I. STUDENT LEARNING GOALS
A. To understand the chemical principles underlying the topics of:
   - reactions and stoichiometry,
   - solutions,
   - bonding and structure,
   - gases,
   - chemical equilibrium,
   - acid-base chemistry,
   - thermochemistry,
   - thermodynamics,
   - electrochemistry,
   - quantum and atomic theory.
B. To be able to apply this knowledge to a wide range of chemistry exercises in order to sharpen problem-solving skills. To accomplish this, student will:
   - memorize a core set of chemical terms, definitions, and equations (to be given);
   - apply knowledge directly to explain or predict the chemistry involved in sustainability topics;
   - transfer knowledge by applying the core principles to understand new and unfamiliar chemistry examples;
   - integrate knowledge and skills from various topics to address examples that incorporate several different chemical principles;
   - reason by combining an understanding of the core principles with general critical thinking and quantitative reasoning skills to solving these problems.
C. To recognize the application of this knowledge and these problem-solving methods to important sustainability challenges and solutions, including:
   - clean water and acid rain
   - clean air
   - greenhouse gases
   - ocean acidification
   - fossil fuels: challenges and future
   - sustainable agriculture
   - biofuels
   - hydrogen energy
   - solar energy
   - batteries

II. SCHEDULE (tentative)

<table>
<thead>
<tr>
<th>week of</th>
<th>topics</th>
<th>textbook reading</th>
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</thead>
<tbody>
<tr>
<td>Aug. 29</td>
<td>Topic 1: Sustainability and Chemistry</td>
<td></td>
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<tr>
<td>Sep. 5</td>
<td>Topic 2: Chemical Stoichiometry</td>
<td>Ch. 2, sections 7-9 and Ch. 3</td>
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<tr>
<td>Sep. 12</td>
<td>Topic 3: Chemical Reactions and Solutions</td>
<td>Ch. 4 sections 1-11</td>
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<tr>
<td>Sep. 19</td>
<td>Topic 4: Bonding and Structure</td>
<td>Ch. 13 sections 1-11, 13</td>
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<tr>
<td>Sep. 26</td>
<td>Topic 5: Gases</td>
<td>Ch. 5 sections 3-7, 12</td>
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<tr>
<td>Oct. 5</td>
<td>Mid-term Exam #1</td>
<td></td>
</tr>
<tr>
<td>Oct. 10</td>
<td>Topic 6: Chemical Equilibrium</td>
<td>Ch. 6 sections 1-2, 5-8</td>
</tr>
<tr>
<td>Oct. 17</td>
<td>Topic 7: Acid-Base Chemistry</td>
<td>Ch. 7 sections 1-6</td>
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<tr>
<td>Oct. 24</td>
<td>Topic 8: Thermochemistry</td>
<td>Ch. 9 sections 1-2, 4-8</td>
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<tr>
<td>Oct. 31</td>
<td>Topic 9: Thermodynamics</td>
<td>Ch. 10 sections 1, 3-13</td>
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<tr>
<td>Nov. 7</td>
<td>Topic 10: Electrochemistry</td>
<td>Ch. 11 sections 1-8</td>
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<tr>
<td>Nov. 18</td>
<td>Mid-term Exam #2</td>
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<tr>
<td>Nov. 28</td>
<td>Topic 11: Introduction to Quantum Theory</td>
<td>Ch. 12 TBA</td>
</tr>
<tr>
<td>Dec. 5</td>
<td>Topic 11 continued</td>
<td>Ch. 12 TBA</td>
</tr>
<tr>
<td>on Dec. 12</td>
<td>Final Exam 1:30-4:30 p.m.</td>
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</tbody>
</table>

Important CHEM 121.01 course materials (schedule, reading assignments, weekly problem sets, some lecture slides, exam information) are available at: [http://moodle.kenyon.edu](http://moodle.kenyon.edu) (log in and select CHEM 121.01). Some materials will not be distributed in class. Some class announcements will be made by e-mail to your Kenyon account.
III. INSTRUCTOR
Prof. Scott D. Cummings   phone: PBX 5355   e-mail: cumingss@kenyon.edu
office: Tomsich Hall 314   office hours: TBA
My schedule is posted on my office door and at:
http://chemistry.kenyon.edu/cummings/schedule.htm

IV. CLASS MEETING TIMES
Section 01 meets in Tomsich Hall 101 during period 2 (9:10-10 am on M,W,F).

V. REQUIRED MATERIALS
A. Steven S. Zumdahl’s Chemical Principles 6th edition and an OWL (online web learning) subscription. There are two options:
Option 1 is available from the Kenyon textbook department (kenyon.bkstr.com) or from major online booksellers. Option 2 is available from the publisher at www.CengageBrain.com. Please ensure you purchase the correct textbook edition. NOTE: used copies of Chemical Principals 6E likely do NOT include the needed OWL access code.
B. a basic scientific calculator – bring to every class.
C. (OPTIONAL) a molecular structure model set (Freeman; ISBN 9780716748229); may be useful in this and other chemistry courses.

VI. COURSE and COLLEGE POLICIES
A. PRE-REQUISITES:
   No prerequisite course, though most students will have completed a year of chemistry in high school. If you have not already, complete the Chemistry Placement Survey. The chemistry department uses this 20-minute survey/quiz to appropriately place students in the introductory course that best matches their chemistry background and demonstrated skills. We also track performance against this metric.
B. ATTENDANCE REQUIREMENTS:
   Class meetings are an important part of this course, and students are expected to attend all classes. Excessive absences will lead to a lower grade and may lead to expulsion from the course. I call your attention to the college policy on class attendance in the Course of Study:
   “Absences for reasons of illness are not ordinarily excused: only when a student is declared by the College physician to be infirm (in a hospital or at home) will a health report be sent from the Health and Counseling Center to the dean of students, giving the days when each patient is judged infirm and recommending that the student’s class absences be excused.”

   ONLY the Dean of Students (NOT the instructor) offers an Excused Absence. If you miss a quiz or in-class exam due to severe illness or emergency, your name must appear on the Dean of Students Excused Absence List in order to make up the work; otherwise a failing grade will be given. In the event of an absence from class, the student is responsible for securing any notes, handouts or announcements from the class.

   Student-Athletes: I call your attention to the college policy on class attendance in the Scheduling Guidelines for Athletic Contests (http://www.kenyon.edu/PreBuilt/provCASatleticsgl.doc). By the end of the first week of classes, please notify the professor all potential athletic conflicts, which should not exceed 10% of our semester meeting times (4 classes).
C. CLASSROOM ETIQUETTE:  
*Personal laptop computers are not allowed in the classroom.* To maintain a respectful learning environment, please *turn off cell phones*. Because of the room arrangement and capacity, please *be on time to class* and *refrain from leaving the room* during class, if possible.

D. ACADEMIC STANDARDS and HONESTY:  
I call to your attention the college policy on Maintenance of Academic Standards and Academic Honesty in the *Course of Study*. I am required to send Progress Reports for students performing below a grade level of C.

I run this and all my courses with the assumption of complete academic honesty by all students.

E. STUDENTS WITH DISABILITIES:  
If you have a physical, psychological, medical, or learning disability that may impact your ability to carry out assigned course work, I urge you to contact the Office of Disability Services at 5453. The Coordinator of Disability Services, Erin Salva (*salva@kenyon.edu*), will review your concerns and determine with you what accommodations are appropriate. ONLY the Coordinator of Disability Services can make accommodations, but please feel free to discuss your concerns in private with me. All information and documentation of disability is confidential.

VII. STUDYING and OUT-OF-CLASS ASSISTANCE

Students are expected to read the textbook, study lecture notes, work on homework problems and discuss chemistry with classmates and the instructor outside of the regular meeting time. *You should be studying* ~7–9 hours a week outside of class for a ½ credit course. In addition, I recommend that you study *throughout the week*, and not just before an exam or quiz. My primary goal is to help you to learn how to teach yourself, so meeting with me will be most productive when you have already put significant effort into your studies. The introductory chemistry sequence is cumulative, so you must retain your command of the material throughout the year. You are in charge of learning the material that we cover, and I am here to assist you.

*I am available* to meet with students throughout the week, and encourage you to discuss your studies with me during regular office hours (*TBA*), by appointment, or by chance whenever my office door is open. My full schedule with office hours is available at *http://chemistry.kenyon.edu/cummings/schedule.htm*.

*Peer chemistry tutors* are available at *The Math and Science Skills Center* to assist you as you work to improve problem-solving and chemistry skills, work on problem sets, and prepare for quizzes and exams. The Center, located in Tomsich 101, is open on Sunday, Tuesday, and Thursday evenings from 7–10 pm. The lead tutor for this course is Jill Pattison (*pattisonj@kenyon.edu*).
VIII. ASSIGNMENTS and ASSESSMENT

Our exploration of each topic in the course will take approximately one week and involve a reading assignment, online mastery quiz, and problem set. Students should complete the reading assignment early in the week and complete the OWL “Mastery” quiz no later than Thursday night. We will study the topic in more depth during the weekly class meetings, while you work on an associated problem set outside of class, typically due on Monday mornings in class or online.

A. QUIZZES
For each topic, there will be an online quiz comprised of sets of OWL “Mastery” questions for core concept units. You should work to answer a sufficient number of questions correctly for each concept unit to achieve mastery; you can retake units to do this, if needed. These are to be worked on individually and without the use of any other materials; the set of questions may take approximately 30–60 minutes to complete. Typically, they should be completed during the beginning of each week, or Thursday evenings at the latest. The mastery questions test basic understanding of important concepts from the assigned reading, allow you to repeat questions until you achieve the correct answer, and offer you instant feedback to assess your learning.

There also will be several unannounced quizzes given in class during the semester. See attendance policy (above) regarding missed in-class quizzes.

B. PROBLEM SETS
A problem set involving more advanced problems for each topic will be due each Monday at 9:10 am. You are encouraged to work with other students on these assignments, but please recognize the difference between working with and copying from others. Each student must submit their own answers to problem sets, which will be graded. Some exam questions will draw directly from problem sets.

C. EXAMINATIONS
Three exams are scheduled: in-class mid-term exams on October 5 and November 18 and a final exam on December 12 from 1:30-4:30 p.m. (as scheduled by the Registrar). Please note these dates and times and do not plan travel on these days; no alternate exam times can be offered. See attendance policy (above) regarding missed in-class exams. All exams are cumulative in coverage.

D. COURSE GRADES:
Grades earned for each assessment category below (along with an evaluation of class attendance) determines the course grade:

- QUIZZES: 10%
- PROBLEM SETS: 20%
- MID-TERM EXAMS: 40%
- FINAL EXAM: 30%

Letter grades for the course are: A / A (90–100%), B / B / B+ (80–89%), C / C / C+ (70–79%), D / D / D+ (50–69%), F (below 50%).

E. GRADING PHILOSOPHY AND METHODS
Grades serve two purposes: to provide feedback to students (formative evaluation) and to evaluate student work to determine a course grade (summative evaluation). Using quizzes and exams, I aim to assess various aspects of student academic work: critical reasoning, quantitative reasoning, knowing basic information, recognizing concepts and themes, thinking by analogy, learning from previous mistakes, and demonstrating a commitment to improvement.
What is the format of assessment?
For practical and pedagogical reasons, assessment of the knowledge you gain in this course is based on in-class exams and quizzes that test your ability to identify core concepts, solve problems and demonstrate understanding within a limited (but reasonable) amount of time.

Exams will typically include some very basic questions (which I anticipate nearly all students will be able to answer correctly), several standard questions (which should be familiar to students who have completed reading assignments and worked on problem sets), and one challenge problem (which I anticipate very few students will be able to answer correctly).

How is student work graded?
For individual questions and total exams and quizzes, points are earned for correct answers and approach to solving quantitative questions and insight and reasoning for qualitative questions:

<table>
<thead>
<tr>
<th>numeric grade</th>
<th>letter</th>
<th>quality of work</th>
</tr>
</thead>
<tbody>
<tr>
<td>90–100%</td>
<td>A</td>
<td>correct answer (with appropriate significant figures for numeric answers) and approach</td>
</tr>
<tr>
<td>80–89%</td>
<td>B</td>
<td>sound approach to problem solving and demonstrated understanding of fundamental concepts, but with some mistakes</td>
</tr>
<tr>
<td>70–79%</td>
<td>C</td>
<td>adequate attempt, but misunderstanding of some key concept</td>
</tr>
<tr>
<td>50–69%</td>
<td>D</td>
<td>inability to solve problem</td>
</tr>
<tr>
<td>0–50%</td>
<td>F</td>
<td>didn’t try (50% for missing a question completely; 0% for absence from class)</td>
</tr>
</tbody>
</table>

All work is evaluated on this absolute grading scale and is NOT graded “on a curve”. You are not competing against each other for grades, so you are encouraged to work with each other in your studies.

What is the typical distribution of grades?
Although grades are not “curved”, there will be a distribution of grades among students in the class. Students in most courses perform at a range of levels, typically a reflection of various factors: effort in the course, interest in the topic and commitment to succeed, preparation with pre-requisite knowledge and skills, and native abilities with the topic. If I have designed my assessment tools effectively, then grades will reflect this spread in student performance: some A grades for truly outstanding work, B grades for work that shows a sound approach and solid understanding, C grades for work that is adequate, D grades for work that is deficient, and F grades for lack of effort or attendance. If everyone earns an A grade, then the exam or course was too easy; if everyone earns a C or D grade then the exam or course was too difficult. For a typical grade distribution, roughly half of the students earning grades that are “below average” and half of the students earning grades that are “above average”.

Chemistry for a Sustainable World