p>E. Read a Manometer and Explain How it Works</p> <p>F. Describe Temperature in Terms of the Celsius, Fahrenheit, and Kelvin Scales</p> <p>G. Apply Boyle's Law to Relate Changes in Gas Pressure and Volume</p> <p>H. Apply Charles Law to Relate Changes in Gas Volume & Temperature</p> <p>I. Apply the Gay-Lussac Law to Relate Changes in Gas Pressure and Temperature</p> <p>J. Predict Changes in Gas Behavior When More Than One Property is Altered Using the General Ideal Gas Law</p> <p>K. Account for the Relative Rates of Diffusion of Different Gases Using Graham's Law</p> <p>L. Describe the Net Pressure of Gas Mixtures Using Dalton's Law of Partial Pressure</p>
<p>5.2</p> <p>5.6</p> <p>8.2</p>	<p>B1-3</p> <p>A1,8</p> <p>A3</p>	<p>V. Structure of the Atom</p> <p>A. Describe the Early Models of the Atom</p> <p>B. Relate the Critical Experiments Which Provide Evidence in Support of the Modern Atomic Model</p> <p>C. Describe the Wave Properties of the Electro-Magnetic Spectrum</p> <p>D. Explain the Production of Light in Terms of Electron Configuration Using the Principles of Quantum Mechanics</p> <p>E. Predict Electron Configurations of Atoms</p> <p>F. Place Electrons in Appropriate Energy Levels and Orbitals</p>
<p>5.2</p> <p>5.7</p> <p>5.8</p> <p>5.9</p> <p>5.10</p> <p>8.2</p>	<p>A1</p> <p>A5</p> <p>D1</p> <p>B1</p> <p>B2</p> <p>A3</p>	<p>VI. Nuclear Chemistry</p> <p>A. Recognize the Properties of Radioactive Elements</p> <p>B. Predict Nuclear Stability</p> <p>C. Classify Radiation as Either Alpha, Beta, or Gamma Decay</p> <p>D. Describe the Mechanism of a Mass Spectrometer</p> <p>E. Determine the Mass Loss in a Given Nuclear Decay</p> <p>F. Calculate Energy Release Using Einstein's Equation</p> <p>G. Use Half-Life to Determine Age Materials, Such as Fossils</p> <p>H. Determine Hazards Posed by Nuclear Waste</p>

5.6 5.8	A2,3,5,8 C2	VII. Periodicity, Periodic Law, and the Periodic Table A. Compare and Contrast Mendeleev's Table and Moseley's Modern Periodic Table of the Elements B. Identify the Different Families and Their Properties in the Periodic Table C. Identify Different Regions of the Periodic Table D. Predict Trends in Chemical Behavior
5.6 5.7	A2-5,7,8 A4,6	VIII. Chemical Bonding A. Identify Covalent Bonding in Compounds B. Apply the Octet Rule C. Draw Lewis Diagrams to Predict Bond Formation D. Predict Bond Order E. Recognize Resonant Structures F. Identify Polar Covalent Bond from Electronegativities G. Identify Coordinate Covalent Bonds H. Predict Molecular Geometry from Bonding Capacity I. Explain the Role of Hybridization in Bonding J. Recognize Ionic Bonding K. Define and Identify Electrolytes L. Relate Multi-Directional Ionic Bonding to the Formation of a Crystal Lattice M. Explain the Role That Water Plays in the Dissociation of Ionic Compounds N. Identify Intermolecular Attractions O. Explain Van Der Waals Forces P. Account for Molecular Polarity Q. Predict the Occurrence of Hydrogen Bonding R. Identify London Dispersion Forces S. Describe the Nature of Bonding in Metals and How it is Responsible for Metallic Properties T. Describe Network Solids
5.6 5.7	A7 A4	IX. States of Matter and Phase Change A. Describe the Evaporation-Condensation Processes B. Account for the Variety of Boiling Points from Different Materials C. Account for Differences in Vapor Pressure for Different Materials D. Account for Differences in Melting Points from Different Materials E. Explain the Phenomenon of Sublimation and Deposition
5.7	B1,2	X. Thermodynamics A. Name and Define Molar Heat of Fusion and Molar Heat of Vaporization B. Determine Specific Heat of a Substance C. Apply the Principles of Calorimetry to Solve Problems Involving Heats of Reaction for Exothermic and

		<p>X. Thermodynamics (continued)</p> <p>Endothermic Reactions with the Aid of Hess's Law</p> <p>D. State & Explain Entropy and Enthalpy of Chemical Reactions in Terms of Gibbs Free Energy</p>
5.6	B1	<p>XI. Rates of Chemical Reaction</p> <p>A. State the Basic Principles of Collision Theory</p> <p>B. Measure Rates of Chemical Reactions</p> <p>C. Enumerate and Describe the Kinetics of Homogenous and Heterogeneous Reaction Systems</p> <p>D. Explain How the Nature of the Reactants Affects Kinetics</p> <p>E. Relate Reactant Concentration to Reaction Rates</p> <p>F. Relate the Temperature of the Reaction System to the Rate of Product Formation</p> <p>G. Describe the Effect of a Catalyst on a Reaction</p> <p>H. Explain the Significance of the Different Parts of a Potential Energy Diagram for a Chemical Reaction</p> <p>I. Discuss the Significance of the Term Activation Energy</p> <p>J. Describe the Activated Complex</p> <p>K. Compute Heats of Reaction</p>
5.6	B1	<p>XII. Chemical Equilibrium</p> <p>A. Enumerate the Conditions for Chemical Equilibrium</p> <p>B. Describe the Nature of a Dynamic Equilibrium</p> <p>C. Apply Le Chatelier's Principle to Predict Shifts in Chemical Equilibria Due to Changes in Concentration, Pressure, Temperature, and the Addition of a Catalyst</p>
5.6	B1,2	<p>XIII. Solutions</p> <p>A. Express Solution Concentrations in Terms of Molarity and Molality</p> <p>B. Predict Amount of Solid Product Formed in Reactions That Take Place in Solution</p> <p>C. Predict Changes in Solubility Arising from Changes in Temperature</p> <p>D. Predict Changes in Solubility Due to Pressure Changes</p> <p>E. Describe the Causes of Dissociation</p> <p>F. Define and Describe the Ionization Process</p> <p>G. Define Hydration</p> <p>H. Explain Colligative Properties of Solutions</p> <p>I. Describe Effects of Solute on Vapor Pressure</p> <p>J. Explain Boiling Point Elevation</p> <p>K. Explain Freezing Point Depression</p> <p>L. Perform Computations Using Molality</p> <p>M. Predict Changes in Vapor Pressure with Changes in Solution Composition</p>
5.6 9.2	B1 A1 F3	<p>XIV. Acids, Bases, and Salts</p> <p>A. Explain the Arrhenius Theory of Acids and Bases</p> <p>B. Discuss the Dissociation Constant for Water</p>

		<p>XIV Acids, Bases, and Salts (continued)</p> <p>C. Explain in Detail the pH and pOH Scales of Acidity</p> <p>D. Perform Titrations and Select Indicators</p> <p>E. Describe the Role and Uses of Buffers</p> <p>F. Account for the Behavior of Acid & Bas Anhydrides in Solution</p> <p>G. Predict the Strength of an Acid from its K_a Value</p> <p>H. Explain the Bronsted-Lowry Theory of Acids and Bases</p> <p>I. Define and Identify Lewis Acids</p>
5.7	B1,2	<p>XV. Solubility Equilibrium</p> <p>A. Explain and Solve Problems Involving Solubility Product Constants</p> <p>B. Predict the Formation of Precipitates</p> <p>C. Write Net Ionic Equations</p>
5.6	A3,4	<p>XVI. Oxidation-Reduction Reactions</p> <p>A. Enumerate the Oxidation Number Rules</p> <p>B. Define Essential Redox Terms</p> <p>C. Predict Redox Reactions</p> <p>D. Balance Redox Reactions</p> <p>E. Describe a Standard Half-Cell</p> <p>F. Calculate Cell Voltages</p> <p>G. Describe Electrolysis and Corrosion in Redox Terms</p>
5.5 5.6	A1 A7	<p>XVII. Organic Chemistry</p> <p>A. Classify Organic Compounds</p> <p>B. Distinguish Between Saturated and Unsaturated Hydrocarbons</p> <p>C. Identify Alkanes, Alkenes, Alkynes, and Aromatics</p> <p>D. Identify Various Functional Groups</p> <p>E. Identify Isomers</p> <p>F. Name Hydrocarbons Using IUPAC System</p> <p>G. Identify Basic Biological Molecules and Their Function</p>

*Note: New Jersey Core Curriculum Content Standards can also be viewed at www.state.nj.us

RESOURCES/ACTIVITIES GUIDE

Text:

Herron, Frank, Sarquis, Schrader, & Kukla
Chemistry
D.C. Heath & Company
1993

Websites:

<http://www.chemistry.org>
Website for the American Chemical Society

SUGGESTED AUDIO VISUAL/COMPUTER AIDS

1. Proxima LCD Projector.
2. Microsoft PowerPoint Software.
3. Microsoft Word Software.
4. Microsoft Internet Explorer Software.

SUGGESTED MATERIALS

Resources for Students (available at IMC)

Text:

Lagowski (ed.)
Macmillan Encyclopedia of Chemistry
Simon & Schuster Macmillan
1997

Websites:

<http://www.classzone.com>
Students self-quiz site available through Houghton Mifflin Company (formally
D.C. Heath & Company)

Resources for Teacher (available at IMC or in Department)

Text:

Knapp
Chem Lab Series 1-12
Atlantic Europe Publishing Company, Ltd.
1998
Contains demonstrations on various chemistry topics

Foglino
Cracking the AP Chemistry Exam
2002
Contains an overview of curriculum concepts

Lab Manual:

Hall, Schrader, Walsh, Kukla, Beach, Gammon, & Young
Chemistry Laboratory Experiments
D.C. Heath & Company
1996

Website:

[http:// www.chemfiesta.com](http://www.chemfiesta.com)
Contains free worksheets for students.