Equinox Program

Course Title: Chemistry Honors

Course Description

How does an atom account for the nature of matter? In this course, participants investigate this question and many others as they study the modern principals of chemistry, including atomic models, valence and ionization, bonding, nomenclature of formulas, moles, stoichiometry, gas laws, molecular forces, polarity, solutions, equilibrium, acids and bases, thermochemistry, and oxidation-reduction. Through experiments, students learn to use proper lab technique, record and analyze data and produce scientific lab reports.

This course covers topics equivalent to a full year of honors-level high school chemistry. Due to the rigor and magnitude of the course content, students must exhibit independence and self-motivation to succeed in this course.

Essential Questions

- How do the interactions of matter and energy explain visible phenomena in the world around us?
- How do we design, conduct, communicate about, and evaluate scientifically valid experiments that examine and apply scientific principles?

Outcomes

Upon successful completion of this course, students will be able to:

- describe, explain, and model chemical and physical processes at the molecular level in order to explain macroscopic properties;
- explain qualitative chemical concepts and trends clearly;
- solve quantitative chemistry problems and demonstrate reasoning clearly and completely;
- integrate multiple ideas in the problem-solving process and check results to make sure they are physically reasonable;
- employ critical thinking and hypothesis-driven methods of scientific inquiry;
- perform laboratory techniques correctly, using appropriate safety procedures;
- analyze the results of laboratory experiments, evaluate sources of error, synthesize this information, and express it clearly in written laboratory reports.

Instructional Strategies

In this course, students must master a large amount of information in a short period of time. To help students succeed, large-group discussions in which principles and concepts are introduced will be a dialogue between the instructor and students. Students will also practice new skills by working through a variety of conceptual and quantitative problems in flexible groups. Additionally, students will work in collaborative teams to solve complex problems and to design and execute lab experiments as they synthesize new chemistry content and laboratory skills.

Resources and Materials

- **Books**
  - Modern *Chemistry*, Davis, R., Frey, R., Sarquis, M., and Sarquis, J. Harcourt College Publishers, 2009. (ISBN: 9780030367861)
- **Materials**
  - Pencil/Pen
  - Scientific or graphing calculator
  - Three-ring binder (at least 1") with loose-leaf paper
- **Laboratory Dress Code**
  - Students must wear long pants (covering the ankles), close-toed shoes, and short-sleeved shirts every day, due to safety regulations at all Northwestern University laboratories.

Student Assessment

- **Pre-Assessment**
  The American Chemical Society (ACS) publishes a standardized, multiple choice chemistry exam which tests the concepts that should be covered in a comprehensive first-year chemistry course. Students will take this exam on the first day of class.

- **CTD Grading Scale**

A+	100-97%	A	96-93%	A-	92-90%
B+	89-87%	B	86-83%	B-	82-80%
C+	79-77%	C	76-73%	C-	72-70%
D+	69-67%	D	66-63%	D-	62-60%
F	below 60%				

- **Breakdown of Final Grade**
  - **45% Tests & Quizzes:** Given the accelerated nature of this course, approximately 1-2 chapters will be covered each day. Each day there will be a short test covering the previous day's material.
  - **25% Laboratory:** Laboratory experiments will be conducted daily. For each experiment, students will either write a formal lab report or answer lab questions in their lab manuals.
  - **20% Final Exam:** Students will take a comprehensive exam on the last day of class, covering the entire scope of the course.
  - **10% Homework:** Homework will be assigned every night and collected daily. The purpose of homework is to reinforce and practice concepts learned in class that day, and to prepare students for the next day's topics. Due to the fast pace of the course, students must take this responsibility seriously.

- **Post-Assessment**
  On the last day of class, students will take an ACS standardized chemistry exam, which will be similar to the pre-assessment.

Schedule

Date	Topics	In-class Activities	Assignments/Assessments
Sunday		Introductions	Read ch. 1-2 in textbook
Day 1 Monday	Introduction to matter & measurement	• Pre-test • Discuss scientific methods, measurement, sig figs, dimensional analysis, error, matter & changes • Lab: Thickness of Aluminum • Lab: Intro to Measurement	• Ch. 1-2 problem set • Read ch. 10-11 (skip 11.3) • Lab reports

Date	Topics	In-class Activities	Assignments/Assessments
Day 2 Tuesday	Gases	**Test: Intro to Measurement & Matter** • Discuss states of matter, kinetic molecular theory, pressure & gas laws • Computer Lab: Gas Law Simulations • Lab: It's a Gas stations • Lab: Molar Mass of Butane	• Ch. 10-11 problem set • Read ch. 3, 4, & 22 • Lab reports
Day 3 Wednesday	Atoms & Nuclear chemistry	**Test: Gases** • Discuss atomic structure & history, isotopes, electron configurations, nuclear decay, and half-lives • Lab: Flame Test • Lab: Candium	• Ch. 3, 4, & 22 problem set • Read ch. 5 & 6 • Lab reports
Day 4 Thursday	Periodic Table & Bonding	**Test: Atoms & Nuclear Chemistry** • Discuss periodic properties (Alien Periodic Table Activity), trends, covalent bonding, ionic bonding (Ionic Bonding Activity), Lewis structures, VSEPR theory, intermolecular forces • Lab: Molecular Models • Lab: Ionic or Covalent?	• Ch. 5 & 6 problem set • Read ch. 7.1 & ch. 8 • Lab reports
Day 5 Friday	Nomenclature & Chemical reactions	**Test: Periodic Table & Bonding + Review of Week 1 Material** • Discuss naming ionic & covalent compounds, types of chemical reactions, balancing chemical reactions, and predicting products • Activity: Balancing Reactions • Lab: Reaction Types	• Ch. 7 & 8 problem set • Read ch. 3.3 & ch. 7.3-7.4 • Lab reports
Day 6 Monday	Stoichiometry Part 1	**Test: Nomenclature & Reactions** • Discuss mole concept, empirical & molecular formulas, mole-mole conversions • Lab: Percent Yield (Day 1) • Lab: Formula of a Hydrate	• Ch. 3.3 & ch. 7.3-7.4 problem set • Read ch. 9 & ch. 11.3 • Lab reports
Day 7 Tuesday	Stoichiometry Part 2	**Test: Stoichiometry Part 1** • Discuss mass-mass conversions, mass-volume conversions, limiting reactants, percent yield • Lab: Percent Yield (Day 2) • Lab: Decomposition of Baking Soda	• Ch. 9 & ch. 11.3 problem set • Read ch. 13 & 14 • Lab reports

Date	Topics	In-class Activities	Assignments/Assessments
Day 8 Wednesday	Solutions & Colligative Properties	**Test: Stoichiometry Part 2** • Discuss types of mixtures, concentrated vs. dilute, molarity, solubility curves, precipitation reactions • Lab: Solutions & Dilutions • Lab: Precipitates & Solubility	• Ch. 13 & 14 problem set • Read ch. 17.1-17.2 • Lab reports
Day 9 Thursday	Thermochemistry	**Test: Solutions** • Discuss energy, heat, endothermic vs. exothermic, specific heat capacity, calorimetry, Hess' law, entropy, heating/cooling curves • Lab: Hess' Law • Lab: Using Specific Heat	• Ch. 17.1-17.2 problem set • Read ch. 17.3-17.4 & ch. 18 • Lab reports
Day 10 Friday	Kinetics & Equilibrium	**Test: Thermochemistry + Review of Week 2 Material** • Discuss factors affecting reaction rate, potential energy diagrams, equilibrium (Equilibrium Activity), K_{eq}, LeChat., rate laws • Lab: Alka Seltzer Reaction Rates • Lab: LeChatelier	• Ch. 17.3-17.4 & ch.18 problem set • Read ch. 15, 16, & 18.3 • Lab reports
Day 11 Monday	Acids & Bases	**Test: Kinetics & Equilibrium** • Discuss acid theories, pH, indicators, K_a & K_b, neutralization reactions, titrations (Virtual Titration Activity) • Labs: Power of Hydrogen & Good Titrations	• Ch. 15, 16, & 18.3 problem set • Read ch. 19 • Lab reports
Day 12 Tuesday	Redox & Electrochemistry	**Test: Acids & Bases** • Discuss oxidation numbers, balancing redox reactions, half reactions, voltaic and electrolytic cells, batteries • Labs: Quick Redox & Lemon Battery	• Ch. 19 problem set • Read ch. 20-21 • Lab reports
Day 13 Wednesday	Organic Chemistry	**Test: Redox & Electrochemistry** • Discuss hydrocarbons, nomenclature, functional groups, isomers, polymers • Labs: Esterification, Alkane Isomers, & Functional Groups	• Ch. 20-21 problem set • Review for final exam! • Lab reports
Day 14 Thursday	Review of Chemistry	**Test: Organic Chemistry** • Review Activities	• Study for final exam!

Date	Topics	In-class Activities	Assignments/Assessments
Day 15 Friday	Final Exam	**Final Exam**	Post-test

CTD Statement on Third-Party Web Sites

Instructors are required to thoroughly review any third-party web sites they intend to use in their courses for inappropriate content. However, because web content continuously changes, CTD disclaims any responsibility for any of the content contained on third-party web sites used in course materials. If you become aware of anything that may be inappropriate, please notify CTD staff immediately.