Syllabus
First Semester General Chemistry
Dr. Saupe - Spring 2023 - CHEM 1305

Stipulations in this syllabus are subject to modification and correction during the semester. All modifications (if any) will be discussed in class and posted on the course Blackboard site.

Instructor:

Dr. Geoffrey Saupe
Course: CRN 21576
Location: UGLC 116
Time: TR 12:00 PM - 1:20 PM
Office Location: PSCI 203-D - also check my research lab in PSCI 104
Phone: 747 - 7559
Email: gsaupe@utep.edu
Teaching Assistant: TBA

Course Information:

This CHEM 1305 course has two required components (for one grade) that all students must register for:

(1) CHEM 1305 Lecture. Meets 2 days a week for 80 minutes each time. It is listed as a 3-credit hour course.

(2) CHEM 1305 Workshop. Meets one day per week for two hours. It is a zero credit-hour course. You should be enrolled in a workshop that has the same professor as your lecture section. There are no exceptions to this. You must be enrolled in both the lecture and workshop. Both are labeled "CHEM 1305". Workshops meet during the first week of classes. Attendance is required.

A different course is the Laboratory CHEM 1105 (not workshop), which is a separate course with a separate grade and a different instructor. CHEM 1105 lab is normally a co-requisite to CHEM 1305 and it is highly recommended that you take them both concurrently. Most majors require CHEM 1105 lab, but some do not. Laboratory CHEM 1105 is three hours in duration and meets once a week.

1305 Workshop and 1105 Laboratory are different courses but BEWARE that both are listed in Goldmine as labs. Only CHEM 1105 is a real laboratory course. CHEM 1305 workshop is part of lecture (this course).
**Required Course Materials:**

1. **REQUIRED:** The **SPRING 2023 version** of *First Semester General Chemistry by Exploration - SPRING 2023*. This is the "workbook" that is required for your CHEM 1305 Workshop. At this time, it is only available through the UTEP bookstore (they will mail it to you, if you request it, but I highly recommend going and getting it in person). You must get the **SPRING 2023 version** for this course. Used or old copies are not usable and not correct. This workbook is ripped up and the page pages are torn out during use in the course. The bookstore often has to restock this book several times during the first week of school. So if you don't find it, please keep checking and you will. Strangely, the book is listed in the UTEP bookstore under the letter "M" for the author's last name initial.

2. **REQUIRED:** **Lecture Textbook and Online Homework system:** The ALEKS electronic homework system is sold as a unit with the e-book of our textbook (i.e they cannot be bought separately). Our textbook is: *Chemistry*, 14th edition, by Jason Overby and Raymond Chang. When you link to the ALEKS.com website, be sure to use the **class code** for our particular section of general chemistry. Our class code is WMXFV-DC3VP. This way you will automatically get the correct textbook and homework.

**SPECIAL CASE:** **IF** you have a scholarship that requires you to use the UTEP bookstore, the UTEP bookstore may be your only option (for purchasing ALEKS). If so, you will need to buy an ALEKS code from the bookstore, and then when you join the correct course online, you enter the code when asked.

**OPTIONAL add-ons** - If you also want the convenience of a paper copy of the textbook, it is acceptable to choose any edition (10, 11, 12, 13 or 14) of this textbook. Used paper copies are very reasonable in price online ($15-$25). You can even get a new version paper copy (loose leaf) added on when you buy ALEKS. A paper copy is only optional, not required.

When you purchase ALEKS, you will be asked if you want the 180-day version or the 360-day version. I recommend the 180-day version, because there is no guarantee that your second semester course will use ALEKS.

**USE THIS Class Code when registering or purchasing ALEKS --- WMXFV-DC3VP.** Choose this when asked and you will automatically get the correct book and homework and instructor.

**Topics Covered** - *See Appended Contents from the Textbook at the end of this syllabus. We will cover the first ten chapters of our textbook. Some topics will be omitted due to time constraints.*

**Prerequisites:**

In order to be enrolled in Chemistry 1305, you should have at minimum:

- Passed or be concurrently enrolled in Math 1508 or
- Have achieved an SAT Math score of 600 or better.

If you do not have met this requirement, you will not do well in the course.
**Attendance:** Attendance in workshops is required and is a significant part of your grade. Attendance in lecture is strongly recommended but not required. **Extra credit will be awarded** to students who come to lecture and scan their physical ID cards (Miner Gold card) into the attendance scanners at the classroom entrance. You Miner Gold card ID is already paid for. Pick it up and use it.

**Workshop:**

*Workshop is a required component* of the CHEM 1305 course. Every student enrolled in a CHEM 1305 Lecture section **must** also be co-enrolled in a CHEM 1305 Workshop section. **All workshops meet during the 1st week of school** (and for the rest of the semester). **Attendance is required** in workshop.

Each of the Workshops meets for a two-hour period and is instructed by a **Peer Leader**. The Workshop format enables the Peer Leaders to use **active learning** techniques to enhance understanding of the chemical principles discussed in class. It also provides opportunities for **hands-on exposure to qualitative and descriptive chemistry activities (Explorations) to enhance learning.** Workshops will often have its own supplemental syllabus to help define the requirements. Check with your Peer Leader (see your emails).

**Workshop Office Hours:** The Team of Workshop Peer Leaders (PLs) have several office hours every day of the school week. The actual hour and location of the office hours will be announced in the workshop and posted on Blackboard. Though each PL has their own specific office hours each week, **you may consult with any Peer Leader during their office hours.**

**Student Major:**

The CHEM 1305 - CHEM 1306 sequence is designed for students who are majoring in a field of science or engineering. Students majoring in other disciplines may prefer (but are not required) to take the CHEM 1307 - 1308 sequence, which contains more descriptive and less quantitative material. Please check with your academic adviser.

**Resources:**

**Blackboard:** Announcements, help files, and grade results will be made available using Blackboard. **You are strongly advised to use the resources posted on Blackboard. Check often for content updates.** To access Blackboard:

- Go to your my.UTEP.edu web page and choose Blackboard. You will need your email username and password. If you don’t know your email username and password, call the HELP desk to request them.
- Click on Blackboard. Go to your CRN.
**Secretarial Services and Main Chemistry Department Office:**
The main office of Chemistry Department is located in the Chemistry and Computer Science Building CCSB 2.0704. The phone number is 915-747-5701.

**Learning Goals:**
This course is the first part of General Chemistry for scientists, engineers, and pre-medical students. Students in the class will gain fundamental knowledge in atomic and molecular structure, nomenclature, physical and chemical changes of matter, chemical reactivity, chemical bonding, quantitative chemical calculations, thermochemistry and the properties of gases. Specifically, students will be able to:
- Describe, explain, and model chemical and physical processes at the molecular level in order to explain macroscopic properties.
- Classify matter by its state and bonding behavior using the Periodic Table as a reference.
- Solve quantitative chemistry problems and demonstrate reasoning clearly and completely.
- Integrate multiple ideas in the problem solving process.
- Learn how to work successfully in teams to solve challenging chemical problems.
- Learn how to argue persuasively but respectfully about chemical concepts.
- Practice oral reporting out to their entire Workshop, thus gaining confidence in public speaking and to reinforce retention of knowledge.

**Instructor Expectations:**
- Students shall attend all lectures and all workshops.
- Students shall complete all homework assignments. It is the students’ responsibility to finish assigned lecture Homework and Assignments by due dates; it is the student’s additional responsibility to finish, and turn in to their Peer Leaders, assigned Workshop Workbook homework by due dates.
- Students will read the textbook chapters covered before class and consult with the professors or Peer Leaders for any questions.
- Students will review exam material that they failed to master and master it before proceeding.

**College of Science Course Withdrawal Policy**
Classes dropped prior to the official census date will be deleted from the student’s semester record. After this date, but only before the official course drop deadline, the College of Science permits any student to drop with an automatic “W”. After the official course drop deadline, students who withdraw must receive grades of “F”. See new drop date on the UTEP website.

The UTEP Spring 2023 course drop deadline is posted on the UTEP website. The College of Science (COS) will remain aligned with the University policy and NOT approve any drop requests after that date. If you have a major issue that prevents completion of your semester, they (COS) will often allow you to withdraw from the university (i.e. you lose all your courses for that semester), which will give you a "W" in the courses on your transcript.
All grades of Incomplete (semester grade = I) must be accompanied by an Incomplete Contract that has been signed by the instructor of record, student, departmental chair, and the Dean. The College of Science requires Incomplete Contracts be limited to one month. A grade of Incomplete is only used in extraordinary circumstances. If the student has missed a significant amount of work (e.g. multiple assignments or tasks), a grade of Incomplete is not appropriate or warranted.

**Laboratories:**
CHEM 1105 Laboratory is a separate course with a different instructor. CHEM 1105 is not Workshop and Workshop is not CHEM 1105. Workshop is an integral part of CHEM 1305. The content and experience in CHEM 1105 laboratory is also designed to enhance the materials covered in lectures for CHEM 1305 and is therefore highly recommended.

**Examinations:**

Four regular examinations and one Final Exam are scheduled. The final exam scheduled time is dictated by the University and is posted on the UTEP College of Science website. Please note the special times for large sections like CHEM 1305. The dates for the four regular exams will be posted on Blackboard.

No makeup of examinations will be provided. When valid absences are expected in advance, and qualified arrangements are made at least 7 days prior to an exam, the instructor may approve taking an exam early. Valid absences are only for proven University related activities (e.g. out-of-town research presentations, sporting events, and other issues pre-arranged with the professor) and must be arranged with the professor at least 7 days prior to the date of the respective examination.

For every examination:

- A regular non-programmable scientific calculator is required. Programmable types like TI-83, TI-84, TI-89, etc are not permitted in the exam. See Blackboard for suggestions.
- NO CELL PHONES, tablets, computers, OR OTHER ELECTRONIC DEVICES MAY BE USED DURING EXAMINATIONS.
- Exams are closed book. No access to notes or photos is allowed during the exams.
- We will be using a special answer sheet for recording multiple choice answers on exams. It is NOT a SCANTRON (green). It is called an Apperson answer sheet. The correct type of answer sheets will provided in class during the exams as needed.

**Academic Honesty:**

Materials (written or otherwise) submitted to fulfill academic requirements must represent a student’s own efforts. Any act of academic dishonesty attempted by a UTEP student is unacceptable and will not be tolerated. Academic dishonesty is prohibited and is considered a violation of the UTEP Handbook of Operating Procedures. It includes, but is not limited to, cheating, plagiarism, and collusion. Violations will be taken seriously and must be referred to the
Office of Student Conduct and Conflict Resolution for disciplinary action. Studying together and discussing homework problems etc is encouraged, but you still must do your own work.

**Students with Disabilities or Special Needs:**

Students with a documented disability or special needs can contact the Center for Accommodations and Student Services (CASS) to take exams with appropriate accommodations. Any pre-arrangements must be made known to the instructor in the first two weeks of class and the appropriate CASS generated documentation presented to the instructor. The CASS office is located in Room 106 Union East Building and can be contacted at (915) 747-5148 Voice, (915) 747-8712 Fax or via email at cass@utep.edu.

For each exam, the student requiring CASS services or special arrangements must notify CASS at least 5 days prior so the professor can be notified and be ready to supply the exam materials to the CASS office. PLEASE CHECK WITH THE CASS OFFICE FOR HELP WITH THE REQUIREMENTS. The CASS office has become very strict about their deadlines. Please be aware and submit requests in time.

I (the Professor) will work with you to help solve issues with the CASS office. Please feel free to ask me for help.

**Grade Evaluation:**

Letter grades for the CHEM 1305 course are assigned on the basis of your performance in the course and are determined by your scores earned during the semester. The final course grade is based on a weighted average calculation using the following:

A) **Final examination** (comprehensive) score (25%)

B) **Workshop** (includes quizzes, homework, and participation) (20%)

C) **ALEKS online lecture Homework** (10%)

D) **Regular Examinations** - best of 3 out of 4 (45%). That is, each exam is worth 15% of your grade.

Four Regular Examinations will be given. **Your lowest regular exam grade will be dropped.** The exact cut-off scores for your letter grade in 1305 will be determined at the end of the semester, but often follows a traditional pattern or better (more lenient), something like 70%, 80%, and 90% for grades of C, B, and A, respectively.

**Course Topics Covered** are Appended (next page). Also see files posted on Blackboard.
Contents in Brief

1 Chemistry: The Study of Change 1
2 Atoms, Molecules, and Ions 38
3 Mass Relationships in Chemical Reactions 75
4 Reactions in Aqueous Solutions 118
5 Gases 172
6 Thermochemistry 230
7 Quantum Theory and the Electronic Structure of Atoms 274
8 Periodic Relationships Among the Elements 326
9 Chemical Bonding I: Basic Concepts 368
10 Chemical Bonding II: Molecular Geometry and Hybridization of Atomic Orbitals 412
11 Intermolecular Forces and Liquids and Solids 465
12 Physical Properties of Solutions 518
13 Chemical Kinetics 562
14 Chemical Equilibrium 621
15 Acids and Bases 666
16 Acid-Base Equilibria and Solubility Equilibria 720
17 Entropy, Free Energy, and Equilibrium 776
18 Electrochemistry 812
19 Nuclear Chemistry 862
20 Chemistry in the Atmosphere 900
21 Metallurgy and the Chemistry of Metals 930
22 Nonmetallic Elements and Their Compounds 956
23 Transition Metals Chemistry and Coordination Compounds 994
24 Organic Chemistry 1025
25 Synthetic and Natural Organic Polymers 1058

Appendix 1 Derivation of the Names of Elements A-1
Appendix 2 Units for the Gas Constant A-7
Appendix 3 Thermodynamic Data at 1 atm and 25°C A-8
Appendix 4 Mathematical Operations A-13
CHAPTER 1

Chemistry: The Study of Change 1

1.1 Chemistry: A Science for the Twenty-First Century 2
1.2 The Study of Chemistry 2
1.3 The Scientific Method 4

CHEMISTRY in Action
The Search for the Higgs Boson 6

1.4 Classifications of Matter 6
1.5 The Three States of Matter 9
1.6 Physical and Chemical Properties of Matter 10
1.7 Measurement 11

CHEMISTRY in Action
The Importance of Units 17

1.8 Handling Numbers 18
1.9 Dimensional Analysis in Solving Problems 23
1.10 Real-World Problem Solving: Information, Assumptions, and Simplifications 27

Key Equations 28
Summary of Facts & Concepts 29
Key Words 29
Questions & Problems 29

CHEMICAL MYSTERY
The Disappearance of the Dinosaurs 36
CHAPTER 2
Atoms, Molecules, and Ions 38

2.1 The Atomic Theory 39
2.2 The Structure of the Atom 40
2.3 Atomic Number, Mass Number, and Isotopes 46
2.4 The Periodic Table 48

CHEMISTRY in Action
Distribution of Elements on Earth and in Living Systems 49

2.5 Molecules and Ions 50
2.6 Chemical Formulas 52
2.7 Naming Compounds 56
2.8 Introduction to Organic Compounds 65

Key Equation 67
Summary of Facts & Concepts 67
Key Words 67
Questions & Problems 68

CHAPTER 3
Mass Relationships in Chemical Reactions 75

3.1 Atomic Mass 76
3.2 Avogadro’s Number and the Molar Mass of an Element 77
3.3 Molecular Mass 81
3.4 The Mass Spectrometer 83
3.5 Percent Composition of Compounds 85
3.6 Experimental Determination of Empirical Formulas 88
3.7 Chemical Reactions and Chemical Equations 90
3.8 Amounts of Reactants and Products 95
3.9 Limiting Reagents 99
3.10 Reaction Yield 103

CHEMISTRY in Action
Chemical Fertilizers 105

Key Equations 106
Summary of Facts & Concepts 106
Key Words 106
Questions & Problems 106
CHAPTER 4  Reactions in Aqueous Solutions 118

4.1 General Properties of Aqueous Solutions 119
4.2 Precipitation Reactions 121

CHEMISTRY in Action
An Undesirable Precipitation Reaction 126

4.3 Acid-Base Reactions 126
4.4 Oxidation-Reduction Reactions 132

CHEMISTRY in Action
Breathalyzer 144

4.5 Concentration of Solutions 145
4.6 Gravimetric Analysis 149
4.7 Acid-Base Titrations 151
4.8 Redox Titrations 155

CHEMISTRY in Action
Metal from the Sea 156

Key Equations 157
Summary of Facts & Concepts 158
Key Words 158
Questions & Problems 158

CHEMICAL MYSTERY
Who Killed Napoleon? 170

CHAPTER 5  Gases 172

5.1 Substances That Exist as Gases 173
5.2 Pressure of a Gas 174
5.3 The Gas Laws 178
5.4 The Ideal Gas Equation 184
5.5 Gas Stoichiometry 193
5.6 Dalton’s Law of Partial Pressures 195

CHEMISTRY in Action
Scuba Diving and the Gas Laws 200

5.7 The Kinetic Molecular Theory of Gases 202

CHEMISTRY in Action
Super Cold Atoms 208

5.8 Deviation from Ideal Behavior 210

Key Equations 213
Summary of Facts & Concepts 214
Key Words 214
Questions & Problems 215

CHEMICAL MYSTERY
Out of Oxygen 228
CHAPTER 6

Thermochemistry 230

6.1 The Nature of Energy and Types of Energy 231
6.2 Energy Changes in Chemical Reactions 232
6.3 Introduction to Thermodynamics 234

CHEMISTRY in Action
Making Snow and Inflating a Bicycle Tire 240

6.4 Enthalpy of Chemical Reactions 240
6.5 Calorimetry 246

CHEMISTRY in Action
White Fat Cells, Brown Fat Cells, and a Potential Cure for Obesity 250

6.6 Standard Enthalpy of Formation and Reaction 253

CHEMISTRY in Action
How a Bombardier Beetle Defends Itself 256

6.7 Heat of Solution and Dilution 258

Key Equations 261
Summary of Facts & Concepts 261
Key Words 262
Questions & Problems 262

CHEMICAL MYSTERY
The Exploding Tire 272

CHAPTER 7

Quantum Theory and the Electronic Structure of Atoms 274

7.1 From Classical Physics to Quantum Theory 275
7.2 The Photoelectric Effect 279
7.3 Bohr’s Theory of the Hydrogen Atom 282
7.4 The Dual Nature of the Electron 287

CHEMISTRY in Action
Laser—The Splendid Light 288

7.5 Quantum Mechanics 291

CHEMISTRY in Action
Electron Microscopy 292

7.6 Quantum Numbers 295
7.7 Atomic Orbitals 297
7.8 Electron Configuration 301
Contents

7.9 The Building-Up Principle 308

CHEMISTRY in Action
Quantum Dots 312

Key Equations 313
Summary of Facts & Concepts 314
Key Words 315
Questions & Problems 315

CHEMICAL MYSTERY
Discovery of Helium and the Rise and Fall of Coronium 324

CHAPTER 8

Periodic Relationships Among the Elements 326

8.1 Development of the Periodic Table 327
8.2 Periodic Classification of the Elements 329
8.3 Periodic Variation in Physical Properties 333
8.4 Ionization Energy 340

CHEMISTRY in Action
The Third Liquid Element? 341

8.5 Electron Affinity 345
8.6 Variation in Chemical Properties of the Representative Elements 347

CHEMISTRY in Action
Discovery of the Noble Gases 358

Key Equation 359
Summary of Facts & Concepts 359
Key Words 360
Questions & Problems 360

CHAPTER 9

Chemical Bonding I: Basic Concepts 368

9.1 Lewis Dot Symbols 369
9.2 The Ionic Bond 370
9.3 Lattice Energy of Ionic Compounds 372

CHEMISTRY in Action
Sodium Chloride—A Common and Important Ionic Compound 376

9.4 The Covalent Bond 377
9.5 Electronegativity 380
9.6 Writing Lewis Structures 384
9.7 Formal Charge and Lewis Structure 387
CHAPTER 10

Chemical Bonding II: Molecular Geometry and Hybridization of Atomic Orbitals 412

10.1 Molecular Geometry 413
10.2 Dipole Moments 423
CHEMISTRY in Action
Microwave Ovens—Dipole Moments at Work 426
10.3 Valance Bond Theory 429
10.4 Hybridization of Atomic Orbitals 431
10.5 Hybridization in Molecules Containing Double and Triple Bonds 440
10.6 Molecular Orbital Theory 443
10.7 Molecular Orbital Configurations 446
10.8 Delocalized Molecular Orbitals 452
CHEMISTRY in Action
Buckyball, Anyone? 454

Key Equations 456
Summary of Facts & Concepts 456
Key Words 456
Questions & Problems 457

CHAPTER 11

Intermolecular Forces and Liquids and Solids 465

11.1 The Kinetic Molecular Theory of Liquids and Solids 466
11.2 Intermolecular Forces 467
11.3 Properties of Liquids 473
CHEMISTRY in Action
A Very Slow Pitch 475
11.4 Crystal Structure 477
CHEMISTRY in Action
Why Do Lakes Freeze from the Top Down? 478
11.5 X-Ray Diffraction by Crystals 483