

**Introduction to Chemical Research****CHEM 294; Spring 2015****Course Name:** CHEM 294: Introduction to Chemical Research, 2 credits**Prerequisites:** CHEM 212 or CHEM 321**Location:****Meeting Time:** 1 hr lecture, 3 hrs lab per week**Instructor:** Dr. Sarah Hayes**Office:** Reichardt 188**Phone:** 907-474-7118**Email:** s.hayes@alaska.edu**Office Hours:** By appointment, or drop by when my door is open**Blackboard Link:** <http://classes.uaf.edu>**Course website:** <http://chemresearch.community.uaf.edu> **Now Active, but Developing****Required materials:** On Being A Scientist: A Guide to Responsible Conduct in Research, 3rd ed.
The National Academies Press: Washington DC. ISBN: 978-0-309-11970-2

Catalogue Course Description: Scientific research is creative and engaging when properly planned and executed. This course introduces students to the process of planning and executing a research project. We will begin with an idea, review primary literature, brainstorm project ideas, pose a testable hypothesis, plan experiments, and execute a small research project.

Pre-requisites: CHEM 212 or CHEM 321

Expanded Course Description: Experience first hand how creative and engaging scientific research can be. In this course, mid-level chemistry majors will be introduced to the process of planning a research project. Students in this course will begin with an idea, then review primary literature to survey ongoing research in that field, brainstorm project ideas, pose a testable hypothesis, then plan an experiment and execute a small research project. The emphasis of this course is to increase research readiness for students entering CHEM 488 by focusing on the research planning skills, although students will also have supervised hands-on lab experience. Students will have individualized support from graduate students enrolled in CHEM 694 Research Mentoring throughout the semester as they discover the research process.

Instructional Methods: Undergraduate students will be paired with graduate student mentors enrolled in CHEM 694 Research Mentoring to develop and execute a research project. The emphasis of this course is on planning a research project through mentoring interactions with graduate students and faculty. Lectures will provide information on topics relevant to project planning while the actual planning and execution will occur during lab time.

Course Goals: Students will learn and practice the process of developing an idea into a testable hypothesis and planning a research project to address their hypothesis. At the conclusion of this course, students will present their research plan and the results of preliminary investigations at the Department

Introduction to Chemical Research
CHEM 294; Spring 2015



Poster Session as well as have a research proposal to potentially submit for funding to continue their project.

Student Learning Outcomes: Students will be prepared to plan and execute their future research projects. Upon successful completion of this course, students will:

- Complete all required safety trainings to work in labs in the UAF chemistry department.
- Propose an area of research, perform a literature review, and pose a testable hypothesis.
- Develop a realistic, statistically valid research plan.
- Execute preliminary experiments to provide preliminary data or proof of concept.
- Create a poster to share the research project and present at the department poster session.
- Identify appropriate funding sources and write a proposal.

Example Student Projects: Student project topics will vary based on the expertise of graduate students enrolled in CHEM 694 and vary each semester.

- Investigation of toxic metals present in mine tailings as a function of particle size, which affects transportability, solubility, and bioaccessibility. This would involve drying soils, size separation using sieves and settling rate in water. Each size fraction could then be analyzed for elemental composition using bulk X-ray Fluorescence by preparing a pressed pellet.
- Investigation of chemical moieties present in size fractionated aerosol particulate samples by acid digestion and subsequent analysis by Inductively Coupled Plasma- Mass Spectrometry. Determining the size fractions metals are associated with is a critical component of determining the distance traveled by particulate matter.

Course Evaluation:

There are **1000 total points available** in this class. Grades are assigned as follows: 1000-900 A, 900-800 B, 800-700 C, etc.

Assignment	Points
Completion of safety training	50
Proposal format, proposal topic	30
Lab rotation summaries	20
Project ideas	100
Literature review	100
Research Project plan	100
Revised Research Project plan	50
Research proposal drafts	150
Proposal peer reviews	50
Research Proposal II	50
Poster	100
Mentor and instructor evaluation	100
Final research proposal	100
Total	1000

Safety training- Students will perform all safety trainings required by the Department of Chemistry.

Lab shadowing summaries- Undergraduate students will participate in shadowing opportunities with graduate students. The students will then write a summary of their experiences.

Introduction to Chemical Research CHEM 294; Spring 2015



Research plan- Students will progressively work toward developing a research plan. Assignments will include a research area, research topic, literature review, research plan, background, research proposal, peer review of two other proposals, proposal revisions, and a poster.

Research Proposal- Students will generate and revise an original research proposal with preliminary data that can be submitted for funding to continue the research project.

Poster- Students will present their research plan and the preliminary results at the Department Poster Session and Potluck.

Mentor and instructor evaluation- Students will have periodic feedback on their progress in their research progress with their mentor and instructor.

Course Policies:

Classroom Behavior and Late work - Students are expected to conduct themselves in a professional manner at all times. Disrespect of the classroom learning environment, instructors or mentors, and fellow students will not be tolerated! Late work is accepted at a 10% per day reduction of the points possible. This is in an effort to keep the entire class moving through the projects efficiently. Continued attendance to class indicates each student agrees to the policies set forth in this syllabus.

Honor code and Academic integrity- Students are expected to conduct themselves in accordance with the UAF Honor code. The Chemistry Department policy states: *Any student caught cheating will be assigned a course grade of F. The students' academic advisor will be notified of this failing grade and the student will not be allowed to drop the course.*

Disability Services- I will work with the Office of Disabilities Services (208 Whitaker Bldg, 474-5655) to provide reasonable accommodation to students with disabilities. It is the student's responsibility to make an appointment with me to discuss appropriate accommodations within the first two weeks of the first class meeting. A letter from disabilities services must be provided for discussion at that time.

Introduction to Chemical Research
CHEM 294; Spring 2015



Week	Lecture	Reading	Items due 288	Items due 686
1-15	Introduction to course, Research interests			Lecture sign-up
	Graduate student overviews 288- Safety training, 686- Mentor training			Research introduction, lab rotation ideas Mentoring Training
1-19	The process of planning research	OBS, Ch. 1-2	Research topic	Lab rotation plan
	Safety in a research lab	OBS, Ch. 8	All safety trainings complete	
1-26	Funding your project			
	Lab rotations			
2-2	Keeping Records	Dunnivant, 2004, Ch 1. <i>"Record keeping"</i>	Proposal format	
	Lab rotations			
2-9	Surveying Primary Literature		Rotations summaries	Rotation self reflection
	Literature review			
2-16	Stating a testable hypothesis	Sneider, 2009, Ch 5. <i>"Questions Drive Research"</i>		
	Literature review			
2-23	Experimental design	Cox, 1958, <i>"Planning of Experiments"</i>	Project ideas	
	Brainstorming project ideas			
3-2	IRB and compliance	OBS, Ch. 7 UAF IRB website	Literature review	Brainstorming notes
	Project planning			
3-9	Writing a research plan		Project plan	Literature review reviews
	288: Write research plan; 686: review project plans			Project plan reviews, mentee evaluations
3-16	Spring Break			
3-23	What is science	Sneider, 2009, Ch 2.	Revised project plans	

**Introduction to Chemical Research
CHEM 294; Spring 2015**



		“What is Science?”		
	Reviewing project plans w faculty			
3-30	Statistical treatment of data	Dunnivant, 2004, Ch 2. <i>“Statistical Analysis of Data”</i>	Research Proposal Draft 1	
	Research Project			
4-6	Making an Effective Poster	Presentation Zen	Research Proposal Peer Reviews	Research Proposal Reviews (mentees)
	Research Project			
4-13	Ethics in Research	OBS, Ch. 3-6; 9-12	Poster Draft 1	
	Research project			
4-20	Science and Society	OBS, Ch. 13	Revised Proposals Draft 2	
	Research project			
4-27	Careers in Science	Tobias, Ch 1.	Poster Draft 2	Proposal Reviews (non-mentees)
	Exit Interviews, poster practice		Mentor evaluations	Mentee evaluations, self evaluations
4-30	Students present at department potluck			
Finals			Final research proposal (due 5-8)	

Key to readings (* pertinent excerpts available on course website)

OBS- On Being A Scientist: A Guide to Responsible Conduct in Research, 3rd ed. The National Academies Press: Washington DC.

* Dunnivant, F.M. Environmental Laboratory Exercises for Instrumental Analysis and Environmental Chemistry. Wiley-Interscience: New Jersey, 2004.

* Snieder, R., Lerner, K. The Art of Being a Scientist: A Guide for Graduate Students and their Mentors. Cambridge University Press: New York, 2009.

* Cox, D.R. Planning of Experiments. Wiley and Sons: London, 1958.

* Reynolds, G. Presentation Zen: Simple Ideas on Presentation Design and Delivery. New Riders: Berkeley, CA, 2008.

* Tobias, S., Chubin, D.E., Aylesworth, K. Rethinking Science as a Career: Perceptions and Realities in the Physical Sciences. Research Corporation. Pgs 15-27. ISBN: 0-9633504-3-9