Chemistry 108

Welcome!

In this course, you will study "real-world" issues that we hope will catch your interest and engage you over the course of the semester, if not for a lifetime. We will consider questions such as, "How can radiation both cause and cure cancer?", "Is global climate change occurring?", "How clean is the air I breathe?", "Does it matter if I eat hydrogenated peanut butter?" and "Why is it hard to recycle certain plastics?" In order to understand and respond thoughtfully to the issues involved, you must understand certain chemical principles as well as be able to think through complex issues that may not have easy answers.

You will find that Chemistry 108 requires a team effort. YOU are part of this team. We need your steady participation over the course of the semester, your collaboration with others, and your input about what can help you to learn.

The Chemistry in Context Philosophy

Chemistry in Context is published by the American Chemical Society for students who are majoring in fields other than chemistry, chemical engineering, or biology. The first edition was released in 1994; right now the 6th edition is in preparation. At the outset, *Chemistry in Context* was the first book of its kind in the college market. Why? Look at its Table of Contents. You will not find a chapter on gas laws, chemical bonding, buffer solutions, or chemical equilibrium. Instead, you will find a list of real-world issues:

- The Air We Breathe
- Protecting the Ozone Layer
- The Chemistry of Global Warming
- Energy, Chemistry and Society
- The Threat of Acid Rain

Chemistry in Context teaches chemistry on a "need to know" basis. Students using *Chemistry in Context* are not asked to learn a particular chemical concept just for the sake of teaching it. Rather, students learn what the chemical principles that they need to know in order to understand a real-world issue. Thus, if there is "no need to know", then the chemical concept is omitted. This may offend some instructors who believe that certain topics *must* be taught. This may even distress some students who have taken chemistry courses where they have succeeded in balancing equations removed from any context or in doing calculation after calculation with no connection to complex, messy, real-world issues. But the authors of this text (with the backing of the American Chemical Society) believe that you will engage best in learning chemistry if it is connected to your life and the real world. Hence *Chemistry in Context*.

In the past, some Chemistry 108 students have commented that they really don't have to read the textbook. This may be true, as the lectures closely follow the textbook. Please note, however, that students also have commented that they really have found it worthwhile to read the textbook, especially before an exam. They also have liked reading it because it tells a story, one that never can completely be told in a lecture. To get the most out of this course, we recommend that you read (and re-read) the relevant chapters in *Chemistry in Context*

From a teacher's point of view, teaching with *Chemistry in Context* is exciting, fun ... and a great deal of work. We who teach cannot just pull out last year's lecture notes and activities, because the real-world issues are different this semester. And we who teach have to learn all sorts of things about real-world science that we were never taught. Thus, depending on your major (history, Japanese, nursing, civil engineering, or physics) you may know more about a particular topic than the teaching staff. Similarly, if you have worked in a power plant or a recycling operation, you may have some useful first-hand knowledge. Please contribute what you know. The students in Chemistry 108 in past years have helped make the course what it is today.

Your instructor in Chemistry 108 is one of the authors of *Chemistry in Context*. With her co-authors (and with funding from the National Science Foundation), she also has trained faculty from dozens of institutions across the country in how to switch to using this type of an approach. If you are interested in becoming a teacher, she'll be glad to tell you more. Also, please know that the authors of *Chemistry in Context* do not receive royalties on the sales of the book. Any profits are reinvested in other educational projects of the American Chemical Society.

Your Role in the Course

As mentioned on the course home page, this course requires a team effort. YOU are part of this team. We need your steady participation over the course of the semester and your collaboration with each other.

Input

We value your input and you can provide it in several ways. For issues that need immediate attention, speak with your instructor after class or send an email message. To participate in course policy making, communicate with the Chemistry 108 Board of Directors (somebody in your discussion section will be chosen as a Board member). If there are topics that you would like to learn about, fill out one of the surveys that periodically will be distributed. Speak with any or all or us, and find what works best for you.

Collaboration

UW-Madison has excellent students. In Chemistry 108, expect to learn from your peers and to form friendships that may last long after the semester ends. You will have many opportunities to work together: in discussion section, in lab, and even in lecture and on quizzes. Sometimes you will work in small groups of two or three people; sometimes the groups will be larger. Many of your future professions require teamwork and we will help you to develop the communication skills that you will need.

Participation

Your steady efforts are needed. As this is a five credit course, expect that it will require at least 15 hours each week. Seven of these hours will be structured: 3 in lecture, 2 in

writing lab and 2 in discussion section. You will need additional time to prepare for lecture, to write papers and reports, to complete assignments and to study for exams. Some students find that 20 hours a week is a reasonable estimate.
One suggestion: pace yourself! All too frequently, students get tired and then fall ill midway in the semester. Although there are many models for success, a tried-and-true method is to work steadily over the course of the semester. This course will be structured to encourage this type of participation.

Required Course Materials

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1. **Chemistry in Context, 5th edition**
   Lucy Eubanks, Cathy Middlecamp, Norb Pienta, Carl Heltzel and Gabriela Weaver
   American Chemical Society
   McGraw-Hill
   2006

2. **Laboratory Manual for Chemistry 108**
   Cathy Middlecamp and José Laboy
   published through the UW-Department of Chemistry
   2006
   NOTE: This manual is sold at the Alpha Chi Sigma table outside our lecture hall.

3. **Laboratory safety goggles**

4. **A non-graphing calculator**
   You will need a simple calculator with no memory function for use on exams.

5. **Handouts**
   These will be distributed in lecture. Extra copies are in the study room (1371 Chemistry)

Grading in Chemistry 108

Do you know the **university policy on academic honesty**? If not, check it out at the site provided by the **Dean of Students**. It is *your* responsibility to follow university policies. Student dishonesty is troublesome for your classmates, your instructor, and for you. It is in everybody's best interests that you work with integrity on your quizzes, exams, labs and all assignments. See Plagiarism And How To Avoid It for helpful information about what works and what doesn't.

Some weeks, you will find a **short assignment** posted on the calendar. Please turn these *before lecture* on the date specified. Each assignment is worth 10 points. If you turn it in more than 10 minutes after the start of lecture, you will lose 5 points (we do it this way so that people do not work on the assignments during lecture). If for some reason you must miss lecture or know you will be late, hand in the assignment ahead of time.

Quizzes in Chemistry 108 will be held each week in lecture except when exam are scheduled. Check the **News of the Week** posted on the calendar each Monday for a sample quiz. Ten quizzes will be given during the semester, each worth 25 points. You can drop your lowest score, so only 9 quizzes will count. Quizzes will be given on the following days (all are Fridays except Nov 21, the Monday before Thanksgiving):
Sept. 9, 16, and 23
Oct. 7, 14, and 28
Nov. 4, 11, and 21
Dec. 2
If you are traveling on university business (e.g., a conference or an athletic event), we will schedule an early quiz/exam for you. **Please give us at least one week notice.** If you miss a quiz on a Friday because of a serious injury or illness AND if you contact us before class beforehand AND if you have talked with nobody about the quiz given in class, we will arrange a late quiz for you.
Remember that you can drop your lowest quiz score, so this ought to give you the personal flexibility that you need.

Exams will be held in class every three to four weeks. Each one will be worth 150 points, and you can drop your lowest exam score. Last year's exams are available on the web. Please use these past exams with care, as each year the topics and the exam content cut-off points are a bit different. We will get an extra room for double seating.
Friday, September 30
Friday, October 21
Monday, November 14 (if we can get a room, if not, the Friday before)
Friday, December 9

Laboratory is held each week. You will be awarded up to 10 points for each completed laboratory experiment. In addition, complete the pre-laboratory questions before lab for 10 points each. Content from the laboratory also will appear on exams. Note: if you miss more than two laboratory experiments, you cannot pass the course.

The **final exam** will be held on **Thursday, December 22, 2005 at 7:45 am**. Yes, this is the very late in exam week (and I had nothing to do with it, honest!) Please note the university policy that your exam may NOT be rescheduled for a reason such as holiday travel plans or family plans (if in doubt, ask your Dean). If you have three or more exams scheduled within a 24 hour period and wish to reschedule your chemistry exam, please talk to Dr. M. by Thanksgiving.

A **point system** is used in Chemistry 108 to assign grades. You earn points for a variety of activities:

9 Quizzes	225 points	25 points/quiz
3 Hour Exams	450 points	150 points/exam

5 Short Assignments	50 points	10 points each
13 Pre-lab questions	130 points	10 points/week
14 Laboratory Experiments	140 points	10 points/week
Final Exam	250 points	
TOTAL	1245 points	

Grades are *not* assigned on a curve and you are *not* competing with your classmates for a grade. Please recognize if for some reason something extra is added or something does not take place, then the scale will be adjusted appropriately.

At the end of the semester, to pass the course you must not have missed more than 2 laboratory experiments. Assuming that this is true, your grade will be assigned using these cutoff points (and the Chemistry 108 instructors reserve the right to correct any math errors in setting up this scale):

A	1165 - 1245
AB	1135 - 1164 points
B	1040 - 1134 points
BC	1000 - 1039 points
C	900 - 999 points
D	845 - 899 points
F	below 845 points

Laboratory Schedule - Fall 2005

Your two-hour laboratory for Chemistry 108 meets each week in room 1329. Our labs meet on Tuesdays and Thursdays only.

Lab attendance is required. If you miss more than 2 lab experiments without an acceptable excuse, you will fail the course. In a scheduled conflict (such as an athletic event) and will need to miss a lab, arrange to attend a different lab section by working something with your Lab Instructor beforehand. Experiments cannot be made up during the following week, as the stockroom personnel remove the chemicals and equipment at the end of each week.

Answer the pre-lab questions on computer each week before lab. These computer assignments are worth 10 points each and must be completed before you go to lab (no credit if after lab). The quiz is open book, so feel free to use your lab manual and textbook. Please work individually. These questions start with the WebElements and Radioactivity lab (week 2)

Safety goggles are required whenever laboratory chemicals are present in the lab. If you take your goggles off in the lab, you will be reminded only twice to put them back on. After this, you will lose 5 points each time you are not wearing them. If your goggles are bothering you, feel free to step out in the hall to take a rest. If you forget your goggles, the stockroom has some extras (but they are pretty scratched up).

Proper clothing attire also is required whenever laboratory chemicals are present. If the weather is warm outside, remember to wear covered shoes (no sandals!) and clothing that covers your legs. You will have to go home and change your clothes if you are not properly attired (and in the process lose points for being late).

Please arrive to lab on time. You need to be present at the start of each laboratory period, as your Lab Instructor often will present important safety information. If you need to be late, notify your Lab Instructor beforehand. You will lose 2 points each time you come in after the bell has rung. For the safety of all involved, everybody needs to be together at the start of lab.

There are no formal lab reports for this class. You will complete a data sheet and answer questions each week during lab. If you turn this in with all items satisfactorily completed, you will receive full credit (10 points) for each lab. Content from the laboratory experiments also will appear on the hourly exams.

Week of	**Experiment**	**Safety/Chemicals**	**Related Web Sites**
Sept. 5	A Tour of the Chem 108 Web Site Radon Detection - Part I	Laboratory safety exercises	Information from the EPA about radon. Check out the news stories! Iowa Radon Lung Cancer Study (from lecture)
Sept. 12	WebElements and Radioactivity An Introduction to Ionic Compounds		WebElements, an award-winning periodic table
Sept. 19	Neutrons and Their Role in Nuclear Reactions *Check-In*		
Sept. 26	Sugar in Soft Drinks and Fruit Juices		
Oct. 3	Preparation & Properties of Gases in a Breath	20% HCl, $NaHCO_3$ phenol red, 6% H_2O_2	
Oct. 10	Visually Delighted Spectrophotometry & Sunglasses		
Oct. 17	Refrigerant Gases	sodium sulfite HCl (conc) bromthymol blue(aq) potassium permanganate (aq) ammonia (conc)	If you are allergic to sulfites, don't come to lab. Do these Web activities instead.

Oct. 24	3-D molecules		
Oct. 31	Chemical Moles - Converting Baking Soda to Table Salt	$NaHCO_3$ HCl (10%)	
Nov. 7	Radon Detection - Part II	6 M NaOH (hot)	
Nov. 14	Energy Content of Fuels		
Nov. 21	*Thanksgiving week - No Lab*		
Nov. 28	Spotlight on Polymers A Silicone Polymer		From the Macrogalleria: Polymers are Everywhere Polymers Go to Hollywood Poly Aquarium
Dec. 5	Soap Making and Gluep *Check-Out*		Please complete the SALG, the Student Assessment of Learning Gains. The Course ID is 714713642; the password will be given in lab.
Dec. 12	pH and Dilutions		

Teaching Staff

Dr. Cathy Middlecamp
Mr. David Good, sec 781, 782
Ms. Rebecca Splain, sec 783, 784
Ms. Jamie Ellis, sec 785, 786
Mr. James Hrovat, sec 787, 788
Mr. Kevin Chau, sec 789, 790
Ms. Danielle Swaney, sec 791, 792
Mr. José Laboy, Assistant Laboratory Director for Chem 108
Dr. Gery Essenmacher, General Chemistry Coordinator
Dr. Gordon Bain, General Chemistry Laboratory Director
Mr. Tom Ladell, General Chemistry Stockroom Manager

Chemistry 108 Topics - Fall 2005

Please consider this to be a "living" document that will be modified as the semester progresses. Why? The instructors of Chemistry 108 aim to be responsive to your interests and questions. Thus, the course is never taught exactly the same two semesters in a row, and we will fine tune the syllabus as the course progresses.

In the table below, CiC refers to Chemistry in Context, 5th edition. As part of your homework, read each CiC Chapter several times, paying particular attention to the sections relating to the lecture material. You will also find that your text does a good job of highlighting the issues that relate chemistry and society. Handouts relating to current events will be distributed in lecture as well.
Doing the exercises (not to be turned in) will help you focus your studying efforts. Expect to see questions relating to these exercises on exams (and sometimes quizzes too).

	Lecture	**Readings**	**Exercises in text**	**Ions/Acids/Bases (memorize)**
1	Are you breathing radon as you sit here?	1.2 What's in a breath? The composition of air (skip "parts per million" for now) 1.6 Classifying matter: Mixtures, elements and compounds 1.14 The inside story of air quality (the part about radon) 2.2 Atomic structure and periodicity	CiC 2: 7, 9 CiC 1: 5d	
2	What would you see if you were the size of a neutron?	1.7 Atoms and molecules 2.2 Atomic structure and periodicity	Your Turn 2.7 on p, n and e CiC 2: 6-8 CiC 1: 36 CiC 7: 3, 4	
3	How do radioactive substances behave?	7.7 What is radioactivity? 2.4 Waves of light (the part about the EM spectrum and gamma rays) 11.9 Minerals: Macro and micro (the part about iodine)	CiC 7: 5, 7, 8, 20, 21, 22ab, 23 Your Turn 7.17 on radiation Your Turn 7.18 on alpha, beta decay	H_2O^+
4	Here today, ... gone tomorrow?	7.9 How long will nuclear waste remain radioactive? Figures Alive! - Chapter 7 (Decay of Fission Products)	CiC 7: 9, 25, 26, 27, 57 Your Turn 7.19 on radon Your Turn	I^-

			7.23 on tritium Your Turn 11.27ab on radioactive I	
5	What happens when radiation hits you? Part 1	7.8 What hazards are associated with radioactivity? 1.6 Classifying matter: Mixtures, elements and compounds (review p. 17 on metals)	CiC 7: 46	Na^{+} K^{+} Cs^{+} Mg^{2+} Ca^{2+} Sr^{2+} Cl^{-} Br^{-}
6	How do humans make radioactive substances?	Lab experiment for Week 3	CiC 7: 10b, 22c	
7	The BIG difference between U-235 and U-238	7.1 A comeback for nuclear energy? 7.2 How does fission produce energy? 7.5 Can a nuclear power plant undergo a nuclear explosion? 7.6 Could nuclear fuel be diverted to make weapons? Figures Alive! - Chapter 7 (Nuclear Fission)	CiC 7: 10c, 18	
8	Radiation that can harm	7.8 What hazards are associated with radioactivity? 7.9 How long will nuclear waste remain radioactive? (review both of these)		Ra^{2+}
9	Radiation in our world	7.8 What hazards are associated with radioactivity? (again, review this section)	Your Turn 7.21 on your radiation dose Your Turn 7.24 on	

			radon CiC 7: 19, 24	
10	What do we mean by clean air?	1.1 Everyday breathing 1.2 What's in breath? (parts per million) 1.3 What else is in a breath? 1.5 The atmosphere: Our blanket of air 1.6 Classifying matter: mixtures, elements and compounds 1.8 Formulas and names: The vocabulary of chemistry	CiC 1: 5-7, 15, 28, 29, 36	HCl, H_2CO_3, HCO_3^- CO_3^{2-}
11	What have humans always done?	1.9 Chemical change: Oxygen's role in burning 1.10 Fire and fuel: Air quality and burning hydrocarbons 1.11 Air pollutants: Direct sources 6.7 Sulfur dioxide and the combustion of coal 6.8 Nitrogen oxides and the acidification of LA 6.9 SOx and NOx: How do they stack up?	Consider This 1.7 on the AQI Your Turn 1.9 on carbon monoxide Your Turn 1.26, 1.27, 1.28 CiC 1: 19ac 21, 22, 23, 29,50 CiC 6: 21, 24	H_2SO_4 SO_4^{2-}
12	Ozone where you live	1.12 Ozone: A secondary pollutant 2.1 Ozone: What and where is it?	Consider This 1.6, and AIRNOW Consider This: 1.33 CiC 1: 8, 17bc, 19b, 48, 51 CiC 2: 3, 29	

13	Sunglasses and sunburn Part 1	2.4 Waves of light 2.6 The oxygen/ozone screen	CiC 2: 19, 36	
14	Sunglasses and sunburn Part 2	2.5 Radiation and matter 2.6 The oxygen/ozone screen 2.7 Biological effects of UV radiation	Consider This 2.17 on UV CiC 2: 5, 21, 39	
15	The ozone hole	Intro to Chapter 2 (p. 61-62) 2.1 Ozone: What and where is it? 2.8 Stratospheric ozone destruction 2.9 Chlorofluorocarbons: Properties, uses and interactions with ozone 2.10 The Antarctic ozone hole: A closer look	Your Turn 2.2, parts a-d CiC 2: 2, 27a, 30, 44, 54, 60a	
16	Seeing Things! Electron pairs and bonds	2.2 Atomic structure and elementary periodicity 2.3 Molecules and models	CiC 2: 12 Your Turn 2.6 on family features Your Turn 2.8, 2.9 on Lewis structures Your Turn 7.25 on iodine	O^{2-}
17	Seeing Things! Electrons where you might not expect them	2.2 Atomic structure and periodicity 2.3 Molecules and models	CiC 2: 14, 32-34, 52, 53	NO_3^-, OH^-
18	Back to CFCs and Cl•	2.9 Chlorofluorocarbons: Properties, uses and interactions with ozone 2.11 Responses to3 a	CiC 2: 41, 42, 46, 47b	

		global concern 2.12 Looking to the future		
19	Why don't CFCs wash out in the rain?	5.5 Water's molecular structure and physical properties 5.9 Covalent compounds and their solutions	Your Turn 5.11 on polar bonds Your Turn 5.12 on polar molecules Consider This 5.15 on oil and water CiC 5: 13ad, 15, 31, 36	NH_4OH, NH_4^+ 5.7 Water as a solvent 5.8 Water solutions of ionic cpds (review the ions!!!)
20	What should we do?	Review Chapter 2	CiC 2: 48, 49, 59ac Your Turn 2.35 on halons Consider This: 2.34 on CFCs past and future	
21	Burning a gallon of gasoline Part 1	3.6 Quantitative concepts: mass 3.7 Quantitative concepts: molecules and moles	Your Turn 3.25 on molar mass CiC 3: 25	
22	Burning a gallon of gasoline Part 2	4.9 Manipulating molecules to make gasoline (the part on isomers) Review density on page 232.	CiC 3: 40, 41 CiC 5: 17a (density calculation) CiC 4: 27, 42ab (both on isomers) CiC 10: 31, 45 (also on isomers)	
23	The Earth as a greenhouse	3.1 In the greenhouse: Earth's energy balance 3.2 Gathering Evidence: The testimony of time	Your Turn 3.3 on the Earth's energy balance Consider	

		3.3 Molecules: How the shape up 3.4 Vibrating molecules and the greenhouse effect	This 3.7 on Mauna Loa cycles CiC 3: 1, 3, 9ab, 10a, 11, 13a,	
24	Greenhouse gases: The windows of the Earth	Review Chapter 3, sections 1-4	CiC 3: 16, 18	
25	The carbon cycle	3.5 Carbon cycle: contributions from nature and humans	Consider This 3.6 on coal mines CiC 3: 2, 4	HNO_3 H_2SO_4
26	A global view of global warming	3.8 Methane and other greenhouse gases 3.9 Gathering evidence: Projecting into the future 3.10 Responding to science with policy changes 3.11 The Kyoto Protocol on Climate Change 3.12 Global warming and ozone depletion	CiC 3: 60ab (Kyoto vs Montreal)	
27	From crude oil to gasoline	4.8 Petroleum 4.9 Manipulating molecules to make gasoline (the part on cracking)	CiC 4: 24, 25ab, 26a, 36, 38a CiC 10: 28	
28	What's all that stuff doing in my gasoline?	1.11 Air pollutants (the part on tetraethyl lead) 4.10 Newer fuels and other sources 4.11 The case for conservation	CiC 4: 28, 43 Consider This 4.22ab: Air Quality	
29	Crude oil: too valuable to burn?	9.1 Polymers: The long, long chain 9.2 The "Big Six:: Theme and variations	Your Turn 9.8 Polyethylene Consider This 9.12a	

		9.3 Addition polymerization: Adding up the monomers 9.4 Polyethylene: A closer look at the most common plastic Figures Alive! - Chapter 9 (Polymers and monomers)	Necking polyethylene Consider This 9.13 HDPE and LDPE CiC 9: 4, 19	
30	From Polyethylene to polyester	9.5 Condensation polymers: Bonding by elimination 9.7 Plastics: Where from and where to?	Consider This 9.16 Can all form polyesters? Consider This 9.17 New combinations CiC 6: 33ab CiC 10: 14, 32	
31	Nylon	9.6 Polyamides: Natural and nylon 10.3 Functional groups 6.1 What is an acid? 6.2 What is a base? 6.3 Neutralization: Bases are antacids	Your Turn 9.19 Kevlar CiC 9: 5, 10, 27 CiC 10: 6abde, 7acde, 8ac, 9, 30	5.7 Water as a solvent 5.8 Water solutions of ionic cpds (review the ions!!!)
32	Polyvinyl chloride: the controversial plastic	9.2 The "Big Six": Theme and variations 9.3 Addition polymerization: Adding up the monomers (review both of these)	Your Turn 9.10 Polystyrene Your Turn 9.11 Teflon CiC 9: 21, 23ab, 24, 26,	
33	Fat is GOOD (at least some of the time)	11.3 Fats and oils: Part of the lipid family 11.4 Saturated and unsaturated fats and oils Figures Alive!	Your Turn 11.11 Fatty acid composition Cic 11: 21, 38	

		Chapter 11 (Fatty acid structures) Figures Alive! Chapter 11 (Fatty acids in foods) Figures Alive! Chapter 11 (A triglyceride)		
34	Trans fats and you	Figures Alive! Chapter 11 (Hydrogenation)	Consider This 11.13 Trans fatty acids CiC 11:22,	
35	From fats to soaps	Pages 247-250 (the part on soaps and hard water)	CiC 5: 29	
36	What is the pH of rain?	6.4 Introducing pH 6.5 Measuring the pH of rain 6.6 In search of the extra acidity 6.7 Sulfur dioxide and the combustion of coal (review) 6.8 Nitrogen oxides and the acidification of LA (review) 6.9 SOx and NOx: How do they stack up? 6.10 Acid deposition and its effects on materials 6.11 Acid deposition, haze and human health	CiC 6: 7-11, 15, 22, 29, 33, 34, 36, 37 Review: CiC 6: 30a	
37	From nylon to hamburger	11.6 Proteins: First among equals 11.7 Good nutrition and alternative diets: Getting enough protein	Your Turn 11.20 Making tripeptides	
38	Something to make your hair curl!	5.6 The role of hydrogen bonding Figures Alive! Chapter 5 (The	CiC 12: 13 CiC 5: 16, 56	

		hydrogen bond) Figures Alive! Chapter 5 (Hydrogen bonding in water) 12.3 Cracking the chemical code (p. 539 only)		
3 9	Protein synthesis & Lava lamps (revisiting the 60s)		(no assignment)	