Syllabus

Course: CH 220.2  Methods in Chemical Research

Semester: Fall, 2005

Professor: Carl Salter
Collier 228     Phone: 610-625-7920     email: csalter@chem.moravian.edu


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.

**Catalog Description:** An introduction to the use of the computer in chemical experimentation and research. The use of spreadsheets and statistical programs to solve problems in chemical equilibrium 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:** The goal of this course is to 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. The production of well-written chemical manuscripts with charts, tables, and chemical drawings is a high priority of this class. The bulk of your grade in this course is determined by the documents that you submit; these documents will be evaluated on writing and presentation of data.

**Attendance:** Because this class meets only on Wednesday afternoons, 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 largely by the writing assignments of the course.

- Five lab reports 40%
- Writing journal 20%
- Spreadsheet portfolio 20%
Reaction paper to Asimov essay 10%
Three “Dear Aunt Gladys” letters 10%

**Tentative Schedule:**

Week 1  Aug 31
Introduction to Statistics thru Guided Inquiry, pgs 1-7
*M&M experiment.* (lab report using template LR1)

Week 2  Sept 7  Read Chapter 3, Harris
Statistics Guided Inquiry pgs 8-19
Introduction to EXCEL Statistical functions. Descriptive Statistics.

Week 3  Sept 14  Read Chapter 4, Harris, sections 1,2,3,6. The t, F and Q tests.
*Histogram* of penny masses: Weigh pennies and make a histogram using both Excel and R!
Finish Statistics Guided Inquiry

Week 4  Sept 21  Read Chapter 5, sections 1,2 Harris.
Linear regression.
Introduction to spectroscopy
*Copper sulfate experiment* using Spectronic 20s. (lab report using template LR2)

**Turn in M&M lab report**

Week 5  Sept 28  Read Chapter 6, section 1-5, Harris.
Introduction to Solver.  **Reaction to Asimov paper due Friday Sept 30**

Week 6  Oct 5  
"pH titration experiment. (lab report LR3)"
"Forensics" test on unknown salt. (letter)

Week 7  Oct 12  
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 19  
Introduction to *Chemical Abstracts using SciFinder Scholar.*
Introduction to the Science Citation Index.
**Turn in "Forensics letter"**

Week 9  Oct 26
Real-time data acquisition: Kinetics of Luminescence Decay (lab report LR4)

Week 10 Nov 2
Real-time data acquisition: Kinetics of Fe(III) reduction by S$_2$O$_3^{-2}$ (lab report LR5)

Week 11 Nov 9
Lab report workshop.
Submit portfolio for review.

Week 12 Nov 16
Spectroscopy of pH indicators

Nov 23 Thanksgiving Break NO CLASS

Week 13 Nov 30
Complete and submit portfolio.

Week 14 Dec 7
Turn in “Aunt Gladys” letters. Submit remaining Lab reports.

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

**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 your quant book by Harris.
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 or Carl Salter.

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 or Carl Salter.

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**The Spreadsheet Portfolio:**

Must be submitted on a flash drive (thumb drive).

Chapter 3 Problems 14, 15, 22.

Chapter 4 Exercises A, B, E, F, Problems 6, 7, 15, 16, 18.

Chapter 5 Problems 1, 2, 3, 4, 9, 10, 14

Chapter 6 Problems 14, 16, 22, 30

DO NOT  have files from other classes on the flash drive you turn in as your portfolio.

DO NOT  have any subdirectories.

DO NOT  use excessively long file names.

DO NOT  use active links to place Excel charts in Word documents.

To move charts into a document use Copy and Paste and press CTRL-SHIFT-F9 to reduce the amount of disk space taken up by the chart.

Each chapter’s homework 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.

I require you to submit your portfolio for an initial review at the end of week 11. YOU ARE STRONGLY ENCOURAGED TO SUBMIT YOUR DEVELOPING PORTFOLIO TO THE INSTRUCTOR AT VARIOUS TIMES DURING THE COURSE FOR CRITICISM AND SUGGESTIONS!

**Lab Report:** 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 tartrazine bleaching 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!

**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; if you disagree with Asimov, pick one example and tell me why you find it unconvincing. Discuss another scientific theory, not used by Asimov but mentioned in chapter 4 of your quant textbook, and why you think it supports or contradicts Asimov’s thesis. Finally, tell me if Asimov’s assay 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 particular, you’ll be writing to her about the lemon/potato experiment and the kitchen experiment, so take good notes!