CHM 151: GENERAL CHEMISTRY I  
Department of Chemistry and Biochemistry  
Northern Arizona University  
Spring 2019  
Sections 1, 2 and 5 – Instructor: Dr. Tony Hascall

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E-mail: antony.hascall@nau.edu  
Phone: 928-523-7088  
Webpage: http://nau.edu/chem

Class Meetings:

<table>
<thead>
<tr>
<th>Section</th>
<th>Time</th>
<th>Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Monday, Wednesday and Friday, 9:10–10:00 a.m.</td>
<td>Science and Health Bldg (#36), room 211</td>
</tr>
<tr>
<td>2</td>
<td>Monday, Wednesday and Friday, 11:30 a.m.–12:40 p.m.</td>
<td>Science and Health Bldg (#36), room 211</td>
</tr>
<tr>
<td>5</td>
<td>Monday, Wednesday and Friday, 1:50–2:40 p.m.</td>
<td>Science and Health Bldg (#36), room 211</td>
</tr>
</tbody>
</table>

Holidays: Monday 1/21 and 3/18-22 (Spring Break)

Failure to attend class during the first two weeks of class or to complete the Math Review Assignment in Achieve by the deadline (Friday 1/18) without notifying the instructor will result in you being administratively DROPPED from the course.

Office Hours: Tues 12:00 – 1:00 p.m., Thurs 11:00 a.m. – 12:00 noon and Thurs 2:00 – 3:00 p.m.  
(No appointment is needed for office hours. You may stop by any time during the scheduled sessions. Feel free to contact the instructor to make an appointment to meet outside these times.)

Recitation: Wednesdays 3:00 – 3:50 p.m. and Thursdays 4:00 – 4:50 p.m. in SHB 502.  
Recitation is not required, but ALL students are encouraged to enroll in OR attend a recitation. It is informal and the goal is to review and amplify lecture material while working problems.

Supplemental Instruction: The SI leaders are Catherine Lepp (cml523@nau.edu) and Kesar Bhatt (kvb35@nau.edu). The times and locations of SI sessions will be announced the first week of class.

Prerequisites: One year of high school chemistry recommended. MAT 108 or MAT 114 with a grade of C or better, or Math Placement Test Results (ALEKS 50+) or International Exchange Student Group

Distribution Block: 4-hours of Science/Applied Science credit (CHM 151 only)  
5-hours of Laboratory Science credit if taken with the lab (CHM 151 and CHM151L)

Required Materials:

◆ Achieve system. You will use Achieve to access the textbook for the class, complete pre-lecture reading assignments and quizzes, homework assignments and review quizzes. We have been given free access to Achieve this semester. Register at achieve.macmillanlearning.com using the access code that was sent by email.

◆ Chem101. www.chem101.co. We have been given a free trial of this system that will be used in class. Instructions to set up an account were sent by email. Bring your device to each class to answer questions on Chem101.

◆ Scientific Calculator. Basic models (available at stores for less than $20) are best. It must handle scientific notation and fractional exponents. No phones other computing devices may be used during exams.
**Reading, Pre-lecture & Homework:** In this hybrid class, it is of **great** importance that you actively study assigned pre-lecture material, read the text and do the homework assignments. Much learning takes place **outside** the classroom. Showing up to every lecture (which you are **required** to do) does **not** guarantee a passing grade. You must come to class **prepared** and you must **repeatedly** practice the material outside of class.

**Time Expectations:** A typical student will need to spend a **minimum** of 2 hours studying for every credit hour. That’s an average **MINIMUM** of 8 hours of studying **each** week for this 4-unit class (in **ADDITION** to the “online” hour of lecture outside of class each week). This number will vary depending on skill and the material covered that week. Weeks with exams will require more time. You should organize your schedule to study in **small** time blocks (~1 hour each) **throughout** the week. Studying in groups is **highly** recommended. Homework that relates to material covered in a particular lecture should be completed **as soon as possible**.

**GRADING POLICY**

Your final grade in the class will be based on a total of 1000 points, calculated as follows:

<table>
<thead>
<tr>
<th>Item</th>
<th>% of Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three midterm exams – scaled to 120 points each</td>
<td>36</td>
</tr>
<tr>
<td>Final exam –200 points</td>
<td>20</td>
</tr>
<tr>
<td>Online homework (Achieve) – 140 points</td>
<td>14</td>
</tr>
<tr>
<td>Quizzes (Achieve) – 140 points</td>
<td>14</td>
</tr>
<tr>
<td>Pre-lecture reading/quizzes (Achieve) – 60 points</td>
<td>6</td>
</tr>
<tr>
<td>Participation/Attendance (Chem101) – 100 points</td>
<td>10</td>
</tr>
</tbody>
</table>

Letter grades will be calculated as follows (The percentages represent “guaranteed” grades. These grade cut-offs may be lowered **slightly**, but will **never** be made higher than what is listed below.):

A ≥ 90%  B ≥ 80%  C ≥ 65%  D ≥ 50%  F < 50%

**Note:** in the event of an extraordinary circumstance, including, but not limited to, an exam being cancelled due the campus being closed, the instructor reserves the right to modify the above grading scheme to one more appropriate for the new circumstances.

Please be aware that a grade of “C” or higher in CHM 151 is required in order to enroll in CHM 152.

**Participation:** Questions and assignments will be given in class using the Chem101 system, which you will complete on your electronic device. If you must miss class for a **valid** reason (e.g. institutional excuse, documented illness), inform the instructor in order to be exempted from that class. Otherwise, if you forget your device or miss class, the points cannot be made up, but your **three lowest participation days will be dropped**. Answers to Chem101 questions submitted on a sheet of paper will **not** be accepted. The questions must be answered on a device using the Chem101 system.

Attempting to obtain participation points for another student who is not in class is **cheating**. If you are caught doing Chem101 work for another student, you **both** will receive a 0% for your participation grade for the **entire semester**. If you are caught cheating a second time, you will receive an “F” for the course.

**Pre-lecture Assignments:** Before most class meetings there will be one or more sections of the textbook assigned to read, and one or two quizzes on the material that must be taken on Achieve and will be due
immediately before class. Since these activities are intended to prepare you for class, they may not be taken late, but your three lowest scores will be dropped.

**Homework:** Success in this class requires skill at problem solving. For this reason, online homework problems will be assigned each week, using the Achieve system. Assignments will be due each Thursday night by 11:59 pm. Questions may be submitted after the deadline, but they will be subject to a late penalty of 10% per day past the deadline. In calculating final grades, your lowest homework score of the semester will be dropped. Most homework questions allow multiple attempts, with small penalties for wrong answers. Please make use of the available hints – there is no deduction for using them. Each assignment will be scaled to be worth the same number of points.

**Online Quizzes:** There will be online quizzes each week except on weeks when there is an exam. Each quiz will review the material on the most recent homework assignment, but there will be no hints or feedback until all answers are submitted. Quizzes will generally be due on Friday nights at 11:59 pm. No extensions will be given. Plan ahead! If you know that you will be busy at the deadline, take the quiz early. Your lowest quiz score will be dropped.

**Homework Notebook:** It is strongly suggested that you keep a homework notebook for this class, in which solutions to all homework problems are neatly and logically recorded. This will help you in your studying since you will be able to review the steps that you followed in solving a problem. When you attend an SI session, or an office hour, please bring your homework notebook.

**In-Class Exams:** Three 50-minute exams will be given in class as shown on the schedule. Each exam will concentrate on material covered since the previous exam. The format of the exams will include multiple choice, short answer questions and calculations. The final exam will be comprehensive and all multiple choice. It must be taken at the scheduled time (10:00 a.m. to 12:00 noon on Tuesday, May 7th).

**Communication:** Check the class webpage OFTEN for announcements and class handouts. E-mail is the best way to contact me (antony.hascall@nau.edu). Do NOT use the BbLearn email to contact me. Use your NAU email account. Please include in your messages a subject indicating your section of CHM 151, an appropriate salutation, grammatically acceptable text, and a closing. Messages lacking these elements may be ignored! Please be aware that I am not allowed to discuss grades by email. I will sometimes send important announcements by email to the whole class, so please check your NAU email account frequently.

**Internet / Phone Policy:** Students will NOT use phones, laptops, etc., in class for non-course related activities. All devices will be kept on SILENT. Research in CHM 151 & 152 (and other courses) clearly shows a negative link between in-class cell phone use and course grade. Texting and driving kills and yet people still do it. Please, help us help you be successful in this course and turn your phone OFF!

**Academic Integrity:** The university’s academic integrity policy will be followed (https://policy.nau.edu/policy/policy.aspx?num=100601). If you are caught plagiarizing and/or cheating on an assignment, you will receive 0% for that assignment. If you are caught cheating a second time, or are caught cheating on the final exam, you will receive an “F” for the entire course. Examples of cheating include, but are not limited to, copying another student’s exam, using any unauthorized material to help answer test questions or attempting to receive participation credit for a class you did not attend. All violations of academic integrity will be documented with the university.

Having a cellphone, smart watch or any other web-enabled device on your person during an exam will be considered a violation of academic integrity and will result in a score of zero for that exam.

**Learning Portfolio:** Students are urged to keep a homework notebook, as mentioned above. You are also encouraged to retain all exams and quizzes as evidence that you developed skills in scientific inquiry, critical thinking and quantitative analysis. Additionally, keeping your old work provides a record in case of errors in grade recording…
No make-ups will be given for missed quizzes or exams except for institutional excuses. One of the complaints of students, instructors, and administrators concerning university education is that it lacks relevance. One of the relevant features of chemical information is that it is often “timed.” That is, if it is late or missing, it is worthless. Therefore, missed quizzes and exams count as zeros. Documentable illnesses/emergency will be considered on an individual basis. Family emergencies must be documented by the Office of Student Life. Remember, the absence must be documentable. If you have an institutional excuse or other valid reason, contact the instructor in advance to arrange how the missed test will be made up. **If the instructor was not notified in advance, a zero will be recorded.** Please note that routine medical or dental appointments are NOT an acceptable reason for missing an exam. You may NOT take an exam in another section of the course.

**Class Schedule:** Note the important dates given here. Please see the class webpage ([http://jan.ucc.nau.edu/~ah476/CHM151Schedule.html](http://jan.ucc.nau.edu/~ah476/CHM151Schedule.html)) for a more detailed schedule including planned topics to be covered each class. Any changes to the schedule will be posted online.

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<thead>
<tr>
<th>Week</th>
<th>Dates</th>
<th>Tests</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1/14-18</td>
<td>none</td>
<td>Math Review assignment due Friday night</td>
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<tr>
<td>2</td>
<td>1/21-25</td>
<td>Quiz 1 due Friday on Achieve</td>
<td>No class Monday; Thursday is last day to</td>
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<td></td>
<td></td>
<td></td>
<td>add/drop classes</td>
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<tr>
<td>3</td>
<td>1/28-2/1</td>
<td>Quiz 2 due Friday on Achieve</td>
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<tr>
<td>4</td>
<td>2/4-8</td>
<td>Quiz 3 due Friday on Achieve</td>
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<tr>
<td>5</td>
<td>2/11-15</td>
<td>Exam 1 Friday</td>
<td></td>
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<td>6</td>
<td>2/18-22</td>
<td>Quiz 4 due Friday on Achieve</td>
<td></td>
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<tr>
<td>7</td>
<td>2/25-3/1</td>
<td>Quiz 5 due Friday on Achieve</td>
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<tr>
<td>8</td>
<td>3/4-8</td>
<td>Quiz 6 due Friday on Achieve</td>
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<tr>
<td>9</td>
<td>3/11-15</td>
<td>Exam 2 Friday</td>
<td></td>
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<tr>
<td>10</td>
<td>3/18-22</td>
<td>Spring Break</td>
<td></td>
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<td></td>
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<td></td>
<td>Monday is last day to withdraw (CEFNS usually will not grant a late drop petition)</td>
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<tr>
<td>11</td>
<td>3/25-29</td>
<td>Quiz 7 due Friday on Achieve</td>
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<tr>
<td>12</td>
<td>4/1-5</td>
<td>Quiz 8 due Friday on Achieve</td>
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<tr>
<td>13</td>
<td>4/8-12</td>
<td>Quiz 9 due Friday on Achieve</td>
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<tr>
<td>14</td>
<td>4/15-19</td>
<td>Quiz 10 due Friday on Achieve</td>
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<tr>
<td>15</td>
<td>4/22-26</td>
<td>Exam 3 Friday</td>
<td></td>
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<tr>
<td>15</td>
<td>4/29-5/3</td>
<td>Quiz 11 due Sunday on Achieve</td>
<td>End of Term Week (CLASS AS USUAL! i.e. there’s still homework etc...)</td>
</tr>
</tbody>
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**Final Exam:** Tuesday May 7th, 10:00 a.m. – 12:00 noon

While class attendance is very important, please be cautious about attending class if you are feeling ill. Please inform me by e-mail if you are feeling unwell. If you are experiencing flu-like symptoms, you should NOT attend class; please take precautions not to infect others and seek medical attention if your symptoms worsen. For more information about the flu, including symptoms and prevention tips, visit [http://nau.edu/Medical-Services/Flu-Shot/](http://nau.edu/Medical-Services/Flu-Shot/)

**Instructor Goals:** My general goals for this course include helping you to develop the abilities to think logically and analytically; to communicate clearly; to work productively as a member of a group seeking to achieve a common objective; to make informed judgments; to foster and sustain an attitude of intellectual curiosity and creativity; and to recognize and honor true excellence when found in any form or context. In addition, I have the following specific goals with respect to skills development:

- Assisting in the development of problem-solving skills.
- Assessing your understanding of the principles needed for later work in chemistry and related courses.
• Improving your skills in learning from the written text, group discussion, and investigation.
• Improving your skills in data interpretation and knowledge synthesis.
• Improving your skills in communicating ideas and results.
• Assisting in developing a true joy of learning.

Resources for Student Success

Successful university students take advantage of services and resources designed to boost learning and achievement. NAU recommends that you begin with:

• **Supplemental Instruction**: [https://nau.edu/academic-success-centers/supplemental-instruction/](https://nau.edu/academic-success-centers/supplemental-instruction/)
  Supplemental Instruction (SI) is available to all students enrolled this course. SI includes four one-hour sessions outside of class each week. These voluntary sessions are led by SI Leaders and include review of challenging course concepts, study skills and test preparation in an interactive, group format. SI Leaders have successfully completed this course and received training to facilitate the sessions.
  The SI program has been helping NAU students succeed for more than a decade. SI is a voluntary program and, on average, students who participate earn higher grades.

  *SI sessions aren’t always easy (in fact, they support some of the most challenging courses on campus), but with time and effort, you can enhance your learning in this course!*

• **Academic Success Centers**: [https://nau.edu/asc/](https://nau.edu/asc/)
  Free drop-in, online, and individual tutoring appointments for math, writing, and over 100 other courses. Located on the second floor of the University Union.

• **ResourceConnect**: [https://nau.edu/provost/vpaa/resource-connect/resource-connect/](https://nau.edu/provost/vpaa/resource-connect/resource-connect/)
  is your online central navigation point for all NAU student resources

• **Action Center**: [https://nau.edu/VPAA/Action-Center/Action-Center/](https://nau.edu/VPAA/Action-Center/Action-Center/)
  provide messages to keep you academically on track – when you get a message **take action!**

**Emergency Textbook Loan Program**: The purpose of this program is to assist students with unmet financial needs in obtaining required textbook(s) for schooling. More information can be found online:
[https://nau.edu/first-generation/textbook-loan-program](https://nau.edu/first-generation/textbook-loan-program)

**University Policies**

NAU’s policies on Safe Working and Learning Environments, Students with Disabilities, and Academic Integrity are included at the end of this syllabus and can be viewed at: [http://nau.edu/Curriculum-and-Assessment/Forms/Curricular-Policy/Syllabus_Policy_Statements/](http://nau.edu/Curriculum-and-Assessment/Forms/Curricular-Policy/Syllabus_Policy_Statements/)

**Liberal Studies Information**

**Course Description**

CHM 151 is the first semester of a 1-year sequence appropriate for pre-professional science and engineering majors. As a liberal studies course, CHM 151 provides a foundation in chemistry – the science of change. The course addresses the following liberal study themes and essential skills:

**Themes:**

**Environmental Consciousness.** Chemical change is of key importance in understanding the behavior of the Earth’s hydrosphere and atmosphere. The chemical and physical properties of gases, liquids and solids are presented in CHM 151. The student learns to name chemical compounds, recognize periodic trends of the elements and predict the product of chemical reactions. With this background, students can begin to interpret the physical and chemical processes of the natural world. Topics that illustrate these processes include aqueous reactions (critical for understanding water quality)
and combustion processes (critical for understanding heat release to the atmosphere). Students will learn to associate these processes with their effect on the environment.

**Technology and its Impact.** Chemistry has a profound impact on the technological developments of the 20th and 21st centuries. Many chemical discoveries have improved the quality of life (drugs, laser technologies and the semiconductor industry) while others have threatened it (CFCs and pesticides). Whenever possible, this course will illustrate how modern technology has been influenced by the fundamental science taught in CHM 151.

**Essential Skills:**

**Scientific Inquiry:** Chemistry is an empirical science. What is taught in CHM 151 represents knowledge that has been acquired over the past 3 centuries through application of the scientific method, a systematic approach to research. Scientific theories will be examined in light of this process, which includes the formulation of a hypothesis, observations, symbolic representation of data, interpretation and conclusions.

**Quantitative Analysis:** Quantitative Analysis is at the root of the physical sciences. Specific skills the student will learn include writing and balancing chemical equations, dimensional analysis, and the application of algebra in the quantification of chemical change.

**Critical Thinking:** Successful chemical problem solving requires the ability to follow a logical, sequential thought process, understand abstract and symbolic language, discriminate between relevant and superfluous data and question underlying assumptions about cause and effect relationships.

**Course Outcomes (linked to theme and skills)**

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

1. Distinguish between chemical and physical processes (**Critical Thinking, Scientific Inquiry**)
2. Utilize mathematical skills to solve chemical problems in mass relationships and stoichiometry (**Quantitative Analysis**)
3. Determine the solubility, concentrations and ionic properties of compounds dissolved in aqueous solutions (**Quantitative Analysis**)
4. Use standardized symbols to represent atoms, molecules, ions and chemical reactions (**Scientific Inquiry**)
5. Describe intermolecular forces which influence the properties of gases, liquids and solids (**Critical Thinking, Quantitative Analysis**)
6. Predict atomic structure, chemical bonding or molecular geometry based on theoretical models and results of empirical studies (**Critical Thinking, Scientific Inquiry**)
7. Apply chemical principles to the understanding of the physical and natural world (**Critical Thinking, Scientific Inquiry**)
8. Recognize the influence of chemical change in environmental situations and its impact on technology (**Environmental Consciousness/Technology and its Impact**)

**Assessment of Outcomes (linked to themes and skills)**

Student learning outcomes will be evaluated using examinations, quizzes and/or homework. These evaluation methods will test the student’s knowledge of scientific principles, their ability to identify and solve problems, and their ability to analyze scientific data. Quiz and exam questions will require students to:

1. Analyze data presented in graphs or tables, theoretical models, or results from empirical studies to draw correct hypotheses or conclusions (**Scientific Inquiry, Critical Thinking**)
2. Perform multi-step calculations using appropriate equations and formulas (**Quantitative Analysis, Critical Thinking**)
3. Identify proper symbolic representation of atoms, molecules, ions and chemical reactions (**Scientific Inquiry**)
4. Determine the products and heat exchange of chemical reactions (**Quantitative Analysis, Critical Thinking**)
5. Based on the physical properties of gases, liquids and solids deduce the nature of the underlying intermolecular forces (**Critical Thinking, Scientific Inquiry**)
6. Apply your knowledge to the chemistry of the natural world/environment. Exams, quizzes and/or homework will include questions that link acquired chemical knowledge to environmental scenarios (e.g. the ion concentration of a lake, the heat released by burning fossil fuels, or the moles of CFCs in the atmosphere) (**Environmental Consciousness/Technology and its Impact**)

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CHM 151 Lecture Topics

We will cover most of the topics in Chapters 1-13 of the Sapling Interactive General Chemistry textbook:

I. Introduction & Atomic Structure
   Ch. 1: Measurement, and Problem Solving  Atoms and Molecules, Classification of Matter, Physical and Chemical Changes, Units and Reliability of Measurements, Problem Solving for Chemistry.
   Ch. 2: Atoms and the Periodic Table  Atomic Theory, Early Experiments, Structure of the Atom, The Periodic Table, Atomic Mass

II. Chemical Reactions & Stoichiometry
   Ch. 3: Compounds, and the Mole  Chemical Bonds, Chemical Formulas and Molecular Models, Elements and Compounds, Naming Compounds and Writing Formulas – Ionic and Molecular, Molar Mass, The Mole Concept (grams to moles to atoms), Molar mass of a compound, Converting from Grams to Moles to Molecules, Percent Composition, Determining Empirical and Molecular Formulas.
   Ch. 4: Chemical Reactions and Aqueous Solutions  Writing and Balancing Chemical Equations, Electrolytes/Nonelectrolytes, Solubility, Precipitation Reactions, Writing Chemical Equations – Molecular, Ionic, Net Ionic, Acid-Base Reactions, Oxidation-Reduction Reactions.
   Ch. 5: Stoichiometry  Amounts of Products and Reactants (Stoichiometry), Limiting Reagent, Theoretical Yield, Percent Yield, Molarity, Dilutions, Solution Stoichiometry, Titrations.

III. Electronic Structure and Periodic Properties

IV. Chemical Bonding
   Ch. 10: Covalent Bonding  Types of Chemical Bonds, Lewis Dot Symbols, Lewis Structures, Resonance, Formal Charge, Exceptions to the Octet Rule, Electronegativity and Bond Polarity, Bond Energies and Bond Lengths.
   Ch. 11: Molecular Shape and Bonding Theories  VSEPR, Molecular Shapes, Polar and Nonpolar Molecules, Valence Bond Theory, Hybridization of Atomic Orbitals, Hybridization in Molecules Containing Double and Triple Bonds, Delocalized Electrons.

V. States & Properties of Pure Matter

VI. Solutions
   Ch. 13: Solutions  Types of Solutions, Energetics of Solution Formation, Factors Affecting Solubility, Concentration Units, Colligative Properties, Freezing Point Depression, Boiling Point Elevation, Osmotic Pressure, Colligative Properties of Electrolytes.