

# Chemistry 311

## Chemistry Across the Periodic Table

### Fall 2015

**Read This Syllabus Today. Keep It for Future Reference.**

Chemistry 311, including lab	4 credit hours
Whole Class Sessions:	1:20 pm MWF B371 Chemistry
Discussion Sessions:	7:45 am B371 or 1315 Chemistry T or R
Laboratory Sessions:	8:50 am 1329 Chemistry T or R
Instructor Information:	Professor Judith N. Burstyn 5327 Chemistry (262-0328) <a href="http://chem.wisc.edu/users/burstyn">http://chem.wisc.edu/users/burstyn</a> burstyn@chem.wisc.edu
Office Hours:	F 2:15 – 3:15 pm, 5327 Chemistry or call or email for an appointment

The 118 known elements are the building blocks of every substance on earth. In Chem 311 you will learn about patterns of reactivity among chemical families, unique properties of selected elements, and how these reactivity patterns and properties are manifest in biological and industrial applications. The course will emphasize coordination chemistry of the transition metals, bioinorganic and solid-state chemistry. You will learn about reactivity through laboratory exploration and problem solving. Students in Chem 311 are expected to have successfully completed Chem 104, Chem 109, Chem 115 or an equivalent with a grade of C or above.

#### **Course Organization and Expectations**

A recommended study strategy for this course is: 1) read the assigned material in the text before each whole class session, 2) attend class, take your own notes, and actively participate in class exercises, 3) as soon as possible after class, begin to work homework problems. When you encounter problems that you cannot solve, refer to the text, your notes, library resources, or your fellow students. Forming a study group with fellow students to review and problem solve is an excellent way to learn chemistry.

To help you to master the new material presented in this course, specific learning objectives are provided for each unit and its associated exam. These objectives are available within the Exam assignments in Canvas (see below). Use the learning objectives to guide your work on the problem sets and practice exams for that course unit. Practice exams keyed to the learning objectives are also available in the same location. Fully worked out answer keys will be made available for you to use to check your work on the practice exams two days before the exam.

Various learning activities are offered to meet the needs of different types of students; however, if you find that your learning needs are not being met or that you are not satisfied with some aspect of the course please bring your concern to Prof. B., your TA, or your Student Board of Directors representative.

**Evaluation Strategies:** Two midterm exams, the best ten of twelve problem sets, and twelve laboratory exercises will be the basis for your grade in Chem 311. The midterm exams will be held at 5:40 PM on Wed. Oct. 7 and Wed. Nov. 11. The final exam will be held at 7:45-9:45 AM on Tues. Dec. 22. Please notify Prof. B. and your TA of any conflicts promptly.

**Required Text & Materials**

**Textbook:** *Descriptive Inorganic, Coordination, and Solid-State Chemistry*, 3<sup>rd</sup> Edition, Glen E. Rodgers, Brooks/Cole 2012, available from local bookstores or on-line. It's OK to use the 2<sup>nd</sup> edition if you prefer to do so.

**Calculator:** An inexpensive calculator is required. It should have capabilities for square roots, logarithms and exponentiation (antilogarithms), and exponential (scientific) notation operations. You may use programmable calculators in this course.

**Auxiliary Materials:** The following materials may be purchased from Alpha Chi Sigma (AXΣ) in the Mills St. atrium of the chemistry building beginning at 7:30 am on Jan. 20.

**Lab Manual** *Chemistry 311, Laboratory Manual*, Spring 2015 edition. (Only sold by AXΣ.)

**Lab Notebook:** Carbonless laboratory notebook with duplicate pages. You will need a new notebook for Chem 311 because you will use all the pages. Sold by AXΣ or the bookstore.

**Safety Goggles:** Industrial quality eye protection is required at all times when you are in the lab. AXΣ sells safety goggles that completely seal around the eyes and fit over regular glasses. These goggles meet our safety requirements.

**Chem 311 Canvas Web Site**

Much material for this course is only available via Canvas. You automatically have access to the 311 materials via Canvas (<https://wisc.instructure.com>) if you are enrolled in this course. If you have a problem logging in, and you have been registered for Chem 311 for at least two days, send an email to instructional technology specialist Dr. Rachel Bain, [rbain@chem.wisc.edu](mailto:rbain@chem.wisc.edu).

**Problem Sets:** Problem sets will usually be due on Monday. Each problem set should take about two hours to complete and will be graded on a low-resolution scale: 0 (not turned in), 3, 4, or 5 points. Your best 10 of 12 5-point problem sets will be used in calculating your final grade.

**Laboratory:** The 311 laboratory is designed to be an integral part of your learning experience. In the lab, you will focus on two primary objectives: the synthesis of compounds and the analysis of their structure. These are essential goals of modern inorganic chemistry research. Your lab exercises will give you the opportunity to explore the reactivity of a wide variety of elements with your own hands, and you will experience the beauty and variety of inorganic compounds. By the end of the semester, you will have prepared your very own rainbow of products. Many people who become inorganic chemists were inspired by their lab experience.

**Exams**

**Learning Objectives, Study Questions and Practice Exams:** Learning objectives and two practice exams for each unit are posted within the unit exam assignment. The course topic schedule lists a selected set of additional study questions from the textbook, which are keyed to the learning objectives for that unit. The study questions are typical of those you should master and you should use them to build your mastery of the course content.

**How To Prepare For Exams:** A recommended strategy is: 1) review the learning objectives for the exam referring to your notes or the text if necessary, 2) work the study questions associated with each objective, spending more time working problems on those topics you find most challenging, 3) simulate the test taking situation by working the practice exam in 50 minutes in a quiet place, 4) "grade" your own test using the answer key as your guide, 5) review those areas that you identify as weak, working extra problems in these areas to reinforce your knowledge.

**Important Administrative Information For Chemistry 311**

**Student Board of Directors:** The Student Board of Directors provides feedback to Prof. B. from the students on how the course is going. The Board consists of one representative from each discussion/lab section, chosen by the students in that section. The board will meet nearly every week at 2:15 PM on Monday to discuss course policies, structure, and content. Meetings will be half an hour or less. Your TA will solicit volunteers for this role in your first discussion. If you are interested in serving as your class representative, send your TA an email (see below) as soon as possible. Include your name, your email address, and your section number in your message.

**Electronic Mail:** You are encouraged to contact Prof. B. by email if you have questions about anything to do with the course. Electronic mail is available at all times of day and night, so you can send messages whenever something comes to mind. Do not, however, expect immediate responses in the middle of the night! Prof. B.'s email address is [judith.burstyn@wisc.edu](mailto:judith.burstyn@wisc.edu). Because Prof. B. gets hundreds of messages every day to that account, she asks that you put the words "Chem 311" in the subject line of any message you send to her. NOTE: *Messages sent without this subject line will likely be buried!*

**What To Do If You Are Sick, Or Otherwise Unable To Attend An Exam or Lab:** If you are unable to attend a specific lab session because of an unavoidable schedule conflict, for example a religious observance, an athletic activity or a family obligation, contact your TA as soon as possible to reschedule. Make up labs can be arranged only during the week when the entire class is doing a lab exercise, so planning ahead is important. If you find that you are unable to attend lab because you are ill, contact your TA as soon as possible. He or she will discuss your situation and decide what to do. **If circumstances arise unexpectedly that preclude your taking an exam, please contact your TA and Prof. B. before the scheduled exam time.** We recognize that in an emergency situation, you may not be able to contact us in a timely way.

**Chemistry Resource Facilities - Computer Room, Study Room, Undergraduate Chemistry Office, Chemistry Library:** Computers are available for use in room 1375 Chemistry. Room 1371 is a study room for chemistry students. The staff in the Undergraduate Chemistry Office, room 1328, can assist you with enrollment, advising, and many other things. The Chemistry Library, on the second floor above the main lecture halls, is a wonderful place to study. Different textbooks, reference works, on-line database searching and other resources for chemistry students are available. Specific materials for this class are on reserve in the Chemistry Library.

**Cell Phone / Computer Policy:** If you bring a cell phone to class or lab, please silence it for the duration of the class or lab period. If there is a situation that absolutely requires you to answer your cell phone during a class, please set the phone to silent/vibrate and sit in a location where you do not disturb other students when leaving the classroom to accept a call. Computers may not be used during class or lab sessions.

**Course Calendar:** A 1-page "semester-at-a-glance" calendar is posted in Canvas to help you plan your study schedule for Chem 311. This calendar lists the due dates for all problem sets, the names of the weekly lab exercises, final due dates for peer-reviewed (CPR) lab reports, and the exam dates. Instructions for each problem set, lab exercise and exam may be found within the specific assignment in Canvas.

**Course Topic Schedule:** A schedule is posted in Canvas listing topics, readings and extra study questions from the textbook to guide your studying for Chem 311.

**Grades:**

Your grade will be based on a maximum of 500 points divided as follows:

Best 10 of 12 Problem Sets @ 5 points each <i>(see course calendar for due dates)</i>	50 points
Twelve Laboratories will make up 30% of your grade* <i>(each week's experiment is listed in the calendar)</i>	150 points
Two midterm exams @ 75 points each <i>(dates and times are listed in the course calendar)</i>	150 points
Final Exam <i>(date and time is listed in the course calendar)</i>	150 points
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Total	500 points

\*Twelve laboratory exercises worth 140 points plus a 10-point spectroscopy assignment.

**Letter Grades:** Final letter grades will be based upon the absolute scale shown below. If you score the number of points indicated, then you will receive the letter grade indicated, regardless of how many other students achieve the same grade. There is no curve. Therefore it is to your benefit (and to your friends' benefit) that you help other students learn and they help you learn.

A	450 points or more	≥90%
AB	435 to 449 points	87-89.9%
B	410 to 434 points	82-86.9%
BC	375 to 409 points	75-81.9%
C	325 to 374 points	65-74.9%
D	275 to 324 points	55-64.9%
F	<275 points	<55%

If necessary, adjustments will be made at the end of the semester, but these adjustments will never lower your final letter grade, only raise it.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	31-Aug	1-Sep	2-Sep 1	3-Sep Malachite Bead	4-Sep 2	5-Sep
6-Sep	7-Sep <b>Labor Day</b>	8-Sep Polysiloxanes*	9-Sep 3 <b>PS 1 due</b>	10-Sep Polysiloxanes*	11-Sep 4	12-Sep
13-Sep	14-Sep 5 <b>PS 2 due</b>	15-Sep Prussian Blue	16-Sep 6	17-Sep Prussian Blue	18-Sep 7 <b>CPR begins</b>	19-Sep
20-Sep	21-Sep 8 <b>PS 3 due</b>	22-Sep Thiatriazoles	23-Sep 9	24-Sep Thiatriazoles	25-Sep 10	26-Sep
27-Sep <b>CPR ends</b>	28-Sep 11 <b>PS 4 due</b>	29-Sep Lewis Adduct*	30-Sep 12	1-Oct Lewis Adduct*	2-Oct 13	3-Oct
4-Oct	5-Oct 14 <b>PS 5 due</b>	6-Oct DMSO Complexes	7-Oct 15 <b>Exam 1</b>	8-Oct DMSO Complexes	9-Oct 16 <b>CPR begins</b>	10-Oct
11-Oct	12-Oct 17 <b>PS 6 due</b>	13-Oct Magnetism*	14-Oct 18	15-Oct Magnetism*	16-Oct 19	17-Oct
18-Oct <b>CPR ends</b>	19-Oct 20 <b>PS 7 due</b>	20-Oct Nickel Series	21-Oct 21	22-Oct Nickel Series	23-Oct 22 <b>CPR begins</b>	24-Oct
25-Oct	26-Oct 23 <b>PS 8 due</b>	27-Oct Nickel Series Salen	28-Oct 24	29-Oct Nickel Series Salen	30-Oct 25	31-Oct
1-Nov <b>CPR ends</b>	2-Nov 26 <b>PS 9 due</b>	3-Nov Co(II)Salen* Synthesis	4-Nov 27	5-Nov Co(II)Salen* Synthesis	6-Nov 28	7-Nov
8-Nov	9-Nov 29 <b>PS 10 due</b>	10-Nov Co(II)Salen* O <sub>2</sub> Adduct	11-Nov 30 <b>Exam 2</b>	12-Nov Co(II)Salen* O <sub>2</sub> Adduct	13-Nov 31	14-Nov
15-Nov	16-Nov 32	17-Nov Ni Nanowires	18-Nov 33	19-Nov Ni Nanowires	20-Nov 34 <b>CPR begins</b>	21-Nov
22-Nov	23-Nov 35	24-Nov NO LAB!	25-Nov 36	26-Nov Thanksgiving	27-Nov NO CLASS	28-Nov
29-Nov <b>CPR ends</b>	30-Nov 37	1-Dec Ru(bipy) <sub>3</sub> Ni(glyme) <sub>2</sub>	2-Dec 38 <b>PS 11 due</b>	3-Dec Ru(bipy) <sub>3</sub> Ni(glyme) <sub>2</sub>	4-Dec 39	5-Dec
6-Dec	7-Dec 40	8-Dec OLED Check Out	9-Dec 41	10-Dec OLED Check Out	11-Dec 42 <b>PS 12 due</b>	12-Dec
13-Dec	14-Dec 43	15-Dec Classes end	16-Dec	17-Dec	18-Dec	19-Dec
20-Dec	21-Dec	22-Dec <b>Final Exam 7:45 AM</b>	23-Dec	24-Dec <b>Christmas Eve</b>	25-Dec <b>Christmas Day</b>	19-Dec

\*Lab exercises that will be graded using Calibrated Peer Review (CPR).

## Topic Schedule, Readings and Suggested Textbook Problems Chem 311 – Chemistry Across the Periodic Table – Fall 2015

Week	Day	Date	Topic	Chapter / Reading	Suggested Problems
	Wed.	9/2	Introduction / Inorganic Synthesis / Periodic Table	Synthesis paper*	None
	Fri.	9/4	Periodicity and its Underlying Principles	9	Ch 9: 13, 22, 37
2	Mon.	9/7	Periodicity and its Underlying Principles	9	Ch 9: 20, 26
	Wed.	9/9	Periodicity and its Underlying Principles	9	Ch 9: 23, 32
	Fri.	9/11	Atomic Structure, Orbitals	Atomic Structure*	Orbitron, Guided Inquiry 2*
3	Mon.	9/14	Effective Use of Chemical Information Resources		
	Wed.	9/16	Atomic Structure, Orbitals	Atomic Structure*	Ch. 9 27, 28
	Fri.	9/18	Molecular Orbital Theory of Homonuclear Diatomics	MO Resources*	Ch 9: 39, 40, 41
4	Mon.	9/21	Hydrogen: Bonding and Descriptive Chemistry	10	Ch 10: 15, 57, 44, 46, 48
	Wed.	9/23	H & O: Bonding and Descriptive Chemistry	10 & 11	Ch 11: 12, 14, 40,
	Fri.	9/25	Oxygen: Bonding and Descriptive Chemistry	11	Ch 11: 20, 26, 54, 55
5	Mon.	9/28	Transition Metal Coordination Chemistry: Introduction	2	Ch 2: 11, 27, 37
	Wed.	9/30	Transition Metal Coordination Chemistry: Structure	3	Ch 3: 15, 22
	Fri.	10/2	Transition Metal Coordination Chemistry: Structure	3	Ch 3: 17, 29
6	Mon.	10/5	Transition Metal Coordination Chemistry: Structure	3	Ch 3: 48, 45, 52
	Wed.	10/7	Review for Exam 1 <sup>#</sup>		
	Fri.	10/9	Transition Metal Coordination Chemistry: Bonding	4	Ch 4: 4, 10, 16, 24
7	Mon.	10/12	Transition Metal Coordination Chemistry: Bonding	4	Ch 4: 35, 39, 46
	Wed.	10/14	Transition Metal Coordination Chemistry: Bonding	4	Ch 4: 48, 54, 55
	Fri.	10/16	Transition Metal Coordination Chemistry: Bonding	4	Ch 4: 57, 61
8	Mon.	10/19	Transition Metal Coordination Chemistry: Reactivity	5	Ch 5: 2, 9
	Wed.	10/21	Transition Metal Coordination Chemistry: Reactivity	5	Ch 5: 16, 17, 26, 27
	Fri.	10/23	Transition Metal Coordination Chemistry: Reactivity	5	Ch 5: 53, 54, 62
9	Mon.	10/26	Transition Metal Coordination Chemistry: Application	6	Ch 6: 12, 14
	Wed.	10/28	Transition Metal Coordination Chemistry: Application	6	Ch 6: 22, 28
	Fri.	10/30	Transition Metal Coordination Chemistry: Application	6	Ch 6: 34, 35

All suggested problems are keyed to the 3<sup>rd</sup> edition of the Rodgers text, which is available in the Chemistry Library. Some of these problems may appear on your problem sets and exams.

\*Synthesis Paper, Atomic Structure, Molecular Orbitals and Guided Inquiry 2 are available in Canvas in the Unit 1 module.

<sup>#</sup>Exams will be held on Wed. Oct. 7 and Wed. Nov. 11 from 5:40-6:55 pm. Locations will be announced and posted in Canvas.

**Topic Schedule, Readings and Suggested Textbook Problems**  
**Chem 311 – Chemistry Across the Periodic Table – Fall 2015**

Week	Day	Date	Topic	Chapter / Reading	Suggested Problems
10	Mon.	11/2	Solid State Structure: Metals and Salts	7	Ch 7: 3, 5, 18, 19
	Wed.	11/4	Solid State Structure: Metals and Salts	7	Ch 7: 31, 33, 45
	Fri.	11/6	Solid State Energetics: Ionic Bonding in Salts	8	Ch 8: 3, 8, 9
11	Mon.	11/9	Solid State Energetics: Ionic Bonding in Salts	8	Ch 8: 13, 23
	Wed.	11/11	Review for Exam 2 <sup>#</sup>		
	Fri.	11/13	Group 1: Na, K, Rb, Cs, Fr	12	Ch 12: 8, 16, 18, 23, 49
12	Mon.	11/16	Groups 1 & 2: Li, Mg	13	Ch 13: 5, 19
	Wed.	11/18	Group 2: Ca, Sr, Ba, Ra	13	Ch 13: 22, 25
	Fri.	11/20	Groups 2 & 13: Be, Al	14	Ch 14: 15, 23
13	Mon.	11/23	Group 13: Ga, In, Tl; Groups 13 & 14 B, Si	14	Ch 14: 39, 44
	Wed.	11/25	Group 14: Ge, Sn, Pb	15	Ch 15: 10, 25, 26
	Fri.	11/27	No class - Thanksgiving		
14	Mon.	11/30	Group 14: Inorganic chemistry of C	15	Ch 15: 15, 29
	Wed.	12/2	Group 15: P, As, Sb, Bi	16	Ch 16: 17, 23, 28
	Fri.	12/4	Group 15: Inorganic chemistry of N	16	Ch 16: 32, 55, 62
15	Mon.	12/7	Group 16: Chalcogens S, Se, Te, Po	17	Ch 17: 9, 10, 12
	Wed.	12/9	Group 16 & 17: Bioinorganic Chemistry of Se and I	18	Ch 17: 30, 31, 44
	Fri.	12/11	Group 17: Halogens	18	Ch 18: 11, 15, 16, 37
16	Mon.	12/14	Group 18: Noble Gases & Overview of Chem 311	19	Ch 19: 12, 14, 24, 32

<sup>#</sup> Exams will be held on Wed. Oct. 7 and Wed. Nov. 11 from 5:40-6:55 pm. Locations will be announced and posted in Canvas.