

Syllabus

Course: CH 220.2 Methods in Chemical Research

Semester: Fall, 2008

Professor: Carl Salter

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Catalog Description: An introduction to the use of the computer in chemical experimentation and research, including the production of research-quality manuscripts that include scientific tables, figures, and chemical drawings. The use of statistical programs and experimental design will be covered. Real-time data acquisition hardware and software will be used by the students to gather data for analysis in spreadsheets. Students will be introduced to on-line searches of the chemical literature using Chemical Abstracts and the Science Citation Index. Fall. One 100 minute period each week. One-half unit credit.

Required Text: Beall & Trimbur, *A Short Guide to Reading and Writing About Chemistry*, 2nd Ed, Longman, 2001.

Optional Texts: D. C. Harris, *Quantitative Chemical Analysis*, 6th Ed, Freeman, 1999. You will read and outline chapters 3, 4, and 5 from *Quantitative Chemical Analysis*; chapters 4 and 5 illustrate the use of EXCEL spreadsheets to analyze chemical data. Any manual on EXCEL will be helpful. *A Guide to Microsoft Excel for Scientists and Engineers* 2nd Ed by B. V. Liengme is available in the Computational Chemistry Lab, CHS 227.

Goal: This is the writing-intensive course for the chemistry major. You will learn how to write about science and science experiments in a variety of formats. The production of well-written chemical manuscripts with charts, tables, and chemical drawings is a high priority of this class. Your grade in this course is determined by the documents that you submit; these documents will be evaluated on writing and presentation of data. The course will also familiarize you with computer techniques that you will need to perform research projects and carry out other functions of a professional chemist. These techniques include searching the literature on a chemical problem, designing statistically sound experiments to answer chemical questions, organizing and analyzing data using spreadsheets, and preparing professional documents that explain your work to other chemists.

Attendance: Because this class meets only one afternoon per week, attendance is critical. One unexcused absence results in failure. An excused absence gives the student the right to make up the missed material sometime during the remainder of the week at a time determined by the instructor. For planned absences that result from participation in a college event such as sports, the student is expected to notify the instructor the week before to schedule a time to make-up the work. You should always bring a USB drive and your writing journal to class.

Evaluation: Your grade will be determined solely by the writing assignments of the course.

Four lab reports	40%
Writing journal	25%
Reaction paper to Asimov essay	10%
Asimov's World of Nitrogen assignment	10%
"Forensics" letter	5%
Two "Dear Aunt Gladys" letters	10%

Tentative Schedule:

- Week 1 Aug 25
Overview of laptops and computer programs.
[Introduction to MSWord and ChemDraw. Introduction to Excel.](#)
[Moving charts and structures to documents.](#)
[Receive writing assignments from Asimov's World of Nitrogen and The Relativity of Wrong.](#)
[World of Nitrogen and World of Carbon are available in the library.](#)
Meter stick and mass experiments, add these graphs and LINEST output to the Clipboard assignment.
- Week 2 Sept 1 (Wednesday only) multimeter experiment.
- Week 3 Sept 8
Descriptive Statistics using Excel. More about LINEST and Least Squares. Experiment "Density of Pennies"
[Lab report: Analyze density of sugar solutions using Excel. Data from CRC Handbook.](#)
[\(lab report using template LR2\)](#)
Statistics: "Errors in Measurements and their effect on Data Sets" in class
Peer review of M&M lab reports and Asimov assignments.
Turn in Clipboard Assignment
- Week 4 Sept 15
Introduction to spectroscopy: Beer's Law.
[Lab report: Copper sulfate experiment using Ocean Optics spectrometers.](#)
[Directions for Copper sulfate experiment.](#)
[\(lab report using template LR3\)](#)
Turn in M&M lab report
- Week 5 Sept 22
[Complete Copper sulfate experiment and analyze unknowns.](#)

1st draft of "Relativity of Wrong" and chapter requests for
World of Nitrogen **due Friday Sept 26**

Week 6 Sept 29
**Lab report: pH titration experiment. (Your own lab report format!)
([titration spreadsheet](#))**
"Forensics" test on unknown salt. (**write letter to defense lawyers
explaining results**)
Receive Aunt Gladys assignments.

Week 7 Oct 6
Experiment: Heat of fusion of Ice: Excel spreadsheet analysis of
data. Nonlinear fits using Solver. (Turn in spreadsheet.)

Week 8 Oct 13
Introduction to [Chemical Abstracts using SciFinder Scholar](#).

Week 9 Oct 20
Peer review of *Relativity of Wrong* draft
Statistics: The t test. The F test. Introduction to EXCEL Statistical
functions.

Turn in both Asimov

Assignments Friday Oct 24

Week 10 Oct 27
Lab report: M&M experiment
[Directions for M&M experiment.](#)
[\(lab report using template LR1\)](#)

Turn in first drafts of Freezing

point and copper sulfate LR's.

Submit writing journal for

review. Friday Oct 31.

Week 11 Nov 3
Lab report workshop.
[Peer review of Freezing point and Copper sulfate lab reports. Revise
as needed.](#)

Week 12 Nov 10
Spectroscopy and kinetics experiment. Bleaching of dyes. Fe(III)
and thiosulfate. (Turn in spreadsheet.)

Week 13 Nov 24 (Monday only) multimeter experiment.

Week 14 Dec 1

Read out loud and turn in Aunt Gladys letters. Submit all Lab reports. Submit writing journal for final grade.

Lab Reports: You will write four lab reports based on the lab experiments you do during the course. An extensive list of online advice about [lab report format, style, and content](#) is available on my web site. For three experiments you will be provided with lab report “template” files that will help guide you through the process of inserting the right information and ideas into your report. For the titration experiment you are on your own.

You will not write a lab report for the heat of fusion of ice or the kinetics experiment; however, these experiments must appear in your writing journal, and you must use the laboratory notebook style suggested by Beall & Trimbur.

The Writing Journal: A bound notebook of the type used for laboratories can be used to submit your writing assignments from the Beall & Trimbur textbook, *A Short Guide to Reading and Writing about Chemistry*. The assignments from the textbook should be completed in the notebook--you may write them by hand, but I must be able to read them!

Divide your bound notebook in two main parts. Use the first two-thirds for your writing journal; use the last third as a lab notebook. Your notebook should contain information on **all** the formal experiments that we do in lab: Copper sulfate, pH titration, heat of fusion of ice, M&Ms, and the kinetics experiment. Your notebook should include spreadsheet analysis of the data pasted into the book.

Here are the Assignments from the *Short Guide to Writing*:

Chapter 1: The Basics Page 12, Exercises 1, 2, 3.

Prior to the copper sulfate experiment: Prepare a list of at least six web references on Spectronic 20s that describe how to use them. Summarize the instructions each reference gives, then combine the instructions to produce your own set of instructions for the Spec 20.

Summarize the research of a chemistry professor at a **Big Ten or Ivy League** university based on web references.

Chapter 2: Scientific Responsibility Page 32, writing assignment 1

Chapter 3: Reading and Writing to Learn Chemistry

Page 36 Exercise 1: list models of acid-base chemistry you find in a general chemistry textbook

Page 45 Exercise 2: use a topic from chapter 4 or 5 of the quant book by Harris.

Page 49 Exercise 3: use chapter 3 of Harris's quant book.

Page 57 Exercise 2

In addition, compare the discussion of acid-base chemistry in a general textbook with that in your Harris's quant book.

Outline Chapters 3, 4, and 5 from Harris's quant book. As you do, answer Harris's essay problems: Chapter 4-1,2, 8, 9, 10, 13, 17; Chapter 5-5, 6.

Chapter 4: Writing Lab Reports Page 61, writing assignment 1.

Chapter 5: How to Read a Scientific Article: Writing Summaries and Critiques

What is the difference between a summary and a critique?

Summarize a research paper written by a member of Moravian's chemistry or biology departments.

Critique *The Pleasures of Merely Measuring* by Harold McGee, from chapter 11 of *The Curious Cook*.

Summarize the excerpt from *Zen and the Art of Motorcycle Maintenance* by Robert Persig.

Chapter 6: Writing Literature Reviews

For the research paper you summarized in Chapter 5, search for more recent related articles using both Chemical Abstracts and Science Citation Index. List roughly a half dozen and summarize their abstracts.

Chapter 7: Writing Research Proposals

Summarize a research proposal written by a member of Moravian's chemistry or biology departments.

Forensics Report: You're the employee of a private analytical chemistry laboratory, and you've been assigned to analyze a chemical recovered from the scene of a mysterious fire at Dr. Langhus's house. Prepare a professional report to Langhus's defense attorneys based on your analysis of the sample. Present the evidence both scientifically and also in a form that is suitable for the use of the attorneys.

Reaction paper to Asimov essay: You will receive a copy of an essay by Isaac Asimov, famous science fiction writer, written late in his life, called *The Relativity of Wrong*. Your assignment is to write a three-to-five page (double-spaced) response to Asimov's essay, explaining his thesis and stating whether or not you agree with it. Asimov cites several examples of scientific theories to support his thesis; if you agree with Asimov, tell me which examples best illustrate his thesis; on the other hand, if you disagree with Asimov, pick one historical example and tell me why you find it unconvincing. Read *Lessons Learned from Lord Rayleigh ...*, *JCE* **1990**, *67*, 925, and discuss the history of another scientific theory and why you think it either supports or contradicts Asimov's thesis. Finally, tell me if Asimov's essay has in any way changed your view of scientific research.

Asimov's World of Nitrogen assignment: You will be assigned a chapter from a book by Asimov on organic chemistry called the *World of Nitrogen*. The book was written in the 1950's; your assignment is to **update the information in the chapter** and include lovely **structures produced by ChemDraw** to illustrate the chemicals Asimov talks about.

Browse *World of Nitrogen*, which is on reserve in the library. You may also want to browse the companion book, *World of Carbon*, if you are just starting organic chemistry-

-it will get you off to a good start in understanding the material. Write a proposal that tells me which two chapters of *World of Nitrogen* you want to work on, and why you want to work on them. What I am particularly interested in is which chemicals in the chapter do you want to find updated information on, and why. Be sure specify your first and second choice. I'll do my best to assign you one of those two chapters.

“Aunt Gladys Letters”: Your Aunt Gladys is curious; she knows you're studying chemistry, and she would like you to explain how some amazing thing that she's heard of really works. Your task is to find the answer to her question on the Internet, in the library, or in the laboratory, and then write a letter back to her that she can understand. In addition, you'll be writing to her about the lemon/potato experiment and the kitchen experiment, so take good notes!

Spreadsheet Requirements For Data from Experiments: Related lab work or assignments **should be in a single excel file** (a "book", as EXCEL calls it), each separate problem should be on its own sheet, and each sheet should be named using the chapter and problem number; for example, "5-13" indicates problem 13 from chapter 5. If a problem has several parts, all parts should be on one sheet proceeding **DOWN** the sheet (not across); keep similar quantities in the same **COLUMNS**.

Data from each experiment should be in one file, and each separate trial should be on a separate, labeled sheet. For example, all titrations from one experiment should be in one book, and data from each individual titration should be on a separate sheet. **Spreadsheets for every experiment MUST** have a summary sheet containing the date the experiment was performed and the identity of your lab partner(s). The summary must have concise tables presenting the key data from all the experimental trials, and the summary should have a brief written discussion of the meaning and importance of the data. The summary page should not contain numbers that are not mentioned in the discussion.