Syllabus – Chemistry 102, General Chemistry I (Lec 402), Spring 2018

Course Information can be found on D2L

Instructor: Dr. Christine Carlson  
Email: cac4@uwm.edu

Office: CHM 143  
Office Hours: TR: 11:00am – 12:00pm or by appointment

The syllabus is subject to change. Only the most current version of this syllabus is valid. If the syllabus is changed after the start of classes, one verbal announcement will be made in lecture and the new version will be uploaded to D2L.

All emails correctly addressed will be answered within 48 hrs. To ensure that your email is correctly addressed you must include your Course number and lecture number in the subject line, ex: Chem 102 – 402. In addition, the email must be sent from your UWM email account.

Overview of the course

Chemistry 102 is the first of a two-semester sequence designed to facilitate the student’s learning of the nature of the material universe. The first semester emphasizes the principles which determines the composition, properties and structure of matter.

Prerequisites

A grade of C or better in Chemistry 100

Or

1 year of high school algebra and 1 year of high school chemistry and a placement score of 1 (score of 20) on the chemistry placement test and a math placement score of 3 (old test) or 30 (new test) [or a grade of C or better in Math 105].

Dropping the Course, Changing Sections, Incompletes

All drops, adds, and section changes of Chemistry Department courses should first be attempted using PAWS. Any changes to your schedule that cannot be done using PAWS will require the stamp of the Chemistry Department. This may also require my signature. A discussion or laboratory TA can never sign an add/drop form. An incomplete can be given only for a student who has been doing satisfactory work, but is unable to complete the course for a reason which I judge to be valid, and must be accompanied by appropriate documentation.
**Important dates** - You will be responsible for knowing the deadlines for drops or withdrawals as determined by the University. *This includes the final day to withdraw from any class for academic reasons.*

Last date to ADD/SWAP – February 2\(^{nd}\), 2018. **I do not allow ADDS or SWAPS after this date.**

Last date to DROP without a W – February 16\(^{th}\), 2018

Last date to DROP a course – April 8\(^{th}\), 2018 - **After this day, I will not sign any withdrawals from the course for academic reasons.**

**Required Materials**

**Course Text:**  *General Chemistry: The Essential Concepts* (7th Edition) by Chang (electronic copies are available) – expected cost range $50-$200 *(depending on source)*

**Classroom Response System:** You will use your own electronic device to enter answers into a classroom response system. To do this, you will need to register on Tophat.com (more information will be given about this). Expected cost is $18 or less.

**Chemistry 102 – Lecture Activities – Spring 2018** – available by the start of classes at Clark Graphics, 2915 North Oakland – expected cost approximately $35.

**Laboratory:**  *Chemistry 102 Lab Manual – Spring 2018* (available by the start of classes at Clark Graphics, 2915 North Oakland) – expected cost approximately $25

**Safety goggles** – expected cost approximately $10

**Bound laboratory notebook with duplication** – expected cost approximately $15

*Safety goggles are absolutely mandatory. They must seal around the eyes and have shielded vents. You must have these prior to the first laboratory period, and they must be worn at all times while you are in the laboratory.*

**Calculator:**  Non-graphing or non-programmable *scientific calculator* with logarithms, exponential functions, etc. – expected cost approximately $20

Graphing calculators, cell phone calculators, laptops, pda’s, etc. are strictly forbidden in exams or quizzes. You may only use a NON-PROGRAMMABLE, scientific calculator for exams or quizzes. If you attempt to use something else which is prohibited you will be required to work with pencil and paper only.
Lectures

Chemistry 190  MWF  1:00PM – 1:50PM

For EVERY lecture you will be assigned a reading from the textbook and problems to work from your lecture activity book. Lecture instruction will be based upon the assumption that each student has done the required reading before lecture.

Using a quiz or an exam as a means to test if you have learned something could be too late to determine you still have a gap in knowledge. Remember, lecture is very important in seeing process and models and hearing concepts and their derivation and application BUT is not the beginning and end of learning. It would be unusual to learn something simply from sitting in lecture. As always, seek help, seek help, seek help!

Homework, Lecture Questions (TopHat) and Lecture Quizzes

Homework will be assigned and graded using the Moodle system. This is a FREE system. More information will be given about this near the start of the semester (and posted on D2L) gives specifics concerning deadlines and procedures for registering. Homework from the textbook (all red-numbered problems) are assumed to be completed but will not be collected or graded.

Lecture Questions – TopHat will be used for a small number of lecture questions (approximately 2 questions per lecture). The lecture question provide for both attendance and an evaluation of how well students are keeping up with the material. The procedure for registering for this will be discussed on the first day of lecture and given on D2L. The percentage of your TopHat participation (NOT correctness) throughout the semester will determine your lecture question total. Students who participate in at least 80% of the questions (NOT 80% of the days) will receive 100% of the points. Participating in less than 80% of the questions will reduce your Lecture Question Total and will affect your grade. If you are in class but are having technical issues impeding your ability to submit your responses you MUST sign the attendance book before the end of the lecture in which you had the technical issue. Email will no longer be a valid method of accounting for your attendance. Signature attendance will only be accepted for students who have an active TopHat account with their name (as shown in D2L) properly recorded in the student’s TopHat account.

Lecture quizzes will be given every week of class except the last week. The lecture quizzes will be given in the last 20 minutes of Friday lectures (exception is quiz 1). Your highest 10 quizzes will count towards your quiz total (with the four lowest being dropped). There are no Early/Late/Make-up quizzes. The only exceptions to this are verified military activities, verified student disability (ARC VISA variable attendance accommodation), religious observance verification (following university policy). Quizzes may include extra credit. Quiz solutions will be posted on D2L.

If you believe that your quiz has been unfairly graded you must return the quiz to your TA before the end of the discussion section. He/she will get the quiz to me and I will re-grade it completely. You should be aware that if you elect to do this, your grade may be higher, the same, or lower, depending on whether or not other problems may have been graded too generously.

Missing a quiz for any reason results in that quiz counting as one of your drops – do not request to take a quiz at any other time since everyone can drop four quizzes.
**Discussion Section / Problem Solving**

You are required to attend the discussion section for which you have registered. Attendance is discussion is important to your understanding of the material presented in lecture, for this reason 2 or the 10 possible points earned in discussion each week will be given for being present on time. Your attendance and participation in discussion sections is essential because your final grade depends critically on your ability to solve problems.

Your highest 10 discussion grades will count towards your discussion total (with the three lowest being dropped), there are no discussion points earned for the first or last discussions of the semester (discussion is still in session these weeks).

In order to have a positive experience in discussion, it is to your benefit to both prepare for discussion and participate. Your discussion section is your opportunity to further understand problems on a more personal basis – you can go over finer details and questions than is simply possible in lecture. Use discussion time wisely.

You can only learn to solve problems by doing them. You must attempt to solve all of the assigned problems as an absolute minimum. It is very important for you to make every attempt to solve problems before seeking help elsewhere. The solution to a problem always looks easier when someone else shows it to you. Remember that you will not be afforded this luxury on an exam.

**Make-up Discussions:** If you are aware in advance of a discussion that you will miss you need to inform me in writing (not email) at least 72 hours in advance of the date of the discussion, your discussion section, and a list of the other discussion sections that you could attend that week. All possible attempts will then be made to make room in one of the other Discussion sections for the requested discussion only so that you do not miss the discussion. This depends on available space. The only exceptions to this policy are verified military activities, verified student disability (ARC VISA variable attendance accommodation), religious observance verification (following university policy).

**Laboratory Begins Week of January 29th (see lab schedule on next page)**

Chemistry is an experimental science – the concepts and models are based on experiment. Thus, the laboratories are designed to give you a “hands-on” experience in order to reinforce concepts. You may encounter material in the laboratory before you see the material in lecture.

- You must attend the laboratory section for which you are registered.
- You must be prepared to perform the experiment before coming to lab.
  - You will need to complete items 1 through 5 per Chapter 1 in Laboratory Manual Section Part 1 in your laboratory notebook for all experiments prior to the start of the lab period.
  - If you do not have this completed, you will not be allowed to do the experiment and receive a grade of zero for the lab.
- Your completed lab report is due at the start of your next lab period. You must submit the original copy and retain the second copy.
  - You must have personally performed the experiment in lab in order to receive a grade for the associated lab report.
  - There are no early / late labs given.
- **Make-up Labs**: If you are aware in advance of a lab that you will miss you need to inform me in writing (not email) at least 72 hours in advance of the date of the lab, your lab section, and a list of the other lab sections that you could attend that week. All possible attempts will then be made to make room in one of the other lab sections for the requested lab only so that you do not miss the lab. This depends on available space.

- The only exceptions to the above policy are verified military activities, verified student disability (ARC VISA variable attendance accommodation), religious observance verification (following university policy). Impossible beyond the week that the lab was originally run.

- Your highest 10 lab grades will count towards your discussion total (with the one lowest being dropped).
- Your labs will be graded following the rubric given in the lab manual, Part 1, Chapter 1.
- You may **not** have your laboratory manual at any point during the experiment. You may only use your laboratory notebook. Therefore you must have an appropriate and complete procedure in your notebook to conduct the experiment.

- A lab practical will be given during the last week of lab.
  - The content of the practical will be based on your experiences in lab.
  - This is not considered a lab examination.
  - You will be allowed to use your bound laboratory notebook (NOT lab manual) for the practical – loose papers, textbooks or photocopies of any other source will not be permitted.
  - The original graded and returned lab reports are **NOT** permitted.
  - You must pass the lab practical (score of 60% or greater) in order to be eligible to pass lab.
  - You must pass lab (score of 60% or greater) in order to be eligible to pass this course.

- Your lab reports must be your original work. Copying in any form (includes identical text on separate lab reports) is considered cheating and WILL result in a zero for the lab, in addition to possible further actions.

- **Safety**: Wisconsin state law requires all students to wear safety goggles which seal around the eyes and have shielded vents while they are in the laboratory. This will be strictly enforced. Failure to comply will result in removal from the laboratory and assignment of a grade of zero. Be certain to handle and dispose of all chemicals safely (ASK if you are unsure). Students who are not prepared for lab are a hazard to themselves and others. You will be expected to know and follow all rules outlined in the safety handout.

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**Laboratory Schedule** – Labs officially begin the week of January 29th, however there is a mandatory Safety Quiz that MUST be perfected before you are to be allowed into Lab (see schedule below).

<table>
<thead>
<tr>
<th>Week of</th>
<th>Experiment</th>
<th>Week of</th>
<th>Experiment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/29</td>
<td>Safety Quiz (D2L) – No Labs</td>
<td>3/19</td>
<td>Spring Break – No labs</td>
</tr>
<tr>
<td>2/5</td>
<td>Safety (Handout) and Skill Inventory</td>
<td>3/26</td>
<td>Color My Nanoworld</td>
</tr>
<tr>
<td>2/12</td>
<td>Scale Activity</td>
<td>4/2</td>
<td>Gas Laws</td>
</tr>
<tr>
<td>2/19</td>
<td>Classification of Matter</td>
<td>4/9</td>
<td>Physical Properties of Water</td>
</tr>
<tr>
<td>2/16</td>
<td>Qualitative Analysis</td>
<td>4/16</td>
<td>Enthalpy</td>
</tr>
<tr>
<td>3/5</td>
<td>Stoichiometry and Acid/Base Titrations</td>
<td>4/23</td>
<td>Intermolecular Forces</td>
</tr>
<tr>
<td>3/12</td>
<td>Beer’s Law</td>
<td>4/30</td>
<td>Lab Practical</td>
</tr>
</tbody>
</table>
Examinations

Four 1-hour exams are scheduled by the university throughout the semester on **Thursday evenings at 5:30PM**, the official time for this exam is 5:30 PM to 7:00 PM, however additional time (beyond 60 minutes) is available at my discretion. The final examination will be given on the date found in the schedule of classes (noted in the table below). Your graded exam (Hour Exam #1, #2, and #3) will be returned in the next regularly scheduled discussion section.

<table>
<thead>
<tr>
<th>Exam</th>
<th>Date</th>
<th>Time</th>
<th>Place</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hour Exam #1</td>
<td>02/15/2018</td>
<td>5:30 pm</td>
<td>LAP 160 / 162</td>
</tr>
<tr>
<td>Hour Exam #2</td>
<td>03/15/2018</td>
<td>5:30 pm</td>
<td>LAP 160 / 162</td>
</tr>
<tr>
<td>Hour Exam #3</td>
<td>04/19/2018</td>
<td>5:30 pm</td>
<td>LAP 160 / 162</td>
</tr>
<tr>
<td>Hour Exam #4</td>
<td>05/10/2018</td>
<td>5:30 pm</td>
<td>LAP 160 / 162</td>
</tr>
<tr>
<td>Final Examination</td>
<td>05/18/2018</td>
<td>10:00 am – 12:00 pm</td>
<td>TBD</td>
</tr>
</tbody>
</table>

If you believe that your exam has been unfairly graded you must return the exam to your TA before the end of the discussion section. He/she will get the exam to me and I will re-grade it completely. You should be aware that if you elect to do this, your grade may be higher, the same, or lower, depending on whether or not other problems may have been graded too generously.

You will be allowed to drop your lowest hour exam score. There will be no early exams, no late exams, and no make-up exams. The only exceptions to this are verified military activities, verified student disability (ARC VISA variable attendance accommodation), religious observance verification (following university policy). **The final exam is mandatory.**

Two standardized final examinations will be used in this course. In order to be eligible to pass the course, you must score in the 35th percentile or higher on both of the standardized final examinations. If you do not take BOTH of the final exams, you cannot pass the course.

Academic Dishonesty

Cheating on an examination, quiz, lab report or other graded material will result in a grade of zero as a minimum consequence. Failure in the course and referral to the Dean may also occur. Academic dishonesty or misconduct in any form will not be tolerated. This includes the use of unauthorized materials during a quiz or exam – such as graphing calculators, etc.

Grading

Your final grade in the course is determined by adding up the total points earned from the following grade categories: Top three Hourly Exams, Final Exam score, quiz total, homework total, lecture question total, discussion total, Lab total and any extra credit earned. The total of these grade categories is divided 800 (the total number of points for the course). **Your percentage is then compared to the grade table on the next page. Students are only given the grade that they have earned in the course.**
The total number of points for the class is 800. A general breakdown by letter grade is shown on the next page but may be altered as needed. Breakdown of the 800 points is as follows:

Exams: Each one-hour exam is worth 100 points; for a total of 300 (dropping the lowest score).

Final Exam: The cumulative final exam is comprised of a two part Chem 102 exam for a total of 200 points. Two standardized final exams will be used and in order to be eligible to pass the course, you must score in the 35th percentile or higher on BOTH of the standardized final examinations.

Quizzes: Each quiz will be worth 10 points and some may include extra credit. The ten highest quiz grades will contribute 50 points to your final grade.

Discussion: Discussion sections points will be accumulated from attending discussion and completing the supplemental problems. The ten highest discussion grades will contribute 50 points to your final grade.

Homework: Online homework will be assigned prior to each exam (for a total of four assignments). Additionally, chapter practice/review assignments will be graded for completion. If you complete at least 70% of ALL practice/review assignments (with a score of at least 25%) available you will receive the conversion of your lowest exam homework score to 100%. Your homework grade is based on the average of your four exam assignments. The online homework cumulative score will contribute 30 points to your final grade.

Lecture Questions: Lecture questions (via TopHat) will contribute 20 points to your final grade. Students who participate in at least 80% of the questions (NOT 80% of the days) will receive 100% of the points.

Laboratory: Laboratory will be worth 150 points. A failing grade (<60%) in laboratory will result in a failing grade for the class. The lab practical will count as two labs and is INCLUDED in your final lab grade. The lowest lab score will be dropped. The lab practical score cannot be dropped.

<table>
<thead>
<tr>
<th>Grade category</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hour Exams</td>
<td>300</td>
</tr>
<tr>
<td>Final examination</td>
<td>200</td>
</tr>
<tr>
<td>Quizzes</td>
<td>50</td>
</tr>
<tr>
<td>Discussion</td>
<td>50</td>
</tr>
<tr>
<td>Homework</td>
<td>30</td>
</tr>
<tr>
<td>Lecture Questions</td>
<td>20</td>
</tr>
<tr>
<td>Laboratory</td>
<td>150</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>800</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Letter grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>92.5-100</td>
<td>A</td>
</tr>
<tr>
<td>89.5-92.4</td>
<td>A-</td>
</tr>
<tr>
<td>86.5-89.4</td>
<td>B+</td>
</tr>
<tr>
<td>82.5-86.4</td>
<td>B</td>
</tr>
<tr>
<td>79.5-82.4</td>
<td>B-</td>
</tr>
<tr>
<td>76.5-79.4</td>
<td>C+</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Letter grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>72.5-76.4</td>
<td>C</td>
</tr>
<tr>
<td>69.5-72.4</td>
<td>C-</td>
</tr>
<tr>
<td>66.5-69.4</td>
<td>D+</td>
</tr>
<tr>
<td>62.5-66.4</td>
<td>D</td>
</tr>
<tr>
<td>59.5-62.4</td>
<td>D-</td>
</tr>
<tr>
<td>Below 59.5</td>
<td>F</td>
</tr>
</tbody>
</table>
Department of Chemistry Policies

Departmental policies regulating the conduct of this course can be found in the main office of the Chemistry Building (CHM 144). University policies can be found at http://www.uwm.edu/Dept/SecU/SyllabusLinks.pdf

Select University Policies: Below are links to a few select University policies

Accommodation of Religious Beliefs: https://www4.uwm.edu/secu/docs/other/S1.5.htm

Final Exam Policy: http://www4.uwm.edu/secu/docs/other/S22.htm

Register’s Office Policies: http://uwm.edu/registrar/students/enrollment-policies/

Active Duty Policy: http://www4.uwm.edu/academics/military.cfm

Lecture Questions - Registering for TopHat

You will be using your own device to give electronic responses into the classroom response system. These devices can be cellphones, laptop computers or tablets. You have the option of downloading an app onto your smartphone. You must also register to do this. To register, you need this information:

1. The 6-digit course code: XXXXXX (available at the start of classes)
2. The password: XXXXXX (available at the start of classes)

Create an Account

1. Go to https://app.tophat.com/e/XXXXXX to access the class directly (preferred) or to tophat.com.
2. Click on student sign up.
3. Select school “UWM” or enter “XXXXXX” under the 6-digit course code.
4. Enter your account details including your First and Last name as listed in D2L.
5. Enter your cell phone number if you wish to text your response (only to be used to link to your TopHat account).
6. If you enter your cell number you will receive a text with a code to enter.

Enroll in this Class

1. Select this course to enroll, “Chem 102 - Lecture 402 – Spring 2018”. You will also need to enter the password “XXXXXX”.
2. At this point, you will need to register/purchase your registration code.
3. Payment information will be requested at this point. Select your code choice (either 1 semester or 5-year code). The costs are:
   - 1-semester code = $15 or 5-year code = $35

4. Through the check-out process the discount will be applied (you may first see a higher cost for a code but as you check out, the cost will be discounted to the rates above). In the event you would like to upgrade from a 1-semester code to a 5-year code, this can be done by calling Tophat at any time before your 1-semester code expires. You will then only pay the difference in the costs.
To use TopHat in class

Remember to bring your device to each and every lecture

You will be prompted to answer a question or a series of questions.

1. Wait until the question is active
2. Using the mobile app, enter your answer.
3. Using text function, enter your answer by texting to the text number shown on the question.
4. Using a laptop or internet access, go to tophat.com, login and enter your answer.

You can enter answers more than once. Only the answer entered last will be counted. You will receive confirmation that your answer was received.

If you have any difficulties with Tophat, please contact 315-636-0905

Online Homework

To use Moodle

1. Go to http://homework.chem.uwm.edu
2. Enter Username: your epanther ID
   Password: your epanther password (just like accessing d2l)
3. Complete your profile using local server time and click update. You may receive an email containing a link to activate your account. Once complete, you should see on the next page a homework button to get to the classes.

To join our class - Click on our lecture: Chemistry 102; Spring 2018; Lecture 402. You will be prompted whether you wish to join this class, Click Yes. Homework is listed under the active week – click on the homework (called a “quiz”) to begin working.

Exam Homework Assignments (1-4):
- There are 4 exam assignments.
- Due dates are clearly noted in Moodle (and will be announced in lecture).
- All Homework assignments are open the day after the first day of classes.
- You will have five attempts at each exam assignment (highest graded attempt counts).
- Your homework grade is based on the average of your four exam assignments.

Chapter Practice/Review Assignments:
- These are all due on the end of the semester.
- If you complete at least 70% of ALL practice/review assignments (with a score of at least 25%) available you will receive the conversion of your lowest exam homework score to 100%.
- You will have an unlimited number of attempts on each assignment as well as be able to submit individual answers for grading.
When using Moodle, carefully read the directions – note that all numeric answers must be entered in standard decimal notation and units are **not** to be included in the answer. Failure to properly enter an answer may result in not receiving credit for an item.

You MUST submit your assignment to obtain a grade – if you do not submit an assignment, it will not be included in the gradebook!

### Tentative Class Schedule (subject to change)

<table>
<thead>
<tr>
<th>Week of</th>
<th>Lecture Topics / Lab / Moodle</th>
<th>Exams and Quizzes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan 22nd</td>
<td>Syllabus; Overview of the course and keys for success Placement Tests; Chapter 1: Introduction and Measurements Lab: Safety Quiz</td>
<td>Quiz 1</td>
</tr>
<tr>
<td>Jan 29th</td>
<td>Chapter 1: Introduction and Measurements Lab: Safety Quiz (cont...)</td>
<td>Quiz 2</td>
</tr>
<tr>
<td>Feb 5th</td>
<td>Chapter 2: Atomic Theory, Formulas and Nomenclature Lab: Safety Handout and Skills Lab</td>
<td>Quiz 3</td>
</tr>
<tr>
<td>Feb 12th</td>
<td>Chapter 3: Stoichiometry Lab: Scale Activity Moodle Exam 1 Homework due no earlier than 2/18</td>
<td>Exam 1, Feb 15th</td>
</tr>
<tr>
<td>Feb 19th</td>
<td>Chapter 3: Stoichiometry Lab: Classification of Matter</td>
<td>Quiz 5</td>
</tr>
<tr>
<td>Feb 26th</td>
<td>Chapter 4: Aqueous Reactions Lab: Qualitative Analysis</td>
<td>Quiz 6</td>
</tr>
<tr>
<td>Mar 5th</td>
<td>Chapter 4: Aqueous Reactions Lab: Stoichiometry and Acid/Base lab</td>
<td>Quiz 7</td>
</tr>
<tr>
<td>Mar 12th</td>
<td>Chapter 5: Gases Lab: Beer’s Law Moodle Exam 2 Homework due no earlier than 3/18</td>
<td>Exam 2, Mar 15th</td>
</tr>
<tr>
<td>Mar 19th</td>
<td>Spring Break – No Classes (No lecture, discussion, or lab)</td>
<td>Quiz 8</td>
</tr>
<tr>
<td>Mar 26th</td>
<td>Chapter 5: Gases Lab: Color My Nanoworld lab</td>
<td>Quiz 9</td>
</tr>
<tr>
<td>Apr 2nd</td>
<td>Chapter 6: Heat Lab: Gas Laws lab</td>
<td>Quiz 10</td>
</tr>
<tr>
<td>Apr 9th</td>
<td>Chapter 7: Electronic Structure Lab: Physical Properties of Water lab</td>
<td>Quiz 11</td>
</tr>
<tr>
<td>Apr 16th</td>
<td>Chapter 8: Periodic Trends Lab: Enthalpy lab Moodle Exam 3 Homework due no earlier than 4/22</td>
<td>Exam 3, Apr 19th</td>
</tr>
<tr>
<td>Apr 23rd</td>
<td>Chapter 9: Bonding Lab: Intermolecular Forces lab</td>
<td>Quiz 13</td>
</tr>
</tbody>
</table>
Learning Objectives

**GER outcomes:** GER courses provide “students with a broad body of knowledge” (UWM Fac. Doc. 1382, p. 2, II, par 1). This course carries the GER natural sciences distribution designation because it prepares students to achieve the following three learning outcomes. Upon successful completion of this course, you should be able to:

1. Understand and apply the major concepts of a natural science discipline, providing insights into its breadth and its relationship to other disciplines;
2. explain and illustrate the relationships between experiments, models, theories and laws; and,
3. demonstrate an understanding of the process of generating and testing of data, and apply this knowledge to the solution of problems.

**Course-specific objectives:** In order to set the GER outcomes within the framework of this course, a set of objectives have been designed to give you a better understanding of what you are expected to learn over the course of the semester, and some indication of how it will be measured as to what degree this has occurred. These will be incorporated through all types of assessments but will be formally measured on the weekly quizzes and hourly exams. In order to prepare for this, certain objectives will be presented each week in discussion with exercises for practice.

The examples of how these may be measured are examples ONLY and should not be interpreted as an inclusive ‘checklist’.

**Objective 1: Understand spatial scale, particularly to the very sizes (on the order of atoms).** As an example you should be able to: estimate measurement, conceptualize relative sizes, use measurement tools skillfully, correctly compare numbers, convert measurements and scales, be able to compare specific objects (atoms and molecules, for example) by size and use the atom as a starting point in representing matter and changes.

**Objective 2: Understand the language of chemistry including naming simple compounds.** As an example you should be able to: properly define important key terms, give a name for a chemical formula of a simple compound, give the chemical formula for a name, give the charges and names for the monoatomic and polyatomic ions of interest (these will be specified).
Objective 3: Understand the relationship between macroscopic, particle and symbolic representations of matter including atom relationships in molecules and compounds. As an example you should be able to: identify macroscopic vs particle representations, read chemical formula, represent bonding detail in molecules, know that some elements exist as diatomic molecules, and be able to interpret organic chemical formulas from line drawings.

Objective 4: Understand the relationship between the composition of atoms and their properties. As an example you should be able to: identify the number of protons, neutrons, and electrons for any isotope or ion, approximate the relative abundance of certain isotopes given the periodic table and additional information (for example, the number of isotopes and the number of neutrons in each), and calculate weighted averages, isotopic masses or relative abundances.

Objective 5: Understand the basics of chemical reactions. As an example you should be able to: balance chemical equations, correctly use terms and states of matter and correctly represent chemical formula.

Objective 6: Understand the basics of mixtures and chemical reactions involving water as a solvent. As an example you should be able to: define key terms of mixtures, represent solutions on a macroscopic and particle-level and quantitatively represent concentrations.

Objective 7: Understand quantitative relationships between substances represented in a balanced chemical equation. As an example you should be able to: do stoichiometric calculations involving moles, masses, volumes, pressures, particles, and concentrations of reactants and/or products also including limited quantities of a reactant.

Objective 8: Understand the basics of the properties and behavior of gases on both the macroscopic and particle level. As an example you should be able to: relate pressure, volume, temperature and amount of an ideal gas, explain the ideal gas law in terms of gas particles, and calculate properties of a mixture of gases.

Objective 9: Understand the role of energy in a chemical reaction, particularly heat. As an example you should be able to: define key terms including heat, work, and energy, identify key components of the first law of thermodynamics, calculate heat, heat capacity and specific heat, calculate change in enthalpy for a reaction by Hess’s law, and interpret an energy diagram.

Objective 10: Understand the basics of quantum mechanics as it applies to assigning quantum numbers to electrons in atomic orbitals as well as writing electron configurations. As an example you should be able to: define key terms, know the rules for assigning quantum numbers, know the general rules for relative energy of atomic orbitals, apply Hunds rule and determine paramaticity of elements in the ground state.
**Objective 11: Understand periodicity of certain properties of the elements.** As an example you should be able to: define key terms, give periodic trends for certain properties, and give general descriptive chemistry facts.

**Objective 12: Understand chemical bonding and molecular shape.** As an example you should be able to: be able to draw a Lewis dot structure, determine a molecular shape from VSEPR theory, determine molecular polarity and determine bond order.

**Objective 13: Understand that breaking chemical bonds is an endothermic process.** As an example you should be able to: be able to correctly identify both an energy diagram and thermochemical equation showing the endothermic process of breaking a chemical bond.

**Objective 14: Understand properties of liquids and solids.** As an example you should be able to: define key terms, correlate properties of liquids, interpret a phase diagram, identify differences between types of solids, and calculate properties of elemental cubic crystals.

**Objective 15: Understand the experimental nature of science.** As an example you should be able to: define all components of the scientific method, identify key experiments and the conclusions made (particularly in atomic and electronic theory), conduct simple experiments in laboratory, use measurement tools accurately, and read equipment to the correct number of significant figures and maintain the correct number of significant figures throughout the calculations.

**Objective 16: Understand how reactions take place over time.** As an example you should be able to: define key terms in kinetics, express the rate of reaction by change in concentration over time, graphically depict change of reaction rates over time, use initial rates to determine reaction order and rate constants, write and derive a rate law, graphically determine the relationship between concentration and time for different reaction orders, write and use integrated rate laws, graphically depict activation energy, calculate activation energy using experimental data, write an overall reaction and rate law given a mechanism, and identify a catalyst and intermediate.

**Objective 17: Understand the basic principles of equilibrium.** As an example you should be able to: define key terms in equilibrium, write an equilibrium constant, describe equilibrium in terms of reaction rates, express the difference in large and small equilibrium constants, express equilibrium constants of gases in concentration and partial pressure, convert between these constants, use reaction quotients to determine reaction direction, calculate equilibrium constants and changes in concentrations, express the effect on equilibrium by changing system conditions.

**Objective 18: Understand equilibrium of aqueous systems.** As an example you should be able to: define key term in acid/base and solubility equilibria, represent and calculate concentrations of acids or bases in water, represent and calculate concentrations when acids and bases react in water, calculate pH and pOH, order and calculate relative strengths of acids, bases and salts, represent non-aqueous systems of acids and bases, interpret titration curves, represent and
calculate concentrations of ionic species in a saturated solution, use equilibrium values to qualitatively analysis a mixture of ionic species.

**Objective 19: Understand the role of energy in a chemical reaction and how this applies to spontaneity of a reaction (integrating Objective 9).** As an example you should be able to:

- define key terms in thermodynamics, represent entropy changes for simple systems, integrate enthalpy and entropy for a system and surroundings, identify key components of the second and third laws of thermodynamics, calculate changes in entropy, enthalpy and Gibbs free energy for a system and integrate spontaneity and equilibrium with thermodynamic calculations and estimations.

**Objective 20: Understand reactions involving the transfer of electrons.** As an example you should be able to:

- define key terms in electrochemistry, balance redox reactions, represent electrochemical cells including cell diagrams, calculate standard cell potentials given standard reduction potentials under both standard and non-standard conditions (Nernst equation), integrate thermodynamics and equilibrium and identify differences between spontaneous (batteries) and nonspontaneous (electrolysis) processes.

In order to measure the degree to which students in this course meet the objectives for this course, the university criterion of understanding and applying the major concepts of a natural science discipline, including its breadth and its relationship to other disciplines will be measured using the final course exam. This final exam will be graded based on correctness of responses and, where appropriate, as supported by student work in problem solving.

**UW System Shared Learning Goal:** This course also meets shared UW System Shared Learning Goal 2: “Critical and Creative Thinking Skills including inquiry, problem solving, and higher order qualitative and quantitative reasoning.” This is met through the course objectives as described previously.

**Time Spent on the Course**

To estimate the time that a student should expect to spend on this course, one can use the standard method of a minimum of 3 hours outside of class for every hour in class. Therefore for a 5 credit course (counting laboratory as only one hour), a student may expect to spend a minimum of 15 hours per week on the course outside of class. This includes studying, reading, doing homework, writing laboratory reports and rewriting class notes.

**Some Notes of Studying**

Learning in this class may come with hard work and dedication. Please remember that much of your learning takes place through your own reading of the textbook, reading of your lecture notes, working problems, and conversations with me, your TA, and your classmates. Please do not expect to learn all of the concepts by attending lecture only. Your teaching team (me, your discussion TA, and your laboratory TA) will work cohesively to present you with learning opportunities. To best use these opportunities, please come prepared. Otherwise
much of what is discussed may be confusing or frustrating. I am hopeful that by the end of the semester, you will find that learning chemistry is exciting and rewarding.

Here are some tips for success in Chemistry 102:

1. Read the text (on the lecture material for the day) **before** attending the lecture.

2. Attend lecture, discussion and laboratory sessions. Take these times seriously. Be on time, stay attentive and take notes.

3. Use your lecture notes – how may be very individual to you. This could include recopying or rereading after lecture (the closer to the lecture the better), adding to lecture notes from textbook material, adding problems, or discussing within a study group. Your lecture notes should be considered another source of information for this course (like your textbook).

4. Do as many problems as you are able – more than those assigned. **You will probably have to average 3-4 problems a day, seven days a week to be successful in the course.** Don’t wait until right before the exam – you will most likely be overwhelmed and unable to properly understand the material. If you have difficulty solving a particular problem, go back to the more straightforward related problems in the text and work them first. Indeed, one of the main purposes of this course is to help you develop your own method of **thinking through** problems. See your homework as an opportunity to test yourself on your own learning – this will allow you to find where you have succeeded in understanding and where you may still need to work through some concepts. Please do not wait until a quiz or exam to test your learning. See me if you would like help with ways to check your learning.

5. Form a study group or attend the group tutoring sessions – these can be a very effective method of learning.

6. Strive for understanding instead of just familiarity. It may take several attempts to gain the level of understanding that will allow you to articulate and use the models presented in this course. Be patient with yourself!

7. Be proactive! If you are struggling to understand something – seek help. Chemistry builds on previous concepts – without fully understanding one concept, it is very difficult to understand the next concept on which it builds.

**I hope your experience this semester will be a rewarding one.**