

# Introductory Chemistry

*Chemistry 121, Fall 2019*

## COURSE DESCRIPTION

The world is increasingly studied and understood at molecular resolution. In this course you will learn the fundamentals required to view scientific questions at the molecular scale and gain practice applying chemistry concepts to solve problems. Chemistry is known as the “central science” because its precepts are essential to many other fields of study. The central importance of chemistry to other disciplines requires that chemists be able to collaborate and communicate in groups of scientists with diverse backgrounds, training, and expertise. Moreover, diverse groups are known to be more effective at solving challenging problems and generating new insights. In light of their importance, Introductory Chemistry is intentionally designed to develop these affective skills as you develop your chemistry knowledge.

**Instructor:** Dr. John Hofferberth

**Email:** hofferberthj@kenyon.edu

**Office:** 312 Tomsich Hall

**Office Hours:** Private Office Hours: MW 2:00-3:00 PM, 312 Tomsich  
(reserve a private office hour appointments at:  
<https://tinyurl.com/y8ahxy9k>)  
Group Office Hours: MW 3:00-4:00 PM, 312 Tomsich (no appointment needed)  
Weekly Review Session: F 3:00-4:00 PM, 101 Tomisch  
Inclusion Hours: F 4:00-5:00 PM (in quad, Tomsich stairwell, or 3rd floor lounge starting 9/6/19)

**Classroom:** 101 Tomsich

**Class Time:** 9:10-10:00 AM, MWF

## REQUIRED MATERIALS

1. *Chemistry*, 11th Ed by Raymond Chang and Kenneth A. Goldsby
2. Basic scientific calculator
3. ALEKS (Assessment and LEarning in Knowledge Spaces) online course-companion
4. Access to moodle.kenyon.edu (search for Chemistry 121)

## COLLECTIVE MISSION

Our collective mission is to help everyone get what they need out of this class. The science of learning suggests that a collaborative and active approach is the best way to accomplish this end. Our goal is to collectively help each individual in our community develop.

## LEARNING GOALS

1. **Critical Thinking Skills** – Students will learn how to evaluate concepts, material, problems and challenges posed in the class and thoughtfully apply appropriate and efficient techniques to meet the needs of a given situation.
2. **Individual and Collaborative Efficacy** – Students will develop skills to effectively solve problems individually and as a member of a team. Students will take responsibility for their own success and seek help and resources appropriately.
3. **Metacognitive Skills** - Students develop the ability to reflect on their own process of learning and relationship to the material to evaluate where their strengths lie and how to how to focus their energy to improve.
4. **Communication** – Students will develop oral, written, and symbolic communication skills. Communication between peers, with the instructor, and to the class as a whole all represent different and important settings to exercise professional communication skills.
5. **Engagement with Scientific Information** – Scientists continue to learn and develop skills throughout their career. Acquisition of information and skill development occurs in a variety of settings using a diversity of information sources including: the professional literature, scholarly texts, technical online resources, seminars, workshops, team members, and

professional superiors. Students will develop their ability to make use of all of these information sources to advance their own learning and skills.

6. **Content Mastery** - Students master the foundational concepts in chemistry that will allow them to advance in their education.

## CONTENT LEARNING OBJECTIVES

### Chapter 2:

- Can describe atomic structure (protons, neutrons, & electrons) and define atomic number and mass number.
- Understand the nature of isotopes
- Interpret, predict, name, and write formulas for ionic and molecular compounds, e.g. recognize molecular formulas and empirical formulas.

### Chapter 3:

- Explain the concept of the mole, and use molar mass in calculations.
- Derive compound formulas from experimental data, i.e. empirical formulas from percent compositions.
- Perform stoichiometric calculations using balanced chemical equations.
- Understanding the meaning of limiting reactants in a chemical reaction.
- Calculating theoretical and percent yields of a chemical reaction.

### Chapter 4:

- Understand the nature of ionic substances dissolved in water.
- Understand the solute-solvent relationship and expressing solutes in molarity.
- Recognize common acids and bases, and understand their behavior in aqueous solutions.
- Recognize common oxidizing and reducing agents and identify oxidation-reduction reactions.

### Chapter 5:

- Understand the physical characteristics of gases.
- Understand the basis of gas laws and how to use those laws.
- Use the Ideal Gas Law.
- Apply the gas laws to stoichiometric calculations.
- Recognize why gases do not behave like ideal gases under some conditions.

**Chapter 6:**

- Assess the transfer of energy as heat associated with changes in temperature and changes of state.
- Understand and apply the first law of thermodynamics.
- Define and understand state functions (enthalpy, internal energy).
- Learn how energy changes are measured.
- Calculate energy evolved or required for physical changes and chemical reactions using tables of thermodynamic data.

**Chapter 7:**

- Describe the properties of electromagnetic radiation.
- Understand the origin of light from excited atoms and its relationship to atomic structure.
- Describe the experimental evidence for particle-wave duality.
- Describe the basic ideas of quantum mechanics.
- Define the four quantum numbers ( $n$ ,  $l$ ,  $m_l$  &  $m_s$ ), and recognize their relationship to electronic structure.
- Write the electron configurations for atoms.

**Chapter 8:**

- Write the electron configurations for monatomic ions.
- Rationalize trends in atom and ion sizes, ionization energies, and electron affinity.

**Chapter 9:**

- Recognize when the rules of Lewis dot structures fail and understand the concept of resonance.
- Understand the properties of covalent bonds and their influence on molecular structure.

**Chapter 10:**

- Use the VSEPR theory to predict the shapes of simple molecules and ions and to understand the structures of more complex molecules.
- Use electronegativity and formal charge to predict the charge distribution in molecules and ions, to define the polarity of bonds, and to predict the polarity of molecules.
- Identify the hybridization of a molecule or ion.
- Understanding the difference between valence bond theory and molecular orbital theory.

### Chapter 14:

- Understand the nature and characteristics of chemical equilibria.
- Understand the significance of the equilibrium constant (K) and the reaction quotient (Q).
- Understand how to use K in quantitative studies of chemical equilibria.

### Chapter 15:

- Use the Brønsted-Lowry and Lewis theories of acids and bases.
- Apply the principles of chemical equilibrium to acids and bases in aqueous solution.
- Predict the outcome of reactions between acids and bases.
- Understanding the influence of structure and bonding on acid-base properties.

## GRADING

Your grade in the course will be determined by your engagement with class activities and your mastery of learning goals and objectives. This course will not be graded on a curve.

### Graded Assignments and Weighting:

Course Preparation Assignments (38 × 10 pts)	380 pts	(25%)
Challenges (38 × 5 pts)	190 pts	(12%)
ALEKS online homework	300 pts	(20%)
Quizzes (11 × 10 pts)	110 pts	(7%)
Seminar Synopses (2 × 25 pts)	50 pts	(3%)
Midterm Exams (3 × 100 pts)	300 pts	(20%)
Final Exam	200 pts	(13%)
<hr/> Total Points	<hr/> 1530 pts	

The instructors will assign fair grades at the conclusion of the term. To estimate your grade during the semester use the following grade scheme.

Grade	Percent of Total Points Earned
A (+/-)	100% - 90%
B (+/-)	89% - 80%
C (+/-)	79% - 70%
D (+/-)	69% - 60%
F	< 60%

## COURSE CHARACTERISTICS

### Preparation:

*The material in this course builds on itself.* For that reason it is imperative that you keep up with the course material. Chemistry is a subject that requires the memorization of facts, the understanding and application of concepts, and the integration and synthesis of knowledge from all parts of the course. To be successful, students will need to employ a variety of study tactics and learning strategies. The instructor will highlight good strategies for the different kinds of materials we study. An understanding of how we learn best is a valuable asset in this course (and others). An excellent guide to understanding how best to learn is the following text and is highly recommended reading prior to and throughout the course: “Make it stick: the science of successful learning”, Brown, Roediger, and McDaniel, ©2014 Harvard University Press. In brief, **ACTIVE** learning strategies are far more valuable than passive ones. The course is structured to encourage the use of effective learning strategies that can be transferred to other courses as you learn how to use them.

### Course Structure and Rationale:

Active preparation is essential for your success in chemistry courses. Prior to each class session (except the first day and prior to exam days), your job will be to expose yourself to the material and concepts that will be the focus of the next session; process, consolidate and organize that information into your course notebook; and complete a Course Preparation Assignment (CPA) in your notebook. Each day when you arrive at class, you will find a pre-session assignment (Meta Monday, Wildcard Wednesday, Formative Friday (low-stakes quiz)) displayed on the screen that you will begin as soon as you are seated. Class will begin with a discussion of the pre-session activity and then there will be a discussion of the CPA to allow you to get feedback and calibrate your understanding of the material. After the CPA discussion, using only your notebook as a resource (not your textbook), you will work with your peers on a challenge activity that will apply and extend your knowledge of the topic. Teams will submit their collective work on the challenge activity at the end of the class session. After class, you will complete the challenge in your course notebook and practice and apply your knowledge in ALEKS. You may also complete practice problems from the textbook as you see fit to build your confidence and reinforce your skills.

The structure used in this course is based on the science of how humans learn best: (1) exposure to new information or concepts (establish short-term memory traces while reading or watching videos), (2) consolidation and organization of information (place new information in your existing scaffold of knowledge while writing the key information into your notebook and completing the CPA), (3) recall and application on

CPAs, challenges, pre-session assignments, ALEKS (shift knowledge into long-term memory and practice cueing it when needed to solve a problem) and (4) timely feedback on your work during class discussions and formative assessments (establish knowledge in long-term memory and solidify it in the scaffold of knowledge available for complex cognitive processes). For more information read “Make it Stick” (referenced above).

Aspects of learning that are less cognitively demanding such as exposure to new terms and concepts, memorization, initial comprehension, and basic applications are focused outside of class sessions. Of primary importance during class sessions, when support and immediate feedback is available, are activities that require higher cognitive functions such as applications to more complex problems, analysis of data, and synthesis of concepts to create new models or ways of understanding. Like most things in life, you will get out of the class what you put in. Doing your part prior to class will allow you to benefit more from what we do in class.

The structured nature of the course is known to improve learning outcomes for *all students* and is especially valuable in maximizing the benefits of having a diversity of backgrounds and life-experiences in our class community. (An excellent literature article with leading references on this topic: CBE—Life Sciences Education Vol. 13, 453–468, Fall 2014)

#### Course Preparation Assignments (CPAs):

The CPA assignment for each class session will appear on Moodle following class. The assignment will have 3 parts: (1) **practice** for the material in the previous session, (2) a listing of new material that you need to **process** before the next class and (3) **CPA questions** that you will answer in your notebook, photograph or scan, and submit to Moodle before midnight the day before your next class session. To photograph or scan your CPA questions you can use a scanning app like “camscanner” but you can often do well with the native camera app on your phone. Campus copiers can be used as scanners if you don’t have access to a digital camera or phone. The image of the CPA questions will be pasted **into a text document with at least 20 words typed prior to the image on the top of the first page**, and submitted via Moodle.

Your work preparing for class is essential and genuine engagement on each CPA will be rewarded with 10 points (~380 points total for the semester, 25% of your grade). In sum, your CPA grade makes the largest single contribution to your final grade. CPA grades are *all or nothing* (0 or 10 points). Each student will be permitted one missed CPA for the semester without a grade penalty. CPAs that are submitted on time, are complete, and show genuine engagement with **every question/prompt** will receive credit. It is your job to correct your CPAs (in your notebook) during the CPA discussion at the beginning of each class. If you have questions about one of your CPA responses it is your

responsibility to ask about it during the CPA discussion - if you have a question, it is very likely that others do as well, so don't hesitate to ask it.

### Course Notebook:

You will be provided with a course notebook (a bound composition notebook) on the first day of class. You may use the provided notebook or any bound notebook you prefer. Your notebook will be the record of your work for the class and will include your processing on readings and videos, your personal work on challenges and practice problems, your pre-session assignments, your CPA responses, and your quizzes. *Bring your notebook to every class session (including exams) and any office hours you attend.*

Your notebook will be a temporal record of your activities for the class. Many students find it helpful to number the pages and make an index on the first few pages. After the index, **there will be no blank pages between your work**. Each day upon entering class, students will date stamp where they completed their out-of-class work. Course notebooks will be checked during the midterm exams and final exam and returned the same day.

### Challenges and Teams:

Following the CPA discussion during each class session, pairs or small teams of students will work on a challenge activity. Challenge activities are designed to build from the CPA and concepts learned earlier in the course. Typically challenges will focus on developing higher-level cognitive abilities. In order to get the most out of challenge activities, teams must work efficiently and make sure that they have the opportunity to work on the difficult parts of the material as a collaborative team. During challenges the instructor will be available as a resource and groups that get stuck should get help quickly. Following class, students are responsible for completing the challenge in their notebook.

Active engagement with the challenges will be evidenced by what is written during the class session. At the end of the class session, each team will submit their collective work on the challenge to be graded. Teams that substantiate their engagement with a rich written record (text, calculations, drawings, structures, mechanisms etc.) of their work will receive full credit (5 points) for the challenge. To be clear, challenge grades will be determined by the level of engagement evidenced by **the written work submitted** and not the correctness or amount of the challenge that was completed.

Student teams will be randomly selected at the beginning of each class session by drawing a popsicle stick. The number and letter on the stick will assign each student a partner (1A with 1A, 1B with 1B, etc) and a group of four students (all students with 1, two pairs of partners). Partners will sit next to one another and groups will sit in the same area of the room so they can work together when needed. To be maximally effective, these collaborations must be inclusive endeavors. Group members who



quickly understand a particular question or part of a challenge should transition to the role of mentor/teacher for other group members. Two individuals who both think they understand but have different answers should carefully listen to each other and try to discover the correct interpretation. Working in teams is an essential skill in the workforce today and people with ability to function well in a team, make the most of all the human resources in a team, and team leadership skills are tremendously valuable. You will assess your own abilities as a team member and the abilities of your teammates during Formative Fridays.

#### ALEKS:

ALEKS online companion – As a supplement to the text, you are asked to purchase access to ALEKS (<https://www.aleks.com>). ALEKS (Assessment and LEarning in Knowledge Spaces) is a Web-based, adaptive questioning, CHEM 121-course specific, program that supports the material taught in the class.

In ALEKS, there are two modes in which you will work: Assessment Mode and Learning Mode. In assessment mode, ALEKS determines what you have and have not yet mastered. Each ALEKS assessment takes about 45 minutes, so please plan accordingly. ALEKS uses the assessment data to determine what topics you have not yet mastered. Then ALEKS has you work in Learning Mode where you work on objectives with tutorials and problems to build your understanding. Working in learning mode is best done in frequent, small blocks of time. For example, 7 30-minute periods with ALEKS in a week is much better than one 3.5-hour block. Your ALEKS grade in the course is determined by the percent mastery of objectives at each of the ALEKS due dates and at the end of the course. Due dates are posted on ALEKS and are mostly synchronized with the content addressed in lecture. The purpose of this is to keep you working regularly on learning chemistry. It is human nature to procrastinate, and this part of the course structure rewards those who work regularly toward mastery!

The percent mastery you earn on each objective or set of objectives associated with each due date will be weighted equally and averaged. The “gradebook” section of ALEKS enables you and me to track these scores. In addition, you will earn an ALEKS score based on your overall level of mastery at the end of the class. The purpose is for you to earn credit for mastery achieved before the course ends, whether or not it is achieved by the deadline. It is also in place to motivate you to work on topics that you forgot, so that by the end of the course you can succeed on the final examination and leave the course with a strong command of general chemistry knowledge. The numerator on the fraction above your ALEKS pie tells you your overall mastery score.

Also note, ALEKS instructs you on the topics you are most ready to learn. As you work through the course, ALEKS periodically reassesses you to ensure that topics learned are also retained. The ALEKS course is very complete in its chemistry coverage and ALEKS avoids multiple-choice questions. Historically students who show a high level of mastery

of an ALEKS course are successful in the accompanying lecture. Please remember that ALEKS is tailored to assist you therefore it is to be completed individually.

#### Quizzes:

Quizzes are an important learning tool that will enable you to calibrate your own understanding of course material. Quizzes have also been shown to help students consolidate their memory of a topic and allow them to build durable knowledge (read “Make it Stick” for details). Quizzes will be given at the beginning of class on Fridays (Formative Friday) and will be 5-10 minutes in length depending on the topic. Students will write their responses to the quiz on the next available blank page of their course notebook.

#### Seminar Synopses:

You will attend two seminars during the semester that relate to the course and prepare a half-page synopsis of each seminar that clearly describes the motivation for the work and the significance of the results presented in the seminar. It should be clear from your synopsis how the seminar relates to this class. You should indicate your name, the title and date of the seminar clearly at the top of the page. Synopses will be typed and submitted electronically on the course Moodle page. If you don't know if a particular seminar relates to the class, just ask during class (so all might benefit). **You must submit your synopsis within 24 hours of each seminar you attend.**

## POLICIES

#### Attendance:

Your attendance at every class session is expected. There will be no grade penalty for excused absences. Notify the instructor in advance of any excused absence so a plan to minimize its impact can be devised. The penalties for an unexcused absence are the points for any class activity that takes place during the absence (challenge, quiz, exam, etc.) and missing the powerful learning experience that took place in class on the day that was missed. Students are responsible for learning material missed as a result of any absence.

#### Office Hours:

Office hours are a valuable resource for you to interact directly with the instructor. To make the most of office hours, come prepared and be organized. For questions about course material, it is good practice to write a list of your questions in your notebook and include the pages in the notebook/textbook where you can find the source of the question. *Always bring your course notebook to office hours.* Arriving at your office hour with a small group of students (2-5) is **preferred** if your questions relate to course

material. For personal questions (those not related to course material), please reserve a private appointment. If you have a personal question that you think needs more than 10 minutes to discuss, email the instructor to set up a time to meet. If you need help but your schedule does not allow you to come to an office hour when you need it, email the instructor to make an appointment.

### Integrity and Collaboration Expectations:

Academic integrity is expected in all aspects of this course. A detailed description of academic integrity and the College policy regarding academic dishonesty can be found [here](#). Many aspects of this class encourage or require collaboration. Daily team challenges will give you the opportunity to develop your ability to collaborate with your peers and the instructor. Learning material at lower cognitive levels (exposure, memorization, basic applications) is a solitary activity and is best done independently. However, work at higher cognitive levels often benefits from a collaborative approach as long as each member of the collaboration develops their own understanding as a result. The cognitive demand of the CPA assignments will vary and collaboration is encouraged when it is helpful for every individual involved. If you collaborate on a CPA assignment, clearly indicate who worked with you at the top of the page. Work submitted for quizzes, ALEKS, seminar synopses, midterm exams, and the final exam is to be completed independently.

### Devices:

Full engagement with the in-class portion of this course will be a key component of success. All electronic devices should be silenced and put away before the beginning of every class session unless otherwise directed by the instructor. On occasion, wireless devices (computers or phones) will be used in class and you are encouraged to bring such devices to class but keep them put away unless they are needed for a particular activity.

### Accessibility Accommodations:

A student with a disability who thinks they may need an accommodation to access a campus program, activity, or service should contact Erin Salva in Student Accessibility and Support Services (SASS) at [salvae@kenyon.edu](mailto:salvae@kenyon.edu) to discuss specific needs. Advance notice is required to review documentation, evaluate accommodation requests and provide notice or make arrangements for any accommodation.

### Title IX:

As a faculty member, your instructor is deeply invested in the well-being of each student they teach. Your instructor is here to assist you with your work in this course. If you come to an instructor with non-course-related concerns, they will do their best to help. It is important for you to know that all faculty members are mandated reporters of any incidents of harassment, discrimination, and intimate partner violence and stalking.

Meaning, faculty must report any such discussion to the Civil Rights/Title IX coordinator. Faculty cannot keep information involving sexual harassment, sexual misconduct, interpersonal violence, or any other form of harassment or discrimination based on a protected characteristic, confidential. The Health and Counseling Center, the College chaplains, and the staff at New Directions Domestic Abuse Shelter & Rape Crisis Center are confidential resources.

## TENTATIVE SCHEDULE

Date (session)	Book Sections/Topic	DUE (midnight day before class)
8/30 - F (0)	Introduction, Course Structure, Community Rules	N/A
9/1 - Bonus Office Hour	7-9 PM in Hayes 109	N/A
9/2 - M (1)	2.1-2.8	CPA and ALEKS (Prereq. Review)
9/3 - Bonus Office Hour	7-9 PM in Hayes 109	N/A
9/4 - W (2)	3.1-3.3	CPA and ALEKS (Objective 1)
9/6 - F (3)	3.5-3.10 (Quiz)	CPA
9/9 - M (4)	4.1, 4.2	CPA
9/11 - W (5)	4.3, 4.4	CPA and ALEKS (Objective 2)
9/13 - F (6)	4.5, 4.6 (Quiz)	CPA
9/16 - M (7)	4.7, 4.8	CPA
9/18 - W (8)	5.1-5.5	CPA and ALEKS (Objective 3)
9/20 - F (9)	<b>EXAM 1 (through Chapter 4)</b>	Practice then sleep well
9/23 - M (10)	5.6-5.7	CPA
9/25 - W (11)	5.8	CPA
9/27 - F (12)	6.1-6.3 (Quiz)	CPA and ALEKS (Objective 4)
9/30 - M (13)	6.4-6.5	CPA
10/2 - W (14)	6.6	CPA
10/4 - F (15)	7.1-7.4 (Quiz)	CPA and ALEKS (Objective 5)

10/7 - M (16)	7.5, 7.6	CPA
10/9 - W (17)	<b>EXAM 2 (through Chapter 6)</b>	Practice then sleep well
10/11 - F	<b>OCTOBER BREAK</b>	ALEKS Open Pie until 10/13 at 11:59PM
10/14 - M (18)	7.7, 7.8	CPA
10/16 - W (19)	7.9	CPA
10/18 - F (20)	8.1, 8.2 (Quiz)	CPA and ALEKS (Objective 6)
10/21 - M (21)	8.3-8.5	CPA
10/23 - W (22)	9.1, 9.2	CPA and ALEKS (Objective 7)
10/25 - F (23)	9.4, 9.5 (Quiz)	CPA
10/28 - M (24)	9.6-9.9	CPA
10/30 - W (25)	10.1, 10.2	CPA and ALEKS (Objective 8)
11/1 - F (26)	10.3 (Quiz)	CPA
11/4 - M (27)	10.4	CPA
11/6 - W (28)	10.5	CPA
11/8 - F (29)	10.6 (Quiz)	CPA
11/11 - M (30)	10.7	CPA
11/13 - W (31)	10.8	CPA
11/15 - F (32)	14.1, 14.2 (Quiz)	CPA and ALEKS (Objective 9)
11/18 - M (33)	14.3	CPA
11/20 - W (34)	14.4, 14.5	CPA
11/22 - F (35)	<b>EXAM 3 (through Chapter 14 Section 3)</b>	Practice then sleep well
11/25-11/29	<b>THANKSGIVING BREAK</b>	ALEKS Open Pie until 11/29 at 11:59PM
12/2 - M (36)	15.1	CPA and ALEKS (Objective 10)
12/4 - W (37)	15.2, 15.3	CPA

12/6 - F (38)	15.4 (Quiz)	CPA
12/9 - M (39)	15.5, 15.6	CPA
12/11 - W (40)	15.7-15.9	CPA
12/13 - F (41)	15.12	CPA and ALEKS (Objective 11)
12/18 - W	<b>EXAM 6:30 PM</b>	