CHEM 1311/1111
General Chemistry
Spring 2021

Instructors:

Dr. Kyle Beran
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Office Hours: MWF 2:00-3:00PM, TR 11:00AM-12:00PM, or by appointment

Mr. Rigel Rilling
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Office: CAV 201B
Office Hours: MW 2:00-5:00PM, T 11:00AM-2:00PM

Dr. Gregory Smith
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Office Hours: MTWR 1-2 pm, or by appointment

Dr. Shanmugapriya Dharmarajan
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Office: CAV 204A
Office Hours: W 2:30-5, F 11-1:30, or by appointment

CHEM 1311 — GENERAL CHEMISTRY LECTURE CLASS

Lecture Class Meeting Times

<table>
<thead>
<tr>
<th>Sec</th>
<th>Days</th>
<th>Time</th>
<th>Instructor</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>010</td>
<td>MWF</td>
<td>09:00 am-09:50 am</td>
<td>Dr. Beran</td>
<td>CAV 211</td>
</tr>
<tr>
<td>020</td>
<td>MWF</td>
<td>10:00 am-10:50 am</td>
<td>Dr. Beran</td>
<td>CAV 211</td>
</tr>
<tr>
<td>030</td>
<td>TR</td>
<td>09:30 am-10:45 am</td>
<td>Dr. Smith</td>
<td>CAV 223</td>
</tr>
</tbody>
</table>
Required Texts and Materials

- **Textbook and ALEKS online homework [Both Required]:**

  **Purchasing Options:**
  1. Textbook – FREE!
  2. ALEKS – McGraw-Hill; [https://www.aleks.com](https://www.aleks.com)

- **McGraw Hill Connect for Virtual Labs** (Lab sections only)
  Purchase access through [https://connect.mheducation.com/](https://connect.mheducation.com/). We will be using the Connect system to perform some Virtual Labs. Instructions for signing up for your specific section will be posted in your lab section’s Blackboard page.

- **Respondus Lockdown & Respondus Monitor**
  Access through Blackboard. Make sure that your computer/laptop is compatible with Respondus software. Respondus Monitor requires a webcam. Lockdown and Monitor will be used for the administration of exams.

- **Approved Lab Goggles [Required]** (available from the ASU Bookstore or from the lab stockroom)

- **Calculator [Required]:** Scientific calculator capable of performing calculations with scientific notation and logarithms. *Bring your calculator to class and to lab every day.* Only non-programmable calculators may be used on the exams.

Course Description

**1311/CHEM 1311 General Chemistry I (3-0).** An introduction to the fundamental laws and theories of chemistry, chemical nomenclature, stoichiometry, atomic structure, chemical bonding, periodic table, chemical equations and reactions, and the properties of heat flow and gases. **Prerequisites:** Students must have received: a score of 580 or above on the mathematics portion of the SAT if taken before March 2016, a score of 600 or above on the mathematics portion of the SAT if taken in March 2016 or after, a score of 26 or above on the mathematics section of the ACT, completed college algebra with a grade of “C” or better, or completed Chemistry 1305 with a grade of “C” or better in order to enroll in Chemistry 1311/1111. **Corequisite:** Chemistry 1111.

**1111/CHEM 1111 General Chemistry I Laboratory (0-3).** Laboratory experiments that focus on laboratory technique, data collection, and analysis. The experiments will expand upon the concepts and topics presented in Chemistry 1311. **Corequisite:** Chemistry 1311.

Technology Requirements

To successfully complete this course, students need to obtain access to ALEKS, an online homework program. These assignments will be averaged to give a 200-point
grade. To register with ALEKS, follow the instructions in the “ALEKS Student Registration” handout.

Respondus Lockdown Browser
Access to exams and quizzes will be through Respondus Lockdown Browser and will be video recorded via Respondus Monitor. Respondus requires a desktop computer or laptop (not a Chromebook) and a webcam. For best results, use an ethernet cable to connect to your Internet source instead of relying on Wifi. Refer to the Blackboard course for Respondus installation instructions.
Click here for more information:
https://www.youtube.com/watch?time_continue=9&v=XuX8WoeAycs&feature=emb_title

Grading

Evaluation and Grades
Course grades will be determined as indicated in the table below.

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Total Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exams (3×100 pts)</td>
<td>300 pts</td>
</tr>
<tr>
<td>Final Exam</td>
<td>150 pts</td>
</tr>
<tr>
<td>Quizzes, classroom participation</td>
<td>150 pts</td>
</tr>
<tr>
<td>ALEKS Homework</td>
<td>200 pts</td>
</tr>
<tr>
<td>Laboratory</td>
<td>200 pts</td>
</tr>
<tr>
<td>Total</td>
<td>1000 pts</td>
</tr>
</tbody>
</table>

Students who are taking both CHEM 1111 and CHEM 1311 for the first time who wish to drop either course must drop both courses, because dropping either course would result in the co-requisite requirement no longer being met.

Overall grades in CHEM 1311/1111 will be determined as follows:
- If BOTH CHEM 1311 and CHEM 1111 are completed, the letter graded will be based on a total of 1000 points.
- For students who begin and complete ONLY CHEM 1311, a percentage will be calculated using only lecture assessments (first four items listed above with 800 points possible) and the letter grade will be assigned based on that percentage.
- For students who begin and complete ONLY CHEM 1111, the percentage will be calculated using only lab assessments and that percentage will be used to assign a letter grade."
Course Delivery
To maintain academic quality while accommodating social distancing needs this semester, this course will use a split delivery model that combines face-to-face teaching with remote instruction. The goal is to provide face-to-face instruction to students who want to return to campus, while also allowing students who may need to learn remotely to participate via virtual class sessions.

How Does It Work?
Your class will be divided and you will be placed into a smaller group of students to maintain physical distancing requirements in our assigned classroom space. Your assigned group will receive a schedule of in-person class meetings. This schedule is not flexible. For instance, if you are supposed to attend class on a Monday, you cannot elect to go on Wednesday with another class group instead. When you are not in the physical class, you will attend live remote sessions at the same time as our scheduled course. You will also be expected to complete coursework via Blackboard. Please refer to this Health and Safety web page for updated information about campus guidelines as they relate to the COVID-19 pandemic.

Attendance
You are expected to attend all class meetings according to the schedule of physical and virtual attendance as explained above. You are expected to arrive on time and to stay until the end of the lecture. Activities such as worksheets and quizzes cannot be made up. You will not be automatically dropped if you stop attending class.

If you feel sick, please stay home. Keep your professor informed as to your status by email (preferred) or telephone (if necessary). Your faculty will work with you to keep up to date in the class.

Grading System
Course grades will be dependent upon completing course requirements and meeting the student learning outcomes. The following grading scale will be used for this course:

- A = 900-1000 points (90-100%)
- B = 800-899 points (80-89.9%)
- C = 700-799 points (70-79.9%)
- D = 600-699 points (60-69.9%)

Exams
The exams will be given outside of regular class time on the dates listed below:

<table>
<thead>
<tr>
<th>Exam</th>
<th>Date</th>
<th>Room</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam 1</td>
<td>Thursday, Friday 25</td>
<td>Online</td>
<td>5:30 pm</td>
</tr>
<tr>
<td>Exam 2</td>
<td>Thursday, March 24</td>
<td>Online</td>
<td>5:30 pm</td>
</tr>
<tr>
<td>Exam 3</td>
<td>Thursday, April 29</td>
<td>Online</td>
<td>5:30 pm</td>
</tr>
</tbody>
</table>

Most of the exams will be over material covered since the last exam. However, the course builds on material delivered earlier so the concepts, calculations and techniques from earlier exams may be required. Only non-programmable calculators may be used on the exams (i.e., no graphic calculators are allowed).

Make up exams will be at the discretion of your individual faculty. Usually, allowances will only be made in the case of an excused university absence. Communication with your instructor is critical.

Final Exam
The Final Exam will be a comprehensive multiple-choice standardized exam published by the American Chemical Society (ACS). Study guides for the ACS exam (“General Chemistry - Official Study Guide”) are available for sale in the lab stockroom and from the ACS web page. The schedule for the 1311 final exams is shown below. The complete final exam schedule is also available on the ASU web page.

<table>
<thead>
<tr>
<th>Sec</th>
<th>Days</th>
<th>Time</th>
<th>Instructor</th>
<th>Final Exam Date</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>010</td>
<td>MWF</td>
<td>09:00 -09:50 am</td>
<td>Dr. Beran</td>
<td>WED, May 12</td>
<td>08:00-10:00 am</td>
</tr>
<tr>
<td>020</td>
<td>MWF</td>
<td>10:00 -10:50 am</td>
<td>Dr. Beran</td>
<td>MON, May 10</td>
<td>10:30 am-12:30 pm</td>
</tr>
<tr>
<td>040</td>
<td>TR</td>
<td>10:00 -10:50 am</td>
<td>Dr. Smith</td>
<td>THUR, May 13</td>
<td>08:00-10:00 am</td>
</tr>
</tbody>
</table>

Blackboard
Information, handouts, homework assignments, and other course documents will either be posted on your instructor’s faculty web page, or on Blackboard.

Last Day to Drop
The last day to drop without creating an academic record: Tuesday, February 9, 2021. The last day to drop the course with a grade of “W”: Thursday, April 30, 2021.
CHEM 1111 — GENERAL CHEMISTRY LABORATORY

Laboratory Meeting Times
The lab classes that accompany the CHEM 1311 lecture course are shown in the table below. The labs will meet first for pre-lab lectures in the Class Room listed in the table, though your instructor may opt for a virtual pre-lab meeting instead.

Note that, on weeks where we meet in person for labs, your lab will be separated into two groups, one in CAV 216 and one in CAV 227 to maximize social distancing. (See “How does it Work,” above.)

<table>
<thead>
<tr>
<th>Section</th>
<th>Day</th>
<th>Meeting Time</th>
<th>Instructor</th>
<th>Class Room</th>
<th>Lab Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>04Z</td>
<td>M</td>
<td>11:00 am-01:50 pm</td>
<td>Dharmarajan</td>
<td>CAV 211</td>
<td>CAV 216/227</td>
</tr>
<tr>
<td>05Z</td>
<td>W</td>
<td>11:00 pm-01:50 pm</td>
<td>Dharmarajan</td>
<td>CAV 223</td>
<td>CAV 216/227</td>
</tr>
<tr>
<td>06Z</td>
<td>T</td>
<td>11:00 pm-01:50 pm</td>
<td>Dharmarajan</td>
<td>CAV 223</td>
<td>CAV 216/227</td>
</tr>
<tr>
<td>07Z</td>
<td>R</td>
<td>11:00 am-01:50 pm</td>
<td>Mr. Rilling</td>
<td>CAV 223</td>
<td>CAV 216/227</td>
</tr>
<tr>
<td>08Z</td>
<td>M</td>
<td>02:00 pm-04:50 pm</td>
<td>Dr. Smith</td>
<td>CAV 219</td>
<td>CAV 216/227</td>
</tr>
<tr>
<td>09Z</td>
<td>T</td>
<td>02:00 pm-04:50 pm</td>
<td>Dr. Smith</td>
<td>CAV 215</td>
<td>CAV 216/227</td>
</tr>
<tr>
<td>10Z</td>
<td>R</td>
<td>02:00 pm-04:50 pm</td>
<td>Dharmarajan</td>
<td>CAV 219</td>
<td>CAV 216/227</td>
</tr>
</tbody>
</table>

The CHEM 1111 General Chemistry laboratory class accompanies this lecture class. The lab is designed to illustrate some of the principles involved in performing scientific measurements, handling chemicals, and performing chemistry experiments. In some cases, the experiments in the lab will introduce you to concepts before you cover them in the lecture course, and in some cases, the experiments will reinforce concepts already covered in the lecture course.

Pay close attention to any announcements in your Bb lab section!!!!

Laboratory Attire
Beginning on the first day of lab, everyone MUST have approved goggles, long-sleeved shirts which cover the midriff, long pants, and shoes with closed toes and heels (no sandals, slides, etc.). (Basically, you should have as little exposed skin as possible.) Anyone not wearing the appropriate attire will not be allowed into lab.
Lab Procedures and Lab Reports
The procedures for these labs will be posted on Blackboard in the section labeled “Lab Resources.” The procedures will provide a description of the background for each experiment, pre-laboratory questions that will be turned in at the beginning of the lab period, a procedure for the experiment, and a lab report form which must be handed in when the lab is completed. It is essential that you read the materials posted in Blackboard for that week’s lab before coming to lab. Each lab will be worth 100 points.

Cleaning Up After Lab
Make sure that your lab area is clean and that all glassware and hardware has been cleaned and returned to the appropriate drawers before leaving the lab.

Make-Up Lab Policy
The lowest lab score will be dropped from the total. If you miss a lab for a valid reason, that is the score that will be dropped.

Lab Safety Training
All students enrolled in lab courses are required to take a Mandatory Laboratory Safety Training and Quiz on Blackboard. Instructions for completing the quiz are given below:
1. Login to Blackboard, and choose the course: entitled “Lab Safety Training.”
2. Under the left-hand menu, choose: “Get Started Here”.
3. There are three sections:
   a. Welcome to Lab Safety Training — There are your instructions.
   b. Lab safety training — Click on “Lab Safety — Click here to begin”. This will download a PowerPoint slide show which will cover the safety training.
   c. The lab safety quiz. You must score 90% or higher. You can take it again in 24 hours.
The Lab Safety Training must be completed by the evening of Sunday, February 7. If not, students will not be allowed to into the lab rooms until the training is completed.

Lab Final
There will be a 100-point lab final given during the week of May 3 – 6, 2021. This grade will not be dropped from the lab total.
<table>
<thead>
<tr>
<th>Date</th>
<th>Week</th>
<th>Lecture</th>
<th>Lab</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1/25</td>
<td>Chapter 1: Matter and Energy — Composition of Matter, States of Matter, Measurements, SI Units, Significant Figures, Unit Conversions</td>
<td>ONLINE Lab Safety Lecture Significant figure lecture and worksheet Virtual Labs Tutorial and Safety Mandatory Lab Safety Training and Quiz (must be completed by Sep. 8)</td>
</tr>
<tr>
<td>2</td>
<td>2/01</td>
<td>Chapter 2: Atoms, Ions, and Molecules — Nuclear Model, Atomic Mass, Periodic Table, Molecular and Ionic Compounds, Naming Compounds and Writing Formulas</td>
<td>FACE TO FACE Measuring mass and volume</td>
</tr>
<tr>
<td>3</td>
<td>2/08</td>
<td>Chapter 2, cont.</td>
<td>ONLINE Take Home Assignment: “Scientific Measurement and Presentation of Data”</td>
</tr>
<tr>
<td>4</td>
<td>2/15</td>
<td>Chapter 3: Stoichiometry The Mole Concept, Balancing Equations, Stoichiometry, Percent Composition, Limiting Reactants</td>
<td>FACE TO FACE Measuring Density</td>
</tr>
<tr>
<td>5</td>
<td>2/22</td>
<td>Chapter 3, cont. Exam 1 – Thurs., Sep. 17 (Ch. 1, 2, 3)</td>
<td>ONLINE LearnSmart Lab – Stoichiometry</td>
</tr>
<tr>
<td>6</td>
<td>3/01</td>
<td>Chapter 4: Solution Chemistry — Concentration, Electrolytes, Acid-Base Reactions, Precipitation Reactions, Redox Reactions</td>
<td>FACE TO FACE Percentage Water in a Hydrate</td>
</tr>
<tr>
<td>Date</td>
<td>Week Of</td>
<td>Lecture</td>
<td>Lab</td>
</tr>
<tr>
<td>------</td>
<td>---------</td>
<td>---------</td>
<td>-----</td>
</tr>
<tr>
<td>7</td>
<td>3/08</td>
<td>Chapter 4, cont.</td>
<td>ONLINE Midterm Exam</td>
</tr>
<tr>
<td>8</td>
<td>3/15</td>
<td><strong>Chapter 5: Thermochemistry</strong> — Energy, Systems, Enthalpy, Heat Capacity, Calorimetry, Hess’s Law, Standard Enthalpies of Formation</td>
<td><strong>FACE TO FACE</strong> Titration of Vinegar</td>
</tr>
<tr>
<td>9</td>
<td>3/22</td>
<td><strong>Chapter 6: Electronic Structure and Periodicity</strong> — Electromagnetic Radiation, Bohr Model, Quantum Theory, Electronic Configurations, Periodic Trends of Elements</td>
<td><strong>ONLINE</strong> LearnSmart Lab – Calorimetry</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Exam 2 – Thurs., Oct. 15 (Ch. 3, 4, 5, 6)</strong></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>3/29</td>
<td>Chapter 6, cont.</td>
<td><strong>FACE TO FACE</strong> Hess’s Law</td>
</tr>
<tr>
<td>11</td>
<td>4/05</td>
<td><strong>Chapter 7: Chemical Bonding and Molecular Geometry</strong> — Ionic and Covalent Bonding, Lewis Structures, Formal Charges/Resonance, Strengths of Bonds, VSEPR Theory, Structure and Polarity</td>
<td><strong>ONLINE</strong> Molecular Structures and Shapes</td>
</tr>
<tr>
<td>12</td>
<td>4/12</td>
<td><strong>Chapter 8: Covalent Bonding</strong> — Valence Bond Theory, Hybrid Orbitals, Multiple Bonds, Molecular Orbital Theory</td>
<td><strong>FACE TO FACE</strong> Emission Spectra of Atoms</td>
</tr>
<tr>
<td>13</td>
<td>4/19</td>
<td><strong>Chapter 9: Gases</strong> — Pressure, Temperature, Volume, Ideal Gas Law, Gas-Phase Stoichiometry, Effusion/Diffusion, Kinetic-Molecular Theory, Non-Ideal Gases</td>
<td><strong>ONLINE</strong> LearnSmart Lab – Gas Law</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Exam 3 – Thurs., Nov. 12 (Ch. 6, 7, 8, 9)</strong></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>4/26</td>
<td>Chapter 9, cont.</td>
<td><strong>Lab Final Exam</strong></td>
</tr>
<tr>
<td>Date</td>
<td>Week Of</td>
<td>Lecture</td>
<td>Lab</td>
</tr>
<tr>
<td>------</td>
<td>---------</td>
<td>---------</td>
<td>-----</td>
</tr>
<tr>
<td>15</td>
<td>5/03</td>
<td><strong>Chapter 10: Liquids and Solids</strong> – Intermolecular Forces, Properties of liquids, Phase transitions</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>5/10</td>
<td><strong>Final Exams, cont.</strong> <em>MAY 10 – 13 Final Exams</em></td>
<td></td>
</tr>
</tbody>
</table>

### General Policies Related to This Course

All students are required to follow the policies and procedures presented in these documents:

- [Angelo State University Student Handbook](#)
- [Angelo State University Catalog](#)

### Academic Integrity

Students are expected to maintain complete honesty and integrity in all work. Any student found guilty of any form of dishonesty in academic work is subject to disciplinary action and possible expulsion from ASU.

The College of Science and Engineering adheres to the university’s [Statement of Academic Integrity](#).

### Accommodations for Students with Disabilities

ASU is committed to the principle that no qualified individual with a disability shall, on the basis of disability, be excluded from participation in or be denied the benefits of the services, programs or activities of the university, or be subjected to discrimination by the university, as provided by the Americans with Disabilities Act of 1990 (ADA), the Americans with Disabilities Act Amendments of 2008 (ADAAA) and subsequent legislation.

Student Disability Services is located in the Office of Student Affairs, and is the designated campus department charged with the responsibility of reviewing and authorizing requests for reasonable accommodations based on a disability. It is the student’s responsibility to initiate such a request by contacting an employee of the Office of Student Affairs, in the Houston Harte University Center, Room 112, or contacting the department via email at [ADA@angelo.edu](mailto:ADA@angelo.edu). For more information about the application process and requirements, visit the [Student Disability Services website](#).
The employee charged with the responsibility of reviewing and authorizing accommodation requests is:

Dallas Swafford  
Director of Student Disability Services  
Office of Student Affairs  
325-942-2047  
dallas.swafford@angelo.edu  
Houston Harte University Center, Room 112

Virtual communication  
Office hours and/or advising may be done with the assistance of the telephone, Collaborate, Skype, etc.

Incomplete Grade Policy  
It is policy that incomplete grades be reserved for student illness or personal misfortune. Please contact faculty if you have serious illness or a personal misfortune that would keep you from completing course work. Documentation may be required. See ASU Operating Policy 10.11 Grading Procedures\(^9\) for more information.

Plagiarism  
Plagiarism is a serious topic covered in ASU’s Academic Integrity policy\(^10\) in the Student Handbook. Plagiarism is the action or practice of taking someone else’s work, idea, etc., and passing it off as one’s own. Plagiarism is literary theft.

In your discussions and/or your papers, it is unacceptable to copy word-for-word without quotation marks and the source of the quotation. It is expected that you will summarize or paraphrase ideas giving appropriate credit to the source both in the body of your paper and the reference list.

Papers are subject to be evaluated for originality. Resources to help you understand this policy better are available at the ASU Writing Center.\(^11\)

Student Absence for Observance of Religious Holy Days  
A student who intends to observe a religious holy day should make that intention known in writing to the instructor prior to the absence. See ASU Operating Policy 10.19 Student Absence for Observance of Religious Holy Day\(^12\) for more information.
**Title IX Statement**

Angelo State University is committed to providing and strengthening an educational, working, and living environment where students, faculty, staff, and visitors are free from sex discrimination of any kind. In accordance with Title VII, Title IX, the Violence Against Women Act (VAWA), the Campus Sexual Violence Elimination Act (SaVE), and other federal and state laws, the University prohibits discrimination based on sex, which includes pregnancy, and other types of Sexual Misconduct. Sexual Misconduct is a broad term encompassing all forms of gender-based harassment or discrimination and unwelcome behavior of a sexual nature. The term includes sexual harassment, nonconsensual sexual contact, nonconsensual sexual intercourse, sexual assault, sexual exploitation, stalking, public indecency, interpersonal violence (domestic violence or dating violence), sexual violence, and any other misconduct based on sex.

You are encouraged to report any incidents involving sexual misconduct to the Office of Title IX Compliance and the Director of Title IX Compliance/Title IX Coordinator, Michelle Boone, J.D. You may submit reports in the following manner:

Online: [www.angelo.edu/incident-form](http://www.angelo.edu/incident-form)

Face to Face: Mayer Administration Building, Room 210

Phone: 325-942-2022

Email: michelle.boone@angelo.edu

Note, as a faculty member at Angelo State, I am a mandatory reporter and must report incidents involving sexual misconduct to the Title IX Coordinator. Should you wish to speak to someone in confidence about an issue, you may contact the University Counseling Center (325-942-2371), the 24-Hour Crisis Helpline (325-486-6345), or the University Health Clinic (325-942-2171).

For more information about resources related to sexual misconduct, Title IX, or Angelo State’s policy please visit: [www.angelo.edu/title-ix](http://www.angelo.edu/title-ix).

**Required Use of Masks/Facial Coverings**

As a member of the Texas Tech University System, Angelo State University has adopted the mandatory [Facial Covering Policy](http://www.angelo.edu(title-ix) to ensure a safe and healthy classroom experience. Current research on the COVID-19 virus suggests there is a significant reduction in the potential for transmission of the virus from person to person by wearing a mask/facial covering that covers the nose and mouth areas. Therefore, in compliance with the university policy students in this class are required to wear a mask/facial covering before, during, and after class. Faculty members may also ask you to display your daily screening badge as a prerequisite to enter the classroom. You are also asked to maintain safe distancing practices to the best of your ability. For the safety of everyone, any student not appropriately wearing a mask/facial covering will be asked to leave the classroom immediately. The student will be responsible to make up any missed class content or work. Continued non-compliance with the Texas Tech University System Policy may result in disciplinary action through the Office of Student Conduct.
Modifications to the Syllabus
This syllabus, including grade evaluation and course schedule, is subject to modification. In particular, the COVID-19 pandemic may require significant changes in course delivery and content on potentially short notice.

Student Learning Outcomes

- **Learning Goal 1:** Students will be able to analyze complex chemical problems and draw logical conclusions.
  - Students will be able to use an understanding of atomic structure at the basic and atomic levels to analyze the structure and reactivity of substances and chemical species.
  - Students will be able to use an understanding of how energy interacts with matter to predict stable chemical species, and perform thermodynamic calculations describing chemical reactions.

- **Learning Goal 2a:** Students will be able to understand and apply scientific reasoning in the chemical sciences.
  - Students will be able to use an understanding of ions and molecules at the atomic level to predict the behavior of reactions in aqueous solutions.
  - Students will be able to use the basic ideas of quantum mechanics to describe how molecular bonds form and to predict molecular shape and polarity. Molecular structure and polarity will be used to predict the forces between molecules and relate those forces to the states of matter and phase changes.

- **Learning Goal 2b:** Students will be able to employ mathematics in the analysis of chemical problems.
  - The mole concept, chemical formulas and balanced chemical equations will be used to do chemical calculations that relate macroscopic measurements to numbers of atoms, ions or molecules.
  - Students will be able to do calculations involving solution concentration and know how to prepare solutions of given concentrations.
  - Students will be able to quantitatively predict gas properties using gas law calculations.

- **Learning Goal 3:** Students will be able to demonstrate technical and analytical skills in chemistry.
  - Students will be able to use the periodic table to determine basic atomic information and to predict trends in atomic properties.
  - Students will be able to interconvert between chemical names and formulas to the extent that they can work problems given only one of those pieces of information.
Students will be able to classify common types of chemical reactions and predict the outcomes of reactions.

Evaluation of Student Learning Outcomes
Student learning outcomes will be evaluated by test questions or by the grading of in-classroom activities, as described by your instructor.

Texas Higher Education Coordinating Board Natural Sciences Objectives
The objective of the study of a natural sciences component of a core curriculum is to enable the student to understand, construct, and evaluate relationships in the natural sciences, and to enable the student to understand the basis for building and testing theories.

Exemplary Educational Objectives
1. To understand and apply method and appropriate technology to the study of natural sciences.
2. To recognize scientific and quantitative methods and the differences between these approaches and other methods of inquiry and to communicate findings, analyses, and interpretation both orally and in writing.
3. To identify and recognize the differences among competing scientific theories.
4. To demonstrate knowledge of the major issues and problems facing modern science, including issues that touch upon ethics, values, and public policies.
5. To demonstrate knowledge of the interdependence of science and technology and their influence on, and contribution to, modern culture.

1 http://angelo.blackboard.com/
2 https://www.angelo.edu/covid-19/returning-to-campus/health-and-safety.php
3 http://uwm.edu/acs-exams/students/student-study-materials/
4 http://www.angelo.edu/services/registrar办公室/final.html
5 https://www.angelo.edu/current-students/student-handbook/
6 https://www.angelo.edu/academics/catalogs/
7 https://www.angelo.edu/live/files/27603-student-handbook-2020-21#page=96
8 https://www.angelo.edu/current-students/disability-services/
9 https://www.angelo.edu/content/files/14197-op-1011-grading-procedures
11 https://www.angelo.edu/current-students/writing_center/academic_honesty.php
12 https://www.angelo.edu/content/files/14206-op-1019-student-absence-for-observance-of