

Syllabus

Course: CH 220.2 Methods in Chemical Research

Semester: Fall, 2006

Professor: Carl Salter

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

Any manual on EXCEL may 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. In addition, you should read chapters 4 and 5 from D. C. Harris's textbook, *Quantitative Chemical Analysis*. It has valuable information about statistics and the use of spreadsheets to analyze chemical data.

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 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.

Goal: 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.

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

Five lab reports	50%
Writing journal and forensics report	20%
Reaction paper to Asimov essay	10%
Asimov's <i>World of Nitrogen</i> assignment	10%
Three " Dear Aunt Gladys " letters	10%

Tentative Schedule:

- Week 1 Aug 30
Overview of laptops and computer programs.
[Introduction to ChemDraw](#). [Introduction to Solver](#).
[Writing assignments from Asimov's World of Nitrogen](#)
Introduction to Statistics thru Guided Inquiry, pgs 1-7
- Week 2 Sept 6
Statistics Guided Inquiry pgs 8-19
Introduction to EXCEL Statistical functions. Descriptive Statistics.
[M&M experiment](#). ([lab report using template LR1](#))
- Week 3 Sept 13
Peer review of M&M lab reports and Asimov assignments.
Finish Statistics Guided Inquiry
- Week 4 Sept 20
The t, F and Q tests.
[Histogram](#) of penny masses: Weigh pennies and make a histogram using both [Excel](#) and [R](#)!
Linear regression.
Turn in M&M lab report
- Week 5 Sept 27
Introduction to spectroscopy
[Copper sulfate experiment](#) using Spectronic 20s. ([lab report using template LR2](#))
- Asimov assignments due Thursday Sept 30**
- Week 6 Oct 4
[pH titration experiment](#). ([lab report LR3](#))
"Forensics" test on unknown salt. ([letter to defense lawyers](#))
- Week 7 Oct 11
Kitchen experiment. Lemon/potato galvanic cell. Record in your journal and [send Aunt Gladys a letter!](#)
Submit writing journal for review. **Turn in copper sulfate lab report.**
- Week 8 Oct 18
Introduction to [Chemical Abstracts using SciFinder Scholar](#).
Introduction to the Science Citation Index.
Turn in "Forensics letter"
- Week 9 Oct 25
[Spectroscopy of pH indicators](#) (lab report LR4)

- Week 10 Nov 1
Real-time data acquisition: Kinetics of Fe(III) reduction by $S_2O_3^{2-}$ (lab report LR5)
- Week 11 Nov 8
Lab report workshop and peer review.
Submit writing journal for review.
- Week 12 Nov 15

Nov 22 Thanksgiving Break NO CLASS
- Week 13 Nov 29
Submit writing journal.
- Week 14 Dec 6
Read out loud and turn in Aunt Gladys letters. Submit remaining Lab reports.

Lab Reports: You will write five 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 two early experiments, the M&M experiment and the $CuSO_4$ experiment, 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 and the remaining experiments you are on your own. You will not write a lab report for the lemon/potato experiment or the kitchen experiment; however, these experiments must appear in your writing journal, and you must use the style suggested by Beall & Trimbur. And you'll write a letter to Aunt Gladys!

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!

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 quant book.

Answer Harris's essay problems in your journal: Chapter 4-1,2, 8, 9, 10, 13, 17; Chapter 5-5, 6.

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

Record the Lemon/potato experiment and the kitchen experiment in your journal using the style described for laboratory notebooks in this chapter. (Note: these are the only lab experiments that you are required to place in your writing journal.)

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 either Dan Libby, Carl Salter, Shari Dunham, or Steve Dunham.

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 either Dan Libby, Carl Salter, Shari Dunham, or Steve Dunham.

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.

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 *Facing the Giant*, 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 receive 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 chemical structures from ChemDraw to illustrate the chemicals Asimov's describes.

“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 particular, 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.