

# CHEM 111: Introductory Chemistry I

Trinity College

Fall 2017

## Class Meetings:

MWF 12-12:50 am  
Clement 105

## Instructor:

Prof. Michelle Kovarik  
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## Office Hours:

Clement 129  
Mondays 1-2 pm  
Thursdays 11 am-12 noon  
and by appointment

## Teaching Assistant:

William Patterson  
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## Supplemental Instruction:

Mira Nakhle  
[mira.nakhle@trincoll.edu](mailto:mira.nakhle@trincoll.edu)

## Inside this syllabus:

Required Materials .....	2
Grading .....	2
Classroom Citizenship.....	2
Academic Integrity .....	2
Important Dates .....	2
Problem Solving Tips.....	3
Resources.....	3
FAQs .....	4

## Course Description & Objectives

The study of the major concepts and theories required for an understanding of chemical phenomena. Principal topics include atomic and molecular structure, gas laws, stoichiometry, changes of state, chemical binding, and solutions in chemical reactions.

After completing this course, students should be able to

- Perform calculations and conversions using with appropriate significant figures (Ch. 1)
- Describe the quantum mechanical model of the atom and support it with evidence from experiments (Ch. 2-3)
- Convert between molecular formulas, names, and structures (Ch. 4-5)
- Identify various types of chemical reactions and perform stoichiometric calculations (Ch. 6-8)
- Use concepts, calculations, and experimental data in thermochemistry to explain the role of heat in chemical reactions (Ch. 9)
- Apply the gas laws to predict the behavior of gases (Ch. 10)

## Course Format

In class, we will alternate between short lectures, group work, and assessments (e.g., quizzes). Much of our discussion will draw on data that you generate in lab, so that the lecture and laboratory portions of the course are complementary. Outside class you should review and summarize your notes, read the relevant sections of the textbook to prepare for class, and keep up with homework. These activities will help you combine conceptual understanding with competence in mathematical operations associated with the chemical concepts we discuss.

**Exams.** In general, exams will be a combination of conceptual short answer, quantitative problem-solving, data interpretation, and experimental predictions. Your first resource for studying for the exams should be the learning objectives in the syllabus and weekly handouts. Quizzes, homework, and class notes will also be useful resources. Please note that if you score below 70% on any exam, you must meet with me individually to discuss strategies to improve your scores in the future.

**Quizzes and Homework.** Quizzes are a low-stakes way to check your conceptual understanding. Quizzes will be scratch-off multiple choice and short answer. Similarly, homework assignments are low-stakes practice for calculations. A major part of your homework grade will be online through the Smartwork platform. For these assignments, you have as many attempts as you need to answer each question correctly. *Smartwork assignments for the week are due at 11:55 pm every Sunday night.* Although you submit your answers online, you should maintain hard copies of the homework in which you show your work and include all units. These hard copies will aid you in preparing for the exams. We will also have supplemental worksheets on important concepts and real-life applications.

## Course Materials

- **Textbook**  
Gilbert, Kirss, and Foster, *Chemistry: An Atoms Focused Approach*, 2<sup>nd</sup> edition, Norton, 2018.
- **Smartwork 5 Online Homework**  
Bundled with the text in the bookstore or purchase separately at [digital.wwnorton.com/atoms2](http://digital.wwnorton.com/atoms2)
- **Laboratory Manual**  
Chemistry 111L/Laboratory Manual for Introductory Chemistry I, Fall 2017 (~\$5)
- **Laboratory safety glasses**  
Available in Chemistry Office (CT 208) for \$5
- **Laboratory notebook**  
Spiral bound, carbonless copy, 100 pages, available in bookstore at a cost of ~\$15.
- **Molecular model kit for general chemistry**  
Available in Chemistry Office (CT 208)
- **Scientific calculator** (bring to class!)
- **Recommended: 3-ring binder for class handouts**

## How do you earn your grade?

Assessment	% of Grade
Exams (3)	50
Quizzes (6)	15
Homework	10
Laboratory	25

### Grading Scale

	+		-	
A	98.00+	93.00+	90.00%+	
B	87.00+	83.00+	80.00%+	
C	77.00+	73.00+	70.00%+	
D	67.00+	63.00+	60.00%+	
F	<60.00%			

## Classroom Citizenship

Please familiarize yourself with the College's policies on attendance, absences, and classroom behavior as outlined in the Student Handbook. This course will be conducted in strict agreement with these policies.

## Academic Integrity

Each student should be familiar with the Trinity College Student Integrity Contract and the section on Intellectual Honesty in the Student Handbook.

**References.** Any ideas in written assignments that (i) did not spring from your own mind and (ii) are not common knowledge to high school science students should be cited at the end of each assignment. Direct quotes are unacceptable. Rewrite all ideas in your own words *and* cite them. If you have a question about

### Important Dates

Drop/Add Deadline.....9/12

Withdraw Deadline.....9/29

Exam 1 .....10/6

Exam 2 .....11/8

Final Exam.....12/18

Smartwork assignments are due every Sunday at 11:59 pm.

Detailed weekly schedules will be distributed throughout the semester.

whether or not your rewording is acceptable, ask before turning in your assignment. Use the *ACS Style Guide* to format your references. Plagiarism and academic dishonesty – copying from another student, copying from another source including the internet, failing to cite a reference, etc – will be subject to the strictest penalties.

**Homework.** I encourage you to discuss homework with your classmates. Your peers should be a primary resource if you are uncertain about how to proceed on a problem (although the TAs, SIs and I are always happy to help, too). That said, I expect each of you to do your own work. Discussing homework problems with your classmates is acceptable; copying your classmate's answers or work is not. If I find evidence of copying or allowing work to be copied, we will need to go through the College's academic honesty proceedings. If you have any questions about whether or not your collaboration with a classmate complies with my expectations, please talk to me about it *before* turning in an assignment.

## Moodle & Email

Moodle and e-mail will be used extensively. All students are required to have an active e-mail account. Please inform me during the first week of class if you prefer to use a non-trincoll address. Students are expected to consult the course Moodle site frequently for assignments, announcements, schedule changes, lecture materials, supplementary course materials and external links.

## Problem-Solving Tips

Being able to problem-solve is one of the most important skills you will develop in this course. With this in mind, here are a few tips to help when you get stuck.

- Identify the goal of the problem.
  - Break large problems into smaller parts and determine a sub-goal for each part.
  - Identify the units your answer will be in and compare to the units of the information you have been given. Form a strategy based on converting from the units of what you know to the units of what you want.
- Do not try to keep track of large quantities of information in your head.
  - Write things down (neatly) as you go.
  - Show your work and keep track of units.
  - Use diagrams and equations to summarize information.
- Check your work.

Ask yourself if you have...

  - Copied the problem correctly (no numbers transposed, no mistakes in units, etc.).
  - Entered calculations into your calculator correctly.
  - Obtained a reasonable result for intermediate steps, based on your common sense, your chemical knowledge, and information from the problem.
  - Written all chemical formulas correctly and balanced all equations.
- Seek new ideas.
  - Consider whether you need to look up information in the textbook or your notes to solve the problem.
  - Brainstorm. Try to generate new ways of thinking about the problem. Draw new diagrams to represent what is happening.
  - Ask a friend for input. Come to office hours, supplemental instruction, or a TA help session.

## Resources

### Accommodation Requests

Please let me know if there are circumstances that might affect your full participation in this class or safety in the laboratory. If you require academic accommodations, talk with me and contact Lori Clapis in the Student Accessibility Resource Center at 860-297-4025 or at [Lori.Clapis@trincoll.edu](mailto:Lori.Clapis@trincoll.edu).

### ACS Style Guide

You can refer to this reference for citation formatting online through the Trinity library website, and hard copies are available in the main library and the Chemistry library.

### Excel for Chemists

A copy of this book is available electronically through the library, and a hard copy is available for use in my office during office hours. You may find it a useful resource.

<http://site.ebrary.com/lib/trinity/Doc?id=10510405>

### Supplemental Instruction

Supplemental instruction will be provided with **Mira Nakhle** with meeting times and location TBA on Moodle. All students are strongly encouraged to attend.

### TA Help Sessions

The teaching assistant, **William Patterson**, regular review and Q&A sessions, times and location TBA on Moodle. Questions about specific homework problems will be addressed in these TA sessions, not at SI.

### The Writing Center

For hours or to schedule an appointment, call 297-2468 or visit <http://trincoll.mywconline.com/>

## Frequently Asked Questions (FAQs)

### *What should I do if I have to miss class?*

Class attendance is mandatory and will be taken at the beginning of each class, so please be on time and do not miss class if at all possible. If you will be absent, please do the following:

- (1) Notify me as soon as possible, preferably before class and by email.
- (2) Email me any assignments that are due, drop them in CT208, or send them to class with a friend.
- (3) Contact a classmate to get the notes and consult Moodle for any handouts that you missed.

### *What if I miss an exam or quiz?*

If you miss an exam or quiz due to incapacitating illness or injury, you must submit confirmation from a medical professional directly to me or through the Dean of Students office. If you will miss an exam for any other College-sanctioned reason (e.g., religious observance), you must discuss your absence with me in advance (preferably at least 3 days prior). In these cases, your other exams/quizzes will be weighted to replace the one missed. Excluding exceptional circumstances (identified by the instructor), in all other cases, missed quizzes and exams will be marked as zeros. Make-ups will be given only in special circumstances at the instructor's discretion.

### *Can I have an extension? What is the penalty for late work?*

Late homework assignments will be penalized at a rate of -10% per day. Extensions must be requested by email at least 24 h before an assignment is due and be accompanied by evidence that you have started the assignment to receive consideration. Do not wait until the last moment as extensions will not be granted for technical difficulties or poor planning.

### *How can I tell what my current grade is?*

Your current overall lecture grade and your grades for individual assignments will always be available in the grade book in Moodle. Remember that your lab grade (kept by your lab instructor) is worth 25% of your final grade in the class. If you have any questions or would like to discuss your performance in the class at any time, please come by office hours or make an appointment.

### *Can I do extra credit?*

There will be no extra credit in this class. Please don't ask! My philosophy is that you should spend your valuable time succeeding at the primary objectives for the course. If you have not completed them, you should not be spending time on additional work. If you have completed them, your grade should not be in need of a boost.

### *Whom should I contact for technical help with Moodle?*

If you are having general technical problems logging on or using Moodle, you should contact the Help Desk at 860-297-2007 or [helpdesk@trincoll.edu](mailto:helpdesk@trincoll.edu). If you are having specific problems with content on our class site, you may want to contact me first so I can make sure it's not a mistake I've made in preparing the content.

### *Whom should I contact for technical support for the Smartwork online homework?*

Be sure that you have done the Smartwork5 demo assignment. You can access support for technical problems at <http://support.wwnorton.com>.

Date	Topic	Reading	After this class period, you should be able to...	Assessments
<i>Week 1</i>				
Lab This Week: Lab Safety and Orientation Session (if you have Monday lab, you must attend another session!)				
Sept 6	chemical laws & theories	1.1 (p. 4-7)	Use data to demonstrate the fundamental laws of chemistry Register for Smarwork5 and do HW1 #1	
Sept 8	matter	1.2-1.3 (p. 9-17)	Determine densities and use them in calculations; convert between temperature scales; classify matter by state and composition Do HW1 #2-6	Smartwork HW1 due Sunday
Ungraded practice: Chapter 1 (p. 39-45) #1.1, 1.3, 1.6, 1.9, 1.15, 1.63, 1.73, 1.77, 1.79, 1.81, 1.87				
<i>Week 2</i>				
Lab This Week: Atomic Spectroscopy				
Sept 11 *tomorrow ends Add/Drop*	energy & light	1.5 (p. 17-18) 3.1 (p. 86-88)	Differentiate between different forms of energy; convert between wavelength, frequency, and energy per photon for electromagnetic radiation Do HW2 #1	
Sept 13	atomic theory	2.1-2.2 (p. 48-55)	List the components of Dalton's atomic theory; define atomic mass, atomic number, mass number, and isotope; describe experimental results that support the nuclear model of the atom Do HW2 #2-5	Quiz 1
Sept 15 *no class--make-up meeting TBA*	quantum theory	3.2-3.3 (p. 89-95)	Use experimental results on the photoelectric effect and diffraction pattern data to support the wave-particle duality of matter; distinguish between continuous and line spectra Do HW2 #6	Smartwork HW2 due Sunday
Ungraded practice: Chapter 2 (p. 76-83) #2.7, 2.25, 2.29, 2.31, and Chapter 3 (p. 131-139) #3.7, 3.11, 3.19, 3.21, 3.23, 3.35, 3.45				
<i>Week 3</i>				
Lab This Week: Density				
Sept 18	models of the atom	3.4-3.5 (p. 95-104)	Reproduce Bohr's calculations of $\Delta E$ for the hydrogen atom and compare the resulting values to the atomic spectrum; compare and contrast the Bohr model with the quantum mechanical model of the atom; summarize the Heisenberg uncertainty principle using words and an equation <i>Discussion of the Atomic Spectroscopy Lab, bring lab materials!</i> Do HW3 #1-5	
Sept 20	quantum numbers	3.6-3.7 (p. 104-110)	Identify the four quantum numbers, their possible values, and their physical meaning; sketch the shapes of <i>s</i> , <i>p</i> , <i>d</i> , and <i>f</i> orbitals; define the Pauli exclusion principle	

			Do HW3 #6	
Sept 22	measurements	1.7-1.8 (p. 20-31)	Apply prefixes and SI units correctly; use dimensional analysis for conversions; distinguish between precision and accuracy; use significant figures appropriately in measurements and calculations <i>Discussion of the Density Lab, bring lab materials!</i> Do HW3 #7-13	Smartwork HW3 due Sunday
Ungraded practice: Chapter 1 (p. 39-45) #1.49, 1.53, 1.93c, Chapter 3 (p. 131-139) #3.55, 3.57, 3.75, 3.79, 3.81, 3.85, 3.91				
<i>Week 4</i>				
Lab This Week: Excel Workshop				
Sept 25	electron configurations	3.8-3.9 (p. 110-120)	Use the Aufbau principle, Hund's rule, and the periodic table to write or draw electron configurations; identify valence electrons and explain their importance Do HW4 #1-6	
Sept 27	electron configurations, cont'd.	See above	See above	Quiz 2
Sept 29 *last day to withdraw*	periodic trends	2.3 (p. 56-59) 3.10-3.12 (p. 120-128)	Distinguish between ionization energy and electron affinity; recall and explain trends in ionization energy, electron affinity, atomic radius, ionic radius, and reactivity based on electron configurations; recognize the various groups and series of the periodic table, including which contain metals, metalloids, and non-metals <i>Pre-Lab Discussion of Periodic Properties Lab, read lab before class and bring your lab manual</i> Do HW4 #7-13	Smartwork HW4 due Sunday
Ungraded practice: Chapter 3 (p. 131-139) #3.93, 3.95, 3.97, 3.109, 3.111, 3.117				
<i>Week 5</i>				
Lab This Week: Periodic Properties				
Oct 2	atomic mass and the mole	2.4-2.5 (p. 59-68)	Calculate average atomic mass from isotopic abundance; convert between number of atoms, moles, and mass Do HW5 #1-7	
Ungraded practice: Chapter 2 (p. 76-83) #2.47, 2.51, 2.53, 2.55, 2.69, 2.71, 2.85, 2.87				
Oct 4	case study #1	Apply the concepts discussed in class so far to a real-life application: neon signs		Case Study #1 due in class
Oct 6	<b>Exam 1: Matter, Measurements, and Energy (Topics from Sept 6-Oct 4)</b>			

Week 6				
No lab this week due to Trinity Days				
Oct 9	<b>Trinity Days</b>			
Oct 11	molecules and molar mass	4.1 (p. 142-147)	Classify compounds as covalent or ionic; calculate molar mass and use it to convert between moles and mass Do HW5 #8-12	
Oct 13	naming	4.2 (p. 147-153)	Name ionic compounds, covalent compounds, and acids, using the names of common polyatomic ions (Table 4.3) as needed Do HW5 #13-17	Smartwork HW5 due Sunday
Ungraded practice: Chapter 2 (p. 76-83) #2.83, 2.91 and Chapter 4 (p. 183-191) #4.27, 4.29, 4.33, 4.35, 4.37, 4.39				
Week 7				
Lab This Week: Structures of Ionic and Metallic Compounds				
Oct 16	Lewis structures	4.3 (p. 168-176) 4.8 (p. 174-178)	Draw chemically appropriate Lewis structures using the octet rule and its exceptions Do HW6 #1-2	
Oct 18	resonance and formal charge	4.4 (p. 161-164) 4.7 (p. 170-173)	Draw all possible resonance structures for a molecule and evaluate equivalent structures based on formal charge Do HW6 #3-5	Quiz 3
Oct 20	chemical bonds	4.5-4.6 (p. 165-170)	Compare and contrast ionic and covalent bonding; use Coulomb's law quantitatively and qualitatively in descriptions of bonding; assess the polarity of a bond based on electronegativity trends <i>Discussion of the Ionic and Metallic Compounds Lab, bring lab materials!</i> Do HW6 #6-8	Smartwork HW6 due Sunday
Ungraded practice: Chapter 4 (p. 183-191) #4.7, 4.55, 4.57, 4.59, 4.61, 4.77, 4.101, 4.115, 4.119, 4.121, 4.129				
Week 8				
Lab This Week: Structures of Covalent Compounds (bring model kit to lab!)				

Oct 23 *midterm*	VSEPR	5.1 -5.3 (p. 194-207)	Determine the geometry, bond angles, and dipole of a molecule using the VSEPR model Do HW7 #1-6	
Oct 25	hybrid vs molecular orbitals	5.4 (p. 208-215) 5.7 (p. 224-230)	Compare and contrast hybrid versus molecular orbitals; determine the hybridization of a molecule from its Lewis structure and relate this to its geometry Do HW7 #7-11	
Oct 27	balancing equations	7.1-7.2 (p. 278-288)	Balance chemical equations Do HW7 #12-14	Smartwork HW7 due Sunday
Ungraded practice: Chapter 5 (p. 238-245) #5.1, 5.3, 5.5, 5.13, 5.17, 5.25, 5.29, 5.45, 5.49, 5.57, 5.63 and Chapter 7 (p. 309-317) #7.3, 7.7, 7.19, 7.21, 7.23, 7.25				
<i>Week 9</i>				
Lab This Week: Gravimetric Analysis of Silver Salts				
Oct 30	stoichiometric calculations	7.3 (p. 288-291)	Convert between masses and moles of reactants and products Do HW8 #1-5	
Nov 1	molecular formulas	7.4-7.5 (p. 291-298)	Calculate percent composition; determine empirical and molecular formulas from data Do HW8 #6-9	Quiz 4
Nov 3	limiting reagents and yield	7.7 (p. 301-307)	Determine the limiting reagent for a reaction and predict theoretical yield; calculate percent yield <i>Discussion of the Silver Salts Lab, bring lab materials!</i> Do HW8 #10-14	Smartwork HW8 due Sunday
Ungraded practice: Chapter 7 (p. 238-245) #7.31, 7.33, 7.35, 7.39, 7.47, 7.49, 7.51, 7.57, 7.71, 7.81, 7.97				
<i>Week 10</i>				
Lab This Week: Observation and Analysis of Aqueous Solutions				
Nov 6	case study #2	Apply the concepts discussed in class so far to a real-life application: biochemistry and astrobiology		Case Study #2 due in class
Nov 8	<b>Exam 2: Bonding, Structure, and Stoichiometry (Topics from Oct 11-Nov 6)</b>			
Nov 10	solutions and solubility	6.3 (p. 257-260) 8.1 (p. 320-324) 8.3 (p. 327-329)	Describe factors affecting solubility; identify non-electrolytes, weak electrolytes, and strong electrolytes; convert between common units of concentration Do HW9 #1-7	Smartwork HW9 due Sunday



Ungraded practice: Chapter 6 (p. 271-275) #6.51, 6.55 and Chapter 8 (p. 361-369) #8.11, 8.13, 8.21, 8.23, 8.27, 8.35, 8.39

*Week 11*

Lab This Week: Calorimetry

Nov 13	concentration and dilution	8.2 (p. 325-329)	Describe in words and calculations how you would prepare a solution of a desired molarity from a solid or from a more concentrated stock solution Do HW10 #1-4	
Nov 15	acid-base reactions	8.4 (p. 329-335)	Identify Bronsted-Lowry acids and bases; predict the products of a neutralization reaction; perform stoichiometric calculations for acid-base reactions including titration data <i>Discussion of the Aqueous Reactions Lab, bring lab materials!</i> Do HW10 #5-9	
Nov 17	precipitation reactions	8.5 (p. 335-341)	Predict the products of a metathesis reaction and their phases; write complete and net ionic equations; perform stoichiometric calculations for precipitation reactions <i>Discussion of the Aqueous Reactions Lab, bring lab materials!</i> Do HW10 #10-14	Smartwork HW10 due Sunday
Ungraded practice: Chapter 8 (p. 361-369) #8.15, 8.29, 8.33, 8.51, 8.53, 8.63, 8.65, 8.69, 8.71, 8.101				
<b>Week 12</b>				
No lab this week due to Thanksgiving				
Nov 20	redox reactions	8.6 (p. 341-353)	Assign oxidation numbers to elements in a reaction; identify redox reactions <i>Discussion of the Aqueous Reactions Lab, bring lab materials!</i> Do HW11 #1-5	Quiz 5
Nov 22	<b>Thanksgiving Break</b>			
Nov 24				
Ungraded practice: Chapter 8 (p. 361-369) #8.75, 8.83, 8.85, 8.89, 8.115				
<b>Week 13</b>				
Lab This Week: Gas Laws				
Nov 27	energy, heat and work	9.1-9.3 (p. 372-383)	Define the relationship between energy, heat, and work using words and an equation; explain the first law of thermodynamics; define enthalpy and explain the difference between $\Delta H$ and $\Delta E$ ; distinguish between endothermic and exothermic reactions Do HW11 #6-7	
Nov 29	heat capacity and calorimetry	9.4-9.7 (p. 383-406)	Use Hess's Law to calculate heats of reactions; distinguish between heat, heat capacity, and specific heat; use calorimetry data to determine heats of reaction <i>Discussion of the Calorimetry Lab, bring lab materials!</i> Do HW11 #8-13	

Dec 1	kinetic molecular theory	10.1-10.2 (p. 432-439)	Summarize the kinetic molecular theory of gases; calculate the velocity of a gas particle at a given temperature; compare and contrast effusion and diffusion  Do HW11 #14-15	Smartwork HW11 due Sunday
Ungraded practice: Chapter 9 (p. 421-429) #9.15, 9.19, 9.23, 9.27, 9.35, 9.47, 9.49, 9.53, 9.61, 9.63, 9.67, 9.71, 9.75, 9.87 and Chapter 10 (p. 467-477) #10.1, 10.9, 10.11, 10.25, 10.29				
<i>Week 14</i>				
Lab This Week: Ester Synthesis and Check-Out				
Dec 4	gas laws	10.3-10.6 (p. 439-453)	Define pressure using words and an equation; explain the gas laws in words; use them in calculations based on word problems; and predict qualitative changes in $P$ , $V$ , $n$ , or $T$  <i>Discussion of the Gas Law Lab, bring lab materials!</i>  Do HW12 #1-8	
Dec 6	gas laws, cont'd	10.7-10.9 (p. 453-461)	Apply Dalton's law of partial pressures; perform stoichiometric calculations for reactions of gases  Do HW12 #9-13	Quiz 6
Dec 8	case study #3	Apply the concepts discussed in class so far to a real-life application: acid car batteries		lead-  Case Study #3 due in class
Ungraded practice: Chapter 10 (p. 467-477) #10.39, 10.41, 10.47, 10.51, 10.53, 10.55, 10.61, 10.69, 10.73, 10.89, 10.91, 10.97, 10.99				
<i>Week 15</i>				
Dec 11	course summary	weekly plans	Identify the main themes of this course and the important ideas that you will use in the future	Smartwork HW12 due tonight
<b>Cumulative Final Exam: 3 pm on Monday, December 18</b>				