
CHM 305
RESEARCH METHODS IN CHEMISTRY

Fall 2016

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Learning Objectives:

- 1) To use the primary and secondary literature to find chemical information,
- 2) To consider situations that could be ethically ambiguous and how to approach them,
- 3) To learn how to extract information from a research paper,
- 4) To write a research proposal and present it, and
- 5) To learn how to maintain a laboratory notebook.

Materials: All materials are located at <http://science.marshall.edu/castella/c305.html>, in Blackboard, or at http://muwww-new.marshall.edu/chemistry/request_for_capstone_research_advisor.pdf.

Attendance: Attendance is required for all class meetings. While it is possible to make up the missed tutorial in the chemistry literature portion of the class, even excused absences will cause problems in the ethics portion of the class because there is only one meeting per topic. Thus, it will be impossible for you to take away from the class what we hope you will learn if you miss classes.

Grading: There are 5 tasks/assignments in this course:

1. writing a proposal,
2. presenting the proposal to the class twice,
3. oral presentation of a scientific research publication
4. taking the CITI ethics course,
5. writing the ethics paper, and
6. participating in the ethics discussion.

The two written assignments (1 and 5) will be graded. Each missed assignment from items 2, 3, 4, and 6 will result in a one letter grade reduction in your course grade. Every second unexcused absence will result in a letter grade reduction. Graded assignments turned in late will have their grades **reduced by one letter grade per day**.

There are due dates for several ungraded assignments and there will be consequences for turning them in late.

- 1) If assignments to be turned in for peer review arrive after the designated date and time, they will not be sent out for review, but will be graded as if they were.
- 2) If your peer review of an assignment arrives after the due date and time, the grade on your paper will be reduced by one-half letter grade for each 12 hour increment.
- 3) For the CITI ethics course, your course grade will be reduced by one-half grade per 24 hour period after the due/date and time.

The course grade will be determined by averaging your proposal and ethics paper grades minus the deductions just described.

Preface

When a research chemist develops an idea for an experiment, that person will almost always check the literature to find if someone else has already attempted it or something closely related. If not, information about how to go about achieving the researcher's goal will almost always be found there. A number of databases have

been compiled to facilitate such searches. Experience will teach you to view each search from several angles, but at the beginning it is important to simply learn what kinds of information are stored in each database and how to retrieve it.

You will do most of your searches on SciFinder Scholar® or PubMed®. After a tutorial, you will learn to search the primary chemical literature by working with one faculty member on a project relating to her or his research.

The Proposal

This part of the course will have three components:

- 1) You will use the MUOnline (Blackboard) course page to examine the profiles of faculty members to determine which projects might interest you as a Capstone project, if you plan to do research. *If you plan to do an internship, select a project that seems interesting to you, but it **must** come from a chemistry department faculty member.*
- 2) You should meet with 3 faculty members to discuss their research with them. This is optional, but recommended. You **must** meet with the person you select and get his or her signature on the Capstone advisor form linked on the materials section of this syllabus. *If you do not plan a research project, you **must** choose a chemistry faculty member as a mentor, otherwise there is no restriction.* Be sure the faculty member you select is willing to mentor you before listing them as your first choice.
- 3) You will select one project and write a short research proposal describing the project as if you would be doing it. The proposal must have at least 5 relevant references from the primary literature. If you are currently working on a project, the project may have a brief description of preliminary results, but most of the proposal must be about what you plan to do.
- 4) The proposal should be 4–6 pages long, employing Times New Roman 12 point font or Arial 10 point font with 1" margins. It should be double spaced with no extra space between paragraphs or section headers. References do not count towards the page total. You may include figures, but use the 'wrap-around' function in your word processor to minimize the space it takes up. Formatting of references should follow [ACS Style](#).
- 5) You must give a draft of the paper for your advisor to comment on at least 5 days prior to the due date for the assignment (October 12). The advisor may ask for it earlier than this. The proposal must be reviewed and signed by your faculty mentor and will be read by a student in class before it is turned in for final grading. The faculty signature should be in the form of an email verifying that s/he has read at least one draft of the proposal and provided comments. **Failure to provide an email will result in a one letter grade reduction on the proposal.**
- 6) At the end of the course, you will make two 10–15 minute presentations on your proposed research. The first will be critiqued by two faculty members and the class. You will have a week to fix the problems and present it again.

Scientific Research Publication

Students will be required to present an assigned research paper. The research paper will be assigned by your CHM 305 faculty mentor to the class.. You will discuss the purpose of the work, the design of the research project used and its operational principles, the data presented, and the conclusions reached. This research paper will be related to the students' research proposal.

Plan the presentation for about 5 to 8 minutes with 2 minutes for questions. This means about 10 slides. The presentation should be organized as follows:

- 1) Describe the chemical problem, why the analysis is needed and the motivation for the work,
- 2) Present details of the measurement method (how everything is fit together and how it works)
- 3) Present and discuss the measurements made and the data presented
- 4) Review the conclusions from the paper and
- 5) Offer your perspectives about what the future holds for the measurement method and what chemical or biochemical problems it could be used to help solve.

As you read through the paper, it may be necessary for you to obtain other literature in order to understand and explain the work presented. Also, note that when you find the article on the journal website, there is very often is supplemental information that you should access and use in your presentation. At the end of your presentation, list the citations you used.

Laboratory Notebooks

There will be one class meeting to discuss the proper construction of a laboratory notebook.

Literature Search

On one or two occasions we will get together to discuss various types of literature references that you may have to make use of during your careers. These include (at a minimum) *Chemical Abstracts*, *PubMed*, *Beilstein*, the “Comprehensive,” “Advances in,” “Progress in,” and “Dictionary of” book series, and the *Kirk-Othmer Encyclopedia of Chemical Technology*. There will also be a demonstration of the online *Science Citation Index*. These books and book series constitute major review sources of information which can be very difficult to track down through the primary literature. We will discuss how to read a scientific paper in one of these meetings.

Ethics

Finally, this course has an ethics component. There are several different projects in which you will participate.

- 1) You will take and pass the CITI Chemistry Research Ethics course. A link to the instructions to the course appears on the CHM 305 course website. The course will take a few hours to complete, so don't wait until the end of the course to try it. You must email me a .pdf copy of the completion certificate when you are done. In rare cases, students have been unable to download the certificate. In this event, take a screenshot and mail it to me showing that you passed.
- 2) You will be given several written scenarios to read and consider. During the week of September 19, we will meet in small groups with another faculty member. You will be asked to describe how you would behave in such a scenario and then we will tell you what we would do. Ethics discussions require 2 hours, there will be several two hour blocks for you to choose from, but each group is limited to four students.
- 3) In early October, you will write a paper discussing an ethical problem presented in a C&E News article: <https://pubs.acs.org/cen/science/89/8932sci1.html>. We will get together for a class period to discuss the article and go through the papers as a group. Students will read another student's paper before they are graded. You should incorporate information from the peer reader and group discussion into your paper, if it is appropriate. This is a formal paper and should be written as such. Your grade will be based on your use of English and force and logic of argument, not on whether the argument is “right” or “wrong.”
 - a. The paper is to be at least 3 pages long and be double-spaced with 1 inch margins in either 12 point Times New Roman or 10 point Ariel font. There should be no extra spacing following paragraphs and should have only your name at the top of the paper.
 - b. There are 3 primary actors discussed: the student, her advisor/mentor, the ‘university’ (which comprises all persons of authority above the advisor as a group). You are to read the article and as much supplementary information as is necessary to make a determination of who acted least ethically in this series of events.
 - c. In the paper, you are to explain why the actor you chose behaved most offensively and to do that you must discuss why it is worse than the other two actors. Although it is your opinion, this is a formal paper and you should not use personal pronouns. For details on how to write a formal opinion, you might read op-ed pieces in a major newspaper like the NY Times or Washington Post.
 - d. The paper must have at least two references beyond the article. If you assert things as true they must either be in the article or you must have a reference. This includes the sequence of events. That is, if you assert one thing causes a second, the chronology must be correct. Internet references are acceptable for this paper.

In all cases, ethics discussions are confidential.

Progress of the Course

Dates	Guide
Wednesday Aug. 24	Introduction – How to pick a research advisor and topic
Wednesday Aug. 31	How to use SciFinder® and PubMed® & sources and kinds of literature
Wednesday Sept. 7	*
Wednesday Sept. 14	A Brief History of Ethics
Sept. 19, 21, 23	Ethics vignettes discussed all week (3-4 students per session)
Wednesday Sept. 28	*
Wednesday Oct. 5	How to write a laboratory notebook
Oct. 10, 12, 14	Discussion of issues raised in ethics paper (1/3 of class each day)
Wednesday Oct. 19	Making a professional presentation
Wednesday Oct. 26	Presenting your assigned scientific publication
Wednesday Nov. 2	Presenting your assigned scientific publication
Wednesday Nov. 9	Presenting your assigned scientific publication
Nov. 14, 16, 18	Research proposals presented all week (must attend at least 2 sessions)
Nov. 27	*
Wednesday Nov. 30	Presenting your Research Proposal makeup
Wednesday Dec. 7	*

*There is no class meeting on these days under normal circumstances. Should campus be closed on the date of a class meeting, these days will be used in place of the missed day.

Assignment Deadlines

September 7 – Advisor selection (turn in paper forms)

October 5 – Draft Ethics paper (submitted electronically in *MU online/Course content* as a Word file by noon)

October 12 – Draft research proposal and peer review of ethics paper (submitted electronically in *MU online/Course content* as Word file by 5:00 p.m.)

November 9 – Final draft of research proposal (submitted electronically in *MU online/Course content* as a Word file by 5:00 p.m.)

November 30 – Final draft of ethics paper (submitted electronically in *MU online/Course content* as a Word file by 5:00 p.m.)

December 7 – CITI Ethics course (certificate submitted by 5:00 p.m.)

Marshall University's policies regarding academic honesty, excused absences, sexual harassment, and disabled students may be found at http://www.marshall.edu/wpmu/academic-affairs/?page_id=802.

Three of the assignments for this class require you to be present and cannot be replicated because they involve group participation. Even with an excused absence, your grade will be reduced by a letter grade if you cannot make alternative arrangements with me.

The papers are due on the date indicated in the syllabus. Even if you have an excused absence, they will be counted as late if not turned in on time. Likewise, if an assignment falls on a day that is cancelled by the university (e.g. a snow day), it should be turned in on time.

Please turn off cell phone ringers before class. Failure to do so may result in you being removed from the room, even during an assignment.