

# Syllabus

**Course:** CH 220.2 Methods in Chemical Research

**Semester:** Fall, 2010

**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 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:** 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.

**Texts:** Beall & Trimbur, *A Short Guide to Reading and Writing About Chemistry*, 2nd Ed, Longman, 2001. ISBN 0-321-07844-6.

\*\* You will read and outline the first chapter of *A Short Guide to Reading and Writing About Chemistry*.

D. C. Harris, *Quantitative Chemical Analysis*, 6th Ed, Freeman, 1999.

\*\* You will read and outline parts of 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.

\*\* Small groups will present a review of selected EXCEL functions

**Other Resources:** You will write reactions to these essays or videos.

[I. Asimov, The Relativity of Wrong](http://hermiene.net/essays-trans/relativity_of_wrong.html), *The Skeptical Inquirer*, Vol. 14 No. 1, Fall 1989

[http://hermiene.net/essays-trans/relativity\\_of\\_wrong.html](http://hermiene.net/essays-trans/relativity_of_wrong.html)

I. Asimov, **Pure & Impure: The Interplay of Science & Technology** *Saturday Review*, 6 (June 9, 1979)

G.F. Martins, **Why the Daniell Cell Works**, *Journal of Chemical Education* 1990, 67 (6), p 482.

S. O. Russo and G. I. H. Hanania **Ferrimyoglobin-fluoride: An undergraduate kinetics**

**experiment** *J. Chem. Educ.*, 1990, 67 (4), p 352

C. Salter and D. L. Langhus **The Chemistry of Swimming Pool Maintenance** *J. Chem. Educ.*, 2007, 84 (7), p 1124

R. Persig *Zen and the Art of Motorcycle Maintenance* Chapter 9 (Induction and Deduction)

["Now we follow the Yellowstone Valley right across Montana."](#)

[James Burke :Connections, Episode 7, "The Long Chain"](#) www.youtube.com,, JamesBurkeWeb

[Phillip Morrison Ring of Truth, Episode 2 "Change"](#) www.viddler.com View the first half of the episode (you can stop when you see bicycles!)

[Ira Remsen on Copper and Nitric Acid,](#)

[http://www.angelo.edu/faculty/kboudrea/demos/copper\\_HNO3/Cu\\_HNO3.htm](http://www.angelo.edu/faculty/kboudrea/demos/copper_HNO3/Cu_HNO3.htm)

**Attendance:** Every Wednesday in either CHS 207 or CHS 209. 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.

Clipboard assignment	5%
Spreadsheet Assignments	5%
Two <a href="#">lab reports</a>	20%
Writing journal	20%
Outline and Reaction paper to Asimov's "Pure & Impure"	15%
Outline and Reaction paper to Asimov's "Relativity of Wrong"	15%
"Forensics" letter	5%
"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      Wed Sept 1  
Introductory writing activities [cubing1](#) [cubing2](#)  
Overview of laptops and computer programs:  
Introduction to MSWord, PCModel, ChemDraw. Moving charts and structures to documents.  
[Clipboard assignment and Excel Functions.](#)  
[Receive writing assignments from Asimov's essays and letters from Aunt Gladys.](#)

- Week 2      Wed Sept 8  
Introductory reading activities: Toulmin analysis  
Introduction to research problems
- Week 3      Wed Sept 15  
**DUE:** group reports on Excel Function (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.)  
Receive "Gaussian Distribution" and "Errors in Measurements and their effect on Data Sets"
- Week 4      Wed Sept 22  
**DUE : Clipboard Assignment**  
Group work on "Gaussian Distribution" and "Errors in Measurements and their effect on Data Sets"
- Week 5      Wed Sept 29  
Synthesis      Working Problems Backwards: Circles, Relative Humidity, Organic [water vapor data](#)
- Week 6      Wed Oct 6  
Induction.      **Class Discussion of Asimov's essays** based on Toulmin analysis. Logical  
Descriptive Statistics using Excel.  
M&Ms and pennies  
**Due: Friday Oct 8 Writing Journal**
- Week 7      Wed Oct 13 (Fall break)  
Introduction to [Chemical Abstracts using SciFinder Scholar](#).  
Introduction to spectroscopy: Beer's Law.  
**Lab experiment: Copper sulfate experiment using Ocean Optics spectrometers.**  
[Directions for Copper sulfate experiment.](#)  
[\(lab report template\)](#)
- Week 8      Wed Oct 20  
[Complete Copper sulfate experiment, analyze and identify unknowns.](#)
- Week 9      Wed Oct 27  
  
**Receive: Statistical Significance Testing: The t test. The F test.**

- Week 10      Wed Nov 3  
**DUE Copper unknown lab report.**  
 Group work on The t test. The F test.
- Week 11      Wed Nov 10  
**Lab report: pH titration experiment.**  
 Titration of lemon juice, and cola. (Write Aunt Gladys a letter.)  
 "Forensics" test on unknown salt. (Write letter to defense lawyers  
 explaining results.)  
Directions for titration experiment  
(titration spreadsheet)  
(lab report template) Be sure **one** graph contains **all three** titration curves!
- Week 12      Wed Nov 17  
 Complete titrations
- Week 13      Wed Nov 24 (Thanksgiving, no class)
- Week 14      Wed Dec 1  
 Discussion of Writing Journals  
**DUE Final draft of Asimov papers, pH titration lab report.**
- Week 15      Wed Dec 8  
**Read out loud and turn in Aunt Gladys letters. Assessment. DUE Writing journal.**

**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.

**The Writing Journal:** A **bound notebook** of the type used for laboratories must be used for you writing journal. I encourage you to write in the journal by hand, but I must be able to read your writing!

**Here are the Assignments for your writing journal:**

- 1) **Outlines** Beall & Trimbur **Chapter 1: The Basics** do Exercises 1, 2, 3 on page 12. Models of Acid-base chemistry in your General Chemistry textbook and in D.C. Harris. Contrast the two descriptions you outline.  
 Chapter 3, **Experimental Error**, sections 4, 5 D.C. Harris and answer essay

problems 8, 9, 11

Chapter 4, **Statistics** sections 2,3,4 D.C. Harris and answer problems, 1,2, 8, 9, 10, 13, 17.

Chapter 5, **Calibration Methods** sections 1, 2 D.C. Harris and answer problems 5, 6.

2) Take notes on the **SciFinder Scholar** tutorial and then do the exercise on my web site. Record your results in your journal.

3) Write down your **Reaction to the Resources Materials**. The questions will help you focus your reflection.

Remsen: What does Remsen suggest students learn in a laboratory that they can't learn elsewhere? Describe an experience you had, like Remsen's, where you learned something by experience or observation that you might not have learned as well by reading a book.

Persig: What claim is Persig making about science and the scientific method? What does Persig mean by "hierarchies"? Would he agree with Asimov's ideas about models of science? How often do you use induction and deduction in your science courses, lab or lecture? in your courses outside science?

Martins: Is Martins talking about just the Daniell cell alone? What is Martins' claim in his paper? How has his paper changed your view of batteries? of redox reactions?

Russo & Hanania: What sort of experiments are proposed in this paper; that is, exactly what will be measured? What claim do R&H make about the insight their lab experiment provides to the students who do it? How has their paper changed your understanding of the connection between thermodynamics and kinetics?

Salter & Langhus: What claim do S&L make about the role of balanced pH in pool chemistry? How has this paper changed your view of acid-base chemistry? What area of "everyday chemistry" would you like to know more about, and why?

Morrison: Which experiments in the video did you find most instructive and exciting? What claim does Morrison make about the connection between conservation of mass and atomic theory? Historically, what experiments were important in establishing conservation of matter?

Burke: What claim does Burke make how progress in science and technology takes place? Do you think he would agree with Asimov's view of the interplay of science & technology? What is the "Long Chain"? What plastics do you use in your everyday consumption of commercial products?

4) **Describe your experiences** with the demonstrations on silver chemistry, copper chemistry, and electrochemistry.

5) Answer [questions 13-32 from the original writing activity](#).

**Reaction papers to Asimov essays:** You will receive two essays by Isaac Asimov, famous science fiction writer.

*Pure and Impure: the Interplay of Science and Technology.* 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, find an example of an interaction between science and technology

that has taken place since Asimov wrote this essay. Extra credit if the science involved is chemistry.

*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 contradict 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.