

# CHEM 1311/1111

## General Chemistry

Spring 2022



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### Instructors:

#### Dr. Janet Maxwell

Email: [Janet.Maxwell@angelo.edu](mailto:Janet.Maxwell@angelo.edu)

Phone: 486-6624

Office: CAV 229B

Office Hours: MWF 9-10 am, TR 9:30-10:30 am or by appointment

#### Mr. Rigel Rilling

Email: [Rigel.Rilling@angelo.edu](mailto:Rigel.Rilling@angelo.edu)

Phone: 486-6654

Office: CAV 201B

Office Hours: MW 2:00-5:00 pm, T 11:00 am-2:00 pm.

#### Dr. Ralph Zehnder

Email: [Ralph.Zehnder@angelo.edu](mailto:Ralph.Zehnder@angelo.edu)

Phone: 486-6662

Office: CAV 204B

Office Hours: W 2:30-5, F 11-1:30, or by appointment

#### Dr. Shanmugapriya Dharmarajan

Email: [shanmugapriya.dharmarajan@angelo.edu](mailto:shanmugapriya.dharmarajan@angelo.edu)

Phone: 486-6626

Office: CAV 204A

Office Hours: M 10:00-12:00 am, T 12:30-1:30 pm, W 12:30 to 2:30 pm

### Class Meeting Times

Sec	Days	Time	Instructor	Location
D10	MWF	08:00 am-08:50 am	Dr. Maxwell	ONLINE
020	MWF	09:00 am-09:50 am	Dr. Zehnder	CAV 219
030	MWF	10:00 am-10:50 am	Dr. Zehnder	CAV 219

## Required

### Texts and Materials

- **Textbook, ALEKS online homework by Wiley, and LabFlow laboratory platform [all three required]:**

Paul Flowers, Klaus Theopold, Richard Langley, and William R. Robinson, *Chemistry 2e* (2<sup>nd</sup> edition). You can access the book by clicking on the following link: [OpenStax Chemistry Textbook by Paul Flowers](#)

#### Purchasing Options:

1. Textbook – FREE!
  2. ALEKS – McGraw-Hill; \$70 for one semester, \$75 for 1 year, [ALEKS HW](#)
  3. LabFlow; \$49.99 per semester,
- **Respondus Lockdown & Respondus Monitor** Access through Blackboard. Make sure that your computer/laptop is compatible with Respondus software. Respondus Monitor requires a webcam. Lockdown Browser and Monitor will potentially be used for the administration of exams.
  - **Approved Lab Goggles [Required]** (available from the ASU Bookstore)
  - **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.*
  - **Access to a Printer** either on campus or off campus

### 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” document. The ten-digit class code that you need for registering with ALEKS is: [QXJTC-ATGDE](#)

You also need access to LabFlow, a platform that we will use for you to upload your lab reports and other related lab assignments. For signup instructions please follow the link and review the pdf file that are located in Blackboard in your lab course.

### Course Delivery

This lecture course will be delivered online via Collaborate. Students are required to attend the class live in order to get credit for course assignments, exams and quizzes. All lab sections will be taught in person on campus by other instructors.

### Attendance

You are expected to attend all class meetings. 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.

### Grading

Assessment	Total Points
Exams (3x100 pts)	300 pts
Final Exam	150 pts
Quizzes (10 x 15 pts)*	150 pts
Homework (ALEKS)	200 pts
Laboratory	200 pts
<b>Total</b>	<b>1000 pts</b>

\*11 quizzes will be given and the lowest quiz grade will be automatically dropped.

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 grade 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.”

## 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%)

C = 700-799 points (70-79%)

D = 600-699 points (60-69%)

F = 0-599 points (<60%)

Dr. Maxwell “rounds up” on your grades. For example, an 89.5% gives you an A.

## Respondus Lockdown Browser

Exams and quizzes will be administered through Respondus Lockdown Browser, in which case you will be video recorded via Respondus Monitor. Respondus requires a desktop computer or laptop 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: [YouTube video with instructions about how to use Lockdownbrowser](#)

## Gradescope

This semester all quizzes and exams will be presented on Respondus and submitted on printed forms using gradescope. Please see **Student Instructions for Gradescope** to the left of your blackboard lecture. No gradescope admissions will be graded if they are not submitted in the correct way printed on the correct forms. That means submissions should be right side up and the pages in numerical order. The use of Gradescope allows me to see your work. Answers that require mathematics will not get credit unless the work is shown. However, you can get partial credit for partially correct work. In addition, all quizzes and exams must be submitted using the proper forms available on Blackboard in gradescope within 5 minutes of logging off of Respondus. Under no circumstances will credit be given for submitting work on the wrong form or a piece of blank paper. Students will also not be given credit for work submitted to gradescope if the student did not work the entire time on Respondus with their answers.

## Quizzes

The quizzes will be given according to the schedule on this syllabus. Each quiz will be worth 15 points. Most quizzes will be given on Fridays, with the exception of Quiz 10, which we will give on a Wednesday since there is no Friday class that week. Quizzes will open at about 9 am and will close at 11:59 pm that same day. To take a quiz, first you must print out the Gradescope form available on Blackboard. Then you must log onto Respondus to see the questions for the quiz. You must show your answers on Gradescope. If the question requires mathematic manipulation, then you must show your work to get credit. Alternately, if some of your work is correct, you will be given partial credit.

## Exams

The exams will be administered as common tests remotely outside of regular class time on the dates listed below:

Exam	Date	Room	Time
Exam 1	Wednesday, Feb. 16	Virtual	5:30 pm
Exam 2	Wednesday, March. 23	Virtual	5:30 pm
Exam 3	Wednesday, Apr. 20	Virtual	5:30 pm

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 display calculators are allowed).**

The exams will be multiple choice, administered on the Respondus Lock-down Browser and Monitor. However, students must print out provided Gradescope sheets to write their multiple choice answers and to show their work. These pages will then be submitted to Gradescope instead of via the Respondus Browser. Work must be shown on questions that require mathematical manipulations or no credit will be given. Partial credit will also be given for answers that are partially correct. No credit will be given if the answers are not written on the required form and submitted according to the guidelines on Gradescope.

## Make-up Exams

Students will only be allowed to take one make-up exam if there is an illness or emergency which is documented in writing. In order for a student to be eligible to take a make-up exam, the student must notify Dr. Maxwell before the exam is missed by telephone, voice mail or email. When a student returns to class after missing an exam, he or she must present a document

such as a doctor's note or funeral notice in order for Dr. Maxwell to give permission for a make-up exam. All make-up exams will be given on Friday, May 6 at 1:00 pm. Students will not be given a second chance for a make-up exam. Each student may take no more than one make-up exam for any reason whatsoever.

## 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 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](#).

Sec	Days	Time	Instructor	Final Exam Date	Time
D10	MWF	08:00 -8:50 am	Dr. Maxwell	Monday, May 9	07:30-10:00 am
020	MWF	09:00 -09:50 am	Dr. Zehnder	Wed., May 11	08:00-10:00 am
030	MWF	10:00 -10:50 am	Dr. Zehnder	Mon., May 9	10:30 am-12:30 pm

## Blackboard

Grades will be posted on [Blackboard](#).<sup>1</sup> Information, handouts, homework assignments, and other course documents will either be posted on your instructor's faculty web page, or on Blackboard.

## Drop Date

The last day to drop the course with a grade of "W" is **Thursday, April 28, 2022**.

# 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 classroom listed in the table.

Section	Day	Meeting Time	Instructor	Class Room	Lab Room
06Z	M	11:00 am-01:50 pm	Mr. Rilling	CAV 211	CAV 216
07Z	W	11:00 am-01:50 pm	Dr. Zehnder	CAV 211	CAV 216
08Z	T	11:00 am-01:50 pm	Dr. Zehnder	CAV 211	CAV 216
09Z	R	11:00 am-01:50 pm	Dr. Zehnder	CAV 211	CAV 216
10Z	M	02:00 pm-04:50 pm	Dr. Dharmarajan	CAV 211	CAV 216
11Z	T	02:00 pm-04:50 pm	Dr. Dharmarajan	CAV 223	CAV 216

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.

## 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

We will be using the platform LabFlow by Catalyst Education for lab procedures, etc. You will have to register and to create an account with LabFlow by following this link: [LabFlow Create Account](#)

A pdf document with more detailed instructions is provided in BlackBoard.

While you sign up you will be prompted to pay a fee of \$49.99

The procedures for the labs will be posted within the LabFlow platform. The procedures will provide a description of the background for each experiment. You will be asked to complete pre-laboratory questions prior to the lab meeting within the LabFlow platform. Your instructor will communicate to you at what time the prelab assignments are due. The lab report itself will be uploaded to LabFlow and must be turned in by whichever due date your instructor requires. Each lab will be worth up to 100 points (up to 20 points for the prelab questions, and up to 80 points for the lab report).

Labs will begin meeting in the second week of class. Bring your calculator!

During the first week there are a few dry activities you must complete online using LabFlow as well as BlackBoard.

## 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

If you have to miss a lab you will be turning in a lab report based on virtual data LabFlow will generate for you. You will have to seek permission from your instructor to be eligible to turn in a 100% virtual lab report. Your instructor will first work with you to attend another face-to-face lab section if that is feasible.

## **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 and Chemical Hygiene."
2. Under the left-hand menu, choose: "Get Started Here".
3. Click on "Get Started Here" in the left-hand column.
4. Follow the instructions under "Welcome to Lab Safety and Chemical Hygiene Training!"
5. You must score 90% or higher on the lab safety quiz.

The Lab Safety Training must be completed by the evening of Sunday, January 23.

## **Lab Midterm and Final Exams**

There will be a 100-point lab midterm (week of 3/7) and a 100-point lab final exam (week of 5/2).

# LECTURE AND LAB SCHEDULE — SPRING, 2022

Date	Week Of	Lecture	Lab
1	1/17	<p><i>Monday, Jan 17 MLK day no classes</i></p> <p><b>Chapter 1: Matter and Energy —</b> Composition of Matter, States of Matter, Measurements, SI Units, Significant Figures, Unit Conversions</p> <p><b>Jan 21 -Quiz 1 opens at 9 am; must be submitted through Gradescope by 11.59 pm</b></p>	<p>Labs Do Not Meet</p> <p>Safety videos and Quiz, Chemistry Math and Labware videos and Quiz to be submitted through <b>LabFlow</b></p> <p>Mandatory Lab Safety Training and Quiz — instructions given in <i>Lab Safety Training</i> section in <b>BlackBoard</b> (must be completed by Jan. 23 in <b>BlackBoard</b>)</p>
2	1/24	<p><b>Chapter 2: Atoms, Ions, and Molecules —</b> Nuclear Model, Atomic Mass, Periodic Table, Molecular and Ionic Compounds, Naming Compounds and Writing Formulas</p> <p><b>Jan 28 -Quiz 2 opens at 9 am; must be submitted through Gradescope by 11.59 pm</b></p>	<p>Lab Safety Lecture</p> <p>Discussion of measurements, significant figures, conversion factors, etc.</p> <p>Conversion Factors and Problem Solving dry lab to be submitted through <b>LabFlow</b></p>
3	1/31	<p>Chapter 2, cont.</p> <p><b>Feb 4 - Quiz 3 opens at 9 am; must be submitted through Gradescope by 11.59 pm</b></p>	<p>Basic Laboratory Techniques</p>
4	2/7	<p><b>Chapter 3: Stoichiometry —</b> The Mole Concept, Balancing Equations, Stoichiometry, Percent Composition, Limiting Reactants</p> <p><b>Feb 11- Quiz 4 opens at 9 am; must be submitted through Gradescope by 11.59 pm</b></p>	<p>Density and Specific Gravity</p>
5	2/14	<p>Chapter 3, cont.</p> <p><b>Exam 1 – Wed., Feb. 16 (Ch. 1, 2,3)</b></p>	<p>Empirical Formulas</p>

Date	Week Of	Lecture	Lab
6	2/21	<b>Chapter 4: Solution Chemistry</b> — Concentration, Electrolytes, Acid-Base Reactions, Precipitation Reactions, Redox Reactions, Titrations <b>Feb 25- Quiz 5 opens at 9 am; must be submitted through Gradescope by 11.59 pm</b>	Chemistry of Copper and Percent Yield
7	2/28	Chapter 4, cont. <b>March 4- Quiz 6 opens at 9 am; must be submitted through Gradescope by 11.59 pm</b>	Solutions, Electrolytes, and Concentrations
8	3/7	<b>Chapter 5: Thermochemistry</b> — Energy, Systems, Enthalpy, Heat Capacity, Calorimetry, Hess's Law, Standard Enthalpies of Formation <b>March 7 - Quiz 7 opens at 9 am; must be submitted through Gradescope by 11.59 pm</b>	Oxidation Reduction Reactions <b>Lab Midterm Exam</b> (covering the lab material from week 1 through week 6)
9	3/14	<b>Spring Break, no classes</b>	<b>No Labs</b>
10	3/21	<b>Chapter 6: Electronic Structure and Periodicity</b> — Electromagnetic Radiation, Bohr Model, Quantum Theory, Electronic Configurations, Periodic Trends of Elements <b>Exam 2 – Wed., March. 23 (Ch. 3, 4, 5, 6)</b>	Titration: Determining the Concentration of an Acid
11	3/28	Chapter 6, cont. <b>April 1 - Quiz 8 opens at 9 am; must be submitted through Gradescope by 11.59 pm</b>	Energy and Specific Heat
12	4/4	<b>Chapter 7: Chemical Bonding and Molecular Geometry</b> — Ionic and Covalent Bonding, Lewis Structures, Formal Charges/Resonance, Strengths of Bonds, VSEPR Theory, Structure and Polarity <b>April 8 - Quiz 9 opens at 9 am; must be submitted through Gradescope by 11.59 pm</b>	Constant Pressure Calorimetry

Date	Week Of	Lecture	Lab
13	4/11	<b>Chapter 8: Covalent Bonding —</b> Valence Bond Theory, Hybrid Orbitals, Multiple Bonds, Molecular Orbital Theory <i>Friday, April 15 spring holiday, no classes</i> <b>April 13 *Wed- Quiz 10 opens at 9 am;            must be submitted through            Gradescope by 11.59 pm</b>	Atomic Spectra
14	4/18	<b>Chapter 9: Gases —</b> Pressure, Temperature, Volume, Ideal Gas Law, Gas-Phase Stoichiometry, Effusion/Diffusion, Kinetic-Molecular Theory <b>Exam 3 – Wed., April. 20 (Ch. 6, 7, 8, 9)</b>	Modeling Geometry and Polarity
15	4/25	<b>Thursday, April 28: Last Day to Drop</b> Chapter 9, cont. <b>April 29 - Quiz 11 opens at 9 am; must            be submitted through Gradescope by            11.59 pm</b>	Analysis of $\text{KClO}_3/\text{KCl}$ using the Ideal Gas Law
16	5/02	<b>Chapter 10: Intermolecular Forces —</b> Intermolecular Forces, Vapor Pressure, Phase Diagrams, Water	<b>Lab Final Exam</b>
17	5/09	<b>Final Exams</b>	

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## 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](#)<sup>1</sup>
- [Angelo State University Catalog](#)<sup>2</sup>

## **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 of disciplinary action and possible expulsion from ASU.

The College of Science and Engineering adheres to the university's [Statement of Academic Integrity](#).<sup>3</sup>

## **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](#).<sup>4</sup> 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](mailto:dallas.swafford@angelo.edu)  
Houston Harte University Center, Room 112

## **E-mails**

For conducting official ASU business please use your official ASU e-mail account. Please make sure that you check your ASU.EDU account on a regular basis. The instructor may send important announcements regarding this course, homework, and/or exams to your ASU e-mail account. You will not be able to use the excuse of not checking your e-mail with regard to assignments, tasks, or exams you missed.

## **Virtual communication**

Office hours and/or advising may be done with the assistance of the telephone, Collaborate, Skype, Facetime, 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](#)<sup>5</sup> for more information.

## **Plagiarism**

Plagiarism is a serious topic covered in ASU's [Academic Integrity policy](#)<sup>6</sup> 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](#).<sup>7</sup>

## **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](#)<sup>8</sup> for more information.

## **Title IX at Angelo State University**

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 Miller, J.D. You may submit reports in the following manner:

Online: [Incident Reporting Form](#)<sup>9</sup>

Face to Face: Mayer Administration Building, Room 210

Phone: 325-942-2022, Email: [michelle.miller@angelo.edu](mailto:michelle.miller@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 the [Title IX website](#).<sup>10</sup>

## Information About COVID-19

Please refer to ASU's [COVID-19 \(Coronavirus\) Updates](#)<sup>11</sup> web page for current information about campus guidelines and safety standards as they relate to the COVID-19 pandemic.

## 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.

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<sup>1</sup> <https://www.angelo.edu/current-students/student-handbook/>

<sup>2</sup> <https://www.angelo.edu/academics/catalog/>

<sup>3</sup> <https://www.angelo.edu/live/files/27603-student-handbook-2020-21#page=96>

<sup>4</sup> <https://www.angelo.edu/current-students/disability-services/>

<sup>5</sup> <https://www.angelo.edu/content/files/14197-op-1011-grading-procedures>

<sup>6</sup> <https://www.angelo.edu/live/files/27603-student-handbook-2020-21#page=96>

<sup>7</sup> [https://www.angelo.edu/current-students/writing-center/academic\\_honesty.php](https://www.angelo.edu/current-students/writing-center/academic_honesty.php)

<sup>8</sup> <https://www.angelo.edu/content/files/14206-op-1019-student-absence-for-observance-of>

<sup>9</sup> <https://www.angelo.edu/incident-form>

<sup>10</sup> <https://www.angelo.edu/title-ix>

<sup>11</sup> <https://www.angelo.edu/covid-19/>