

Syllabus

Course: CH 220.2 Methods in Chemical Research

Semester: Fall, 2009

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. ISBN 0-321-07844-6.

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	20%
Clipboard assignment	5%
Outline and Reaction paper to Asimov essay	15%
"Forensics" letter	5%
Three "Dear Aunt Gladys" letters	15%

There is no Final Exam for this half-unit course.

It is within the instructor's purview to apply qualitative judgment in determining grades for an assignment or for the course.

Students who wish to request accommodations in this class for a disability should contact Mr. Joe Kempfer, Assistant Director of Learning Services for Disability Support, 1307 Main Street (extension 1510). Accommodations cannot be provided until authorization is received from the office of Learning Services.

Tentative Schedule:

Week 1	Aug 31 Overview of laptops and computer programs: Introduction to MSWord, PCModel, ChemDraw. Moving charts and structures to documents. Introduction to Excel. Graphs, including Lightbulb data. Clipboard assignment and Excel Functions. Receive writing assignments from Asimov's <i>The Relativity of Wrong</i> and letters from Aunt Gladys.
Week 2	Sept 7 (Labor Day)
Week 3	Sept 14 Excel Function reports (oral). Read 1st Aunt Gladys letter (oral). LINEST and Least Squares. Meter stick and mass experiments, experiment with "Density of Pennies" (add these graphs and LINEST output to the Clipboard assignment.) Lab report: Analyze density of sugar solutions using Excel. <u>data spreadsheet</u> (lab report template) "Gaussian Distribution" and "Errors in Measurements and their effect on Data Sets"
Week 4	Sept 21 Turn in Clipboard Assignment Gaussian Distribution Activity. Working Problems Backwards: Circles, Relative Humidity, Organic
Synthesis	water vapor data DUE Friday Sept 25 Sugar experiment, Clipboard

assignment

- Week 5 Sept 28
Introduction to spectroscopy: Beer's Law.
Lab experiment: Copper sulfate experiment using Ocean Optics spectrometers.
[Directions for Copper sulfate experiment.](#)
[\(lab report template\)](#)
- Week 6 Oct 5
Complete Copper sulfate experiment, analyze and identify unknowns.
Be sure **one** graph contains **all three** titration curves!
- Week 7 Oct 12 (Fall break)
DUE Friday Oct 16 Copper experiment, outline of your Toulmin analysis of *The Relativity of Wrong*
- Week 8 Oct 19
Introduction to [Chemical Abstracts using SciFinder Scholar](#).
- Week 9 Oct 26
Discussion of *The Relativity of Wrong* based on Toulmin analysis.
Logical Induction.
Descriptive Statistics using Excel.
Statistics: The t test. The F test.
- Week 10 Nov 2
Lab experiment: M&M experiment
[Directions for M&M experiment.](#)
[\(lab report template\)](#)
- Week 11 Nov 9
Lab report: pH titration experiment.
"Forensics" test on unknown salt. (Write letter to defense lawyers explaining results.)
[Directions for titration experiment](#)
[\(titration spreadsheet\)](#)
[\(lab report template\)](#)
- Week 12 Nov 16
Complete titrations

Week 13 Nov 23 (Thanksgiving)
DUE Tuesday Nov 24 M&M lab report.

Week 14 Nov 30
Spectroscopy and kinetics experiment. Fe(III) and thiosulfate.
(Turn in spreadsheet.)
**DUE Friday Dec 4 Final draft of *The Relativity of Wrong*,
and writing journal.**

Week 15 Dec 7
**Read out loud and turn in Aunt Gladys letters. Submit
remaining Lab reports.**

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, which you should consult as you write your report. For each 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. The template follows the guidelines on the lab report style page. Your conclusion section should always present a [Toulmin analysis](#) of your conclusions, making clear what is your **claim**, your **warrant**, and your **data** (or **grounds**). Your statements about data should clearly refer to tables, graphs, or observations made earlier in the lab report. You will not write a lab report for the kinetics experiment; however, this experiment 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, M&Ms, titrations, 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.

You must ask a faculty member to recommend a paper to you, and they should send me an email confirming which paper they gave you.

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.

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. To assist your analysis of Asimov's paper, you will submit a [Toulmin analysis](#) of his argument. The classroom discussion of Asimov's paper will also be based on your Toulmin analysis.

To develop your paper further, consider these points: 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. In addition, you must read *Lessons Learned from Lord Rayleigh ...*, *JCE* **1990**, 67, 925, and discuss the history of the scientific theory presented in this article--does it support or contradicts Asimov's

thesis and why? Finally, tell me if Asimov's essay has in any way changed your view of scientific research.

“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 soda and lemon juice, so take good notes!

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. The DA believes that the markings on the bottle are significant, and he wants them explained! 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. Be sure to explain the partial label on the bottle. Your statement of conclusions should be organized using a Toulmin analysis.

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.