

# SENIOR THESIS IN CHEMISTRY - CHEM 485 (3 CREDITS)

Spring Semester 2018

## INSTRUCTOR:

Greg Crouch, Fulmer 414, 335-8388, gcrouch@wsu.edu

Class Meeting: M/W/F 13:10-14:00 PM, Fulmer 432

Office Hours: by appointment

## PREREQUISITES:

Certified Majors in Chemistry; Senior Standing

## REQUIRED MATERIALS:

Microsoft Office 365, a chemistry drawing system, and a citation management system such as Endnote. These are freely available or available using our existing licenses.

## COURSE DESCRIPTION:

Chem 485 is the capstone course requirement for all chemistry majors (BA and BS) that culminates in the development a major work of scientific communication. This work can be rely upon a variety of media, including a written research thesis, a scientifically descriptive paper written for the lay audience, a poster or PowerPoint presentation, or a YouTube video. Alternate or combinations of media are acceptable with the permission of the instructor. Whichever form is selected, the topic of the work has to be approved by the course instructor during the first two weeks of the semester. Topics can range from undergraduate research in chemistry to scientific topics being debated in the news (climate change, GMOs, cell phones and cancer, etc.) For those students who participated in undergraduate research and chose a written thesis, the writing must conform to the American Chemistry Society-style guide. All topics must be clearly developed, widely researched, and well cited.

## COURSE OBJECTIVES

*To develop critical thinking skills through:*

- Developing a work of scientific evidence-based communication guided by iterative peer review. For example, if a written thesis is selected, a student would be expected to develop an outline then proceed through the typical first to final draft process with detail given to citations. For those making a video, storyboards or similar tool would be required to show process. All final projects will be assessed by the course instructor and peers to determine if the work uses appropriate style to clearly expresses complex topics based on acceptable scientific evidence. Several questions will be asked:
  - Does the topic relate to existing research or research problems?
  - Is the evidence cited valid?
  - What foundational work has been done by others (history, methods, techniques, prior approaches, etc.)?
  - Why it matters.
  - Does the work address ethical issues?

## LEARNING OUTCOMES.

The following table lists the expected learning outcomes, how those outcomes will be addressed in class, and how those outcomes will be evaluated for a course grade.

Students who complete this course will be able to:	The following course experiences will address this outcome:	This outcome will be evaluated by:
Search bibliographic and particularly chemical (formula, chemical	Developing competency using ChemDraw, SciFinder Scholar and	Satisfactory completion of a citation assignment within the second week.

structure, reaction properties, biological sequence) databases using modern search tools.	Endnote within the second week of class. Continued use and mastery of these tools throughout the course.	Ongoing review of literature references in developing thesis throughout the semester.
Understand how research is disseminated to the scientific and lay communities. Including the process of peer review.	Discuss the principles and procedures of the peer review process for manuscripts and proposals.	Presentation and discussion of scenarios.
Critically read and analyze scientific literature.	Learning to evaluate a peer reviewed publication for breadth. Reading to discover strengths and weaknesses in research design. Presenting a literature review in group setting.	Selection and approval of an appropriate thesis topic selection. Evaluation of a written outline, thesis, and final presentation based on the selected thesis topic.
Develop a project outline or other process tracking system and work collaboratively through at least two peer editing cycles and one instructor edit cycle in order to optimize organizational structure.	Completing a minimum of three cycles of editing using appropriate tools.	Ongoing evaluation of thesis development.
Discuss ethical and unethical examples of scientific research.	Evaluating well-known cases withdrawn publications Evaluate unsubstantiated claims made in the media.	Completing an ethics in research assignment. Presentation and discussion of scenarios.
Summarize a topic in a manner that is appropriate to the lay community.	Develop a one-page summary statement of the work in language appropriate for a non-specialist. Review and critique this summary within group cohort prior to submissions of summary.	Evaluation of the summary statement.
Develop a rubric to evaluate clarity and content.	Work as a class to develop a rubric that can be used to broadly and systematically evaluate the clarity and scope of the work.	Evaluation of rubric.
<i>Option Poster Presentation</i>		
Clearly and comfortably present a thesis poster to the faculty and students in the chemistry department.	This is the culmination of all skills learned during the course.	Evaluation of the poster clarity and the student's ability to answer questions related to the presentation.
<i>Option PowerPoint Presentation</i>		
Clearly and comfortably present a 10-minute thesis PowerPoint presentation in an open forum.	This is the culmination of all skills learned during the course.	Evaluation of the PowerPoint clarity and the student's ability to answer questions related to the presentation.
Students selecting other media as the basis for disseminating their work will be appropriately assessed.		

## GRADING SCHEME, WORK FLOW, AND EXPECTATIONS:

Course letter grades will be awarded based on the following semester assignments with 1000 points possible.

<b>Points possible</b>	<b>Due on week</b>	<b>Assignment title</b>	<b>Expectations</b>
50	1	Citation assignment	The student will be able to use SciFinder scholar to search an assigned topic. Grades will be based on the retrieval and citation of pertinent references.
50	2	Thesis topic selection	The student will select a thesis topic with approval of the course instructor. The thesis topic must be supported by at least five peer reviewed papers found using SciFinder Scholar and referenced using Endnote. Two of the five papers must be no older than 18 months in publication date. Based on this topic, the student will prepare a draft outline. This outline will be edited by the instructor and returned within five days to the student. Grades will be based on the retrieval and citation of pertinent references.
75	3	outline	The final outline will be completed and be made available on the course SharePoint collaboration site.
75	5	First draft	A first draft (or storyboard) will be submitted to the SharePoint site. The first draft must contain all references in appropriate Endnote format. All artwork will also be included. Document edits will be available within two weeks of submission. Grades will be based on quality of the draft including appropriate layout (introduction, body, results, discussion, conclusion)
75	8	Second draft	A revised and expanded draft will be submitted to the SharePoint site for editing. Document edits will be available within two weeks of submission. Grades will be based on how the student addressed the editorial comments from the first draft.
75	10	Presentation evaluation rubric	A jointly developed rubric will be submitted by the class as an aid in evaluating the work. The rubric will help students understand how create an assessment instrument that will provide structured feedback. This is a group assignment as all students will develop and use the same rubric. A class grade will be based on how effectively this rubric performs during use.
200	11	Final draft (collected as the Capstone assignment)	A final draft will be submitted. If the draft is in the form of a written thesis, it should be at least 10 pages (double spaced with 1" margins using 11 pt Times font) including figures and tables but not including references. The body of the thesis must follow: 1) an abstract, 2) an introduction to include enough background to place the thesis in appropriate context and include a discussion of experimental techniques, 3) a hypothesis, specific aim, or research question, 4) experiments or treatments (including controls), 5) results, including data analysis and/or structure identification if appropriate, and 6) conclusions. Grades will be based on how the student addressed the editorial comments from the second draft.
25	10	Lay audience first draft	A document that effectively distills scientifically complex idea to a lay audience. This may or may not be connected to the research thesis. For example, if the research thesis uses mass spectrometry as a tool to gather data, the lay paper may explore the role of mass spectrometry in society (airport screen for explosives). This draft will undergo two cycles of peer editing and describe the science in broadly understood language.
100	12-15	Lay audience final draft	The final draft will have undergone two cycles of instructor editing and will be submitted for grading. Grades will be based on instructor feedback and an in-class analysis.
200	12-15	Presentations	Presentations or other media will be presented from the 12 <sup>th</sup> to the 15 <sup>th</sup> weeks of the semester. PowerPoint presentations should be timed for 10 minutes with 5 minutes for questions. Videos should be no longer than 10 minutes in length. The evaluation rubric will be used by the audience to evaluate the presentation. Grades will be based on the quality of slides, clarity of oral presentation, understanding of the chemistry concepts involved, length of presentation, and quality of question responses.

75	1-15	Class participation (including scenarios)	Students are expected to participate in in-class discussions on topics relating to ethics, research misconduct, societal impact of research based on case studies from the current literature. Grades will be based on the level of participation.
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- Letter grades will be based on the following scale:

A	900	B	800	C	700	D	600
A-	885	B-	785	C-	685	F	below 600
B+	870	C+	770	D+	670		

## LECTURE SCHEDULE & TOPICS:

Thesis development is ongoing throughout the semester with the culmination of a poster or PowerPoint presentation. In class work coincides and reinforces this process. A tentative schedule is shown below that correlates the in class work and ongoing thesis development. Class participation is expected throughout the semester.

<b>Lecture</b>	<b>Topics</b>	<b>Thesis Timeline</b>	<b>Work Due</b>
Week 1	Searching the scientific literature; evaluating source validity and original research. Use of SciFinder Scholar and Endnote.	Select a topic and develop a bibliography	Citation assignment
Week 2	Refining searches; citations and research impact factors	Complete draft bibliography	Approved thesis topic and bibliography as described above.
Week 3	Responsible conduct in research	Complete draft outline	Thesis outline
Week 4	Publication ethics	Start first draft	Participation
Week 5	Research design (examples of good and bad)	Complete first draft of thesis	First draft of thesis
Week 6	Data interpretation (proper use of control experiments)	Develop thesis	
Week 7	The peer review process/retracted publications	Develop thesis	
Week 8	Case studies of science and the media/misuse of statistics	Complete second draft of thesis	Second draft of thesis
Week 9	Assessment – writing an evaluation rubric		
Week 10	PowerPoint slide and poster creation.	Poster Design PP presentation design	Rubric
Week 11	Communicating scientific research in simple language. (examples of good and bad).	Start final thesis, no lecture – class draft thesis presentation/critiques	Final thesis
Week 12	No lecture	PowerPoint presentation	Lay audience paper (lay language) Presentations
Week 13	No lecture	PowerPoint presentation	Presentations
Week 14	No lecture	PowerPoint presentation	Presentations
Week 15	No lecture	PowerPoint presentation Poster presentation	Presentations
Finals week		PowerPoint presentation (if needed)	

Evidence of Student Progress Towards Learning Goals: Course Learning Goal	Course Topics that Advance this Learning Goal	Method of Evaluation	Maps to WSU Learning Goals
<b>LG1: To locate, read, comprehend, and critique primary scientific literature</b>	Thesis development starting with topic selection to outline to finished presentation. Use of online search engines. Preparation of citations and use of EndNote.	Appropriate citations based on thesis topic, iterative editing in stages throughout the semester with the culmination of a thesis document	<ol style="list-style-type: none"> <li>1. Critical and Creative thinking               <ol style="list-style-type: none"> <li>1.1 Define, analyze, and solve problems.</li> <li>1.2 Integrate and synthesize knowledge from multiple sources.</li> </ol> </li> <li>3. Scientific Literacy               <ol style="list-style-type: none"> <li>3.1 Identify scientific issues underlying global, national, local and personal decisions and communicate positions that are scientifically and technologically informed.</li> <li>3.2 Evaluate the quality of scientific and health-related information on the basis of its source and the methods used to generate it.</li> <li>3.3 Pose and evaluate arguments based on evidence and apply conclusions from such arguments appropriately.</li> </ol> </li> <li>4. Information Literacy               <ol style="list-style-type: none"> <li>4.1 Determine the extent and type of information needed</li> <li>4.2 Implement well-designed search strategies.</li> <li>4.3 Access information effectively and efficiently from multiple sources.</li> <li>4.4 Assess credibility and applicability of information sources.</li> <li>4.5 Use information to accomplish a specific purpose.</li> </ol> </li> </ol>
<b>LG3: Integrate and synthesize information from peer reviewed sources into a coherent thesis</b>	Thesis	Grading of thesis for breadth of content, logical coherence, and writing quality.	<ol style="list-style-type: none"> <li>1. Critical and Creative Thinking               <ol style="list-style-type: none"> <li>1.1 Define, analyze, and solve problems.</li> <li>1.2. Integrate and synthesize knowledge from multiple sources.</li> <li>1.6 Combine and synthesize existing ideas, images, or expertise in original ways.</li> </ol> </li> <li>3. Scientific Literacy               <ol style="list-style-type: none"> <li>3.1 Identify scientific issues underlying global, national, local and personal decisions and communicate positions that are scientifically and technologically informed.</li> <li>3.2 Evaluate the quality of scientific and health-related information on the basis of its source and the methods used to generate it.</li> <li>3.3 Pose and evaluate arguments based on evidence and apply conclusions from such arguments appropriately.</li> </ol> </li> <li>5. Communication               <ol style="list-style-type: none"> <li>5.2 Tailor message to the audience.</li> <li>5.3 Express concepts, propositions, and beliefs in coherent, concise and technically correct form.</li> </ol> </li> </ol>
<b>LG3: Prepare group evaluation rubric</b>	Develop rubric to be used to evaluate PowerPoint Presentation OR poster OR other	Rubric will be used by audience members during the presentations and posters. Audience members will be asked to judge the completeness of the rubric.	<ol style="list-style-type: none"> <li>2. Quantitative Reasoning               <ol style="list-style-type: none"> <li>2.5 Identify and evaluate important assumptions in estimation, modeling, and data analysis.</li> </ol> </li> <li>3. Scientific Literacy               <ol style="list-style-type: none"> <li>3.2 Evaluate the quality of scientific and health-related information on the basis of its source and the methods used to generate it.</li> <li>3.3 Pose and evaluate arguments based on evidence and apply conclusions from such arguments appropriately.</li> </ol> </li> </ol>
<b>LG4: Prepare and present a PowerPoint or poster</b>	PowerPoint Presentation OR poster	1. Evaluation of	<ol style="list-style-type: none"> <li>1. Critical and Creative Thinking               <ol style="list-style-type: none"> <li>1.6 Combine and synthesize existing ideas, images, or expertise in original ways.</li> </ol> </li> </ol>

<p><b>poster presentation of a research thesis</b></p>		<p>PowerPoint or Poster 2. Responses to questions</p>	<p>1.7 Think, react, and work in an imaginative way characterized by a high degree of innovation, divergent thinking, and risk taking 2. Quantitative Reasoning 2.1 Explain information presented in mathematical forms (e.g., equations, graphs, diagrams, tables, and words). 2.4 Make judgments and draw appropriate conclusions based on the quantitative analysis of data, while recognizing the limits of this analysis. 2.6 Express quantitative evidence in support of the argument or purpose of work (in terms of what evidence is used and how it is formatted, presented, and contextualized). 5. Communication 5.3 Express concepts, propositions, and beliefs in coherent, concise and technically correct form. 5.5 Speak with comfort in front of groups.</p>
<p><b>LG4: Write summary in language appropriate for the general public</b></p>	<p>Written assignments</p>	<p>1. Group discussion 2. Evaluation of written summary.</p>	<p>3. Scientific Literacy 3.2 Evaluate the quality of scientific and health-related information on the basis of its source and the methods used to generate it. 5. Communication 5.2 Tailor message to the audience. 5.3 Express concepts, propositions, and beliefs in coherent, concise and technically correct form.</p>
<p><b>LG5: Identify the fundamental concepts behind publication and research ethics, peer review, responsible conduct of research, and the rules for scientists serving on government review panels.</b></p>	<p>In class activities related to ethics, misconduct, and research regulations</p>	<p>Participation in discussions about case studies and other provided materials.</p>	<p>1. Critical and Creative Thinking 1.4 Understand how one thinks, reasons, and makes value judgments, including ethical and aesthetic judgments 3. Scientific Literacy 3.3 Pose and evaluate arguments based on evidence and apply conclusions from such arguments appropriately. 4. Information Literacy 4.6 Access and use information ethically and legally.</p>
<p><b>LG6: Effectively communicate science to peers in both written and oral formats</b></p>	<p>1. PowerPoint or poster presentation in public arena. 2. Thesis summary paper 3. Critiques</p>	<p>1. Evaluation of ability to answer questions following presentation. 2. Thesis summary evaluation. 3. Evaluation of presentation using rubric.</p>	<p>1. Critical and Creative Thinking 1.1 Define, analyze, and solve problems. 5. Communication 5.3. Express concepts, propositions, and beliefs in coherent, concise and technically correct form. 7. Depth, breadth, and Integration of learning 7.2 By showing a depth of knowledge within the chosen academic field of study based on integration of its history, core methods, techniques, vocabulary, and unsolved problems</p>

## STUDENTS WITH DISABILITIES:

Reasonable accommodations are available for students with a documented disability. If you have a disability and need accommodations to fully participate in this class, please either visit or call the Access Center (Washington Building 217; 509-335-3417) to schedule an appointment with an Access Advisor. All accommodations MUST be approved through the Access Center.

## ACADEMIC INTEGRITY:

Academic integrity will be strongly enforced in this course. Any student caught cheating on any assignment will be given an F grade for the course and will be reported to the Office Student Standards and Accountability. Cheating is defined in the Standards for

Student Conduct WAC 504-26-010 (3). It is strongly suggested that you read and understand these definitions:  
<http://conduct.wsu.edu/default.asp?PageID=338>

## SAFETY STATEMENT:

The following websites detail the WSU Safety policy and plan. The content of these sites will be discussed on the first day of the term

- <http://safetyplan.wsu.edu>
- <http://alert.wsu.edu>
- <http://oem.wsu.edu>