Chemistry 234 - Organic Chemistry Laboratory II

(This syllabus is subject to change with written or verbal notification)

Instructors:

Professor:	Section(s):	Office:	Office Hours:
John Hofferberth	Tues	Tom 312	MWR 2:30-4:00, F 2:30-3:00 PM (by appointment)
William Cooper	Wed and Thurs	Tom 314	TW 10:00-Noon, R 10:00-11:00 AM

Course Resources:

Textbooks: Mayo; Pike and Trumper "*Microscale Organic Laboratory*" (any edition)
Zubrick "The Organic Chem Lab Survival Manual" (any edition)

Webpage: Moodle

Electronics: Laptop or Tablet

Grading Policy:

Students will be assigned fair letter grades by the course instructors based on their behavior, performance, and progress toward mastering the learning goals for the course (see below) *at the conclusion of the semester*. The table below summarizes the approximate grade weighting for different aspects of this course.

	Group/Individual	Weighting	Point Value
Weekly Plan	Group	20 pts (12 weeks)	240 pts
Notebook	Group	20 pts (12 reports)	240 pts
Reports	Group	40 pts (2 reports)	80 pts
Final Exam	Individual	150 pts	150 pts
Teamwork/Participation	Individual	30 pts (6 surveys)	180 pts
		Total:	**890 pts**

Course Description and Philosophy:

This course is designed to develop your ability to engage in organic chemistry research. A successful research project requires conceptual understanding, mastery of laboratory techniques, proficiency with instrumentation and software, and strong interpersonal skills. This semester you will work in small teams on a current research challenge from Professor

Hofferberth's laboratory. The instructors do not know what the results and conclusions of your projects will be.

There is a growing body of literature that supports the idea that course-based undergraduate research experiences (CUREs), like this course, represent a powerful high-impact educational practice which benefits all science students more than a traditional laboratory course (leading reference: CBE--Life Sciences Education, Vol. 13, 29-40, 2014). The primary difference between this approach and a "traditional" one is that traditional labs are instructor defined and instructor driven. Students in traditional labs learn more about meeting the expectations of the instructor and less about the science they are supposed to be studying. In contrast, course-based research experiences do not have these liabilities and are known to lead to a host of higher-level learning outcomes including: increased identity formation of students as scientists, increased ability to navigate the uncertainty of real-world problems, increased persistence in science, improved resilience and grit, better research skill attainment, increased self efficacy, improved motivation, improved communication skills, improved collaboration skills, and improved attainment of technical technical and analytical skills.

In addition to these pedagogical reasons, the instructors truly want to advance the research problem that has been selected for the course and we have thus structured the course as a CURE.

Learning Outcomes:

It is valuable for you to know the learning goals and specific learning objectives for the course so you know what you are supposed to be learning, you can monitor your own progress throughout the semester, and you understand what the instructors will be looking for during assessments. It is also valuable for you to understand the level of cognitive demand (higher order cognitive demand (HOC) and lower order cognitive demand (LOC)) and the Bloom's level required to master each learning objective ([Lower Level] Knowledge -> Comprehension -> Application -> Analysis -> Evaluation -> Synthesis [Higher Level]).

Overall Goals:

1. Everyone in the class gains the skills and knowledge they need to advance toward their own professional dreams and goals.

2. Students learn about the nature of science research.

3. Students develop their ability to engage in organic chemistry research.

Learning Objectives:

1. Students will be able to analyze/evaluate (Analysis, HOC) potential reactions or protocols to accomplish a given chemical transformation or operation (purification, analysis) in lab.

2. Students will be able to assess (Analysis, HOC) the quality of documentation of an experimental procedure and recognize (Comprehension, LOC) the conventions used in experimental protocols in synthetic organic chemistry literature articles.

3. Students can recall (Knowledge, LOC), list (Knowledge, LOC), and perform (Application, LOC/HOC) standard organic chemistry laboratory techniques and know when to apply (Analysis/Evaluation, HOC) them in a process they design (Synthesis, HOC).

4. Students will be able to design (Synthesis, HOC) a synthesis experiment or chemistry process based on precedent literature articles or procedures.

5. Students will be able to assess (Evaluation, HOC) the safety of a proposed process/protocol.

6. Students will be able to plan effectively for lab work (HOC).

7. Students can work effectively in a research team (HOC)

8. Students will be able to acquire (Application, LOC) and analyze (Analysis, HOC) spectroscopic data (IR, NMR) to understand the outcome of experiments they design.

9. Students will be able to keep a detailed and repeatable laboratory notebook (Synthesis, HOC).

10. Students will be able to share their findings in the form of written reports using the conventions of organic chemistry literature articles (HOC)

Research Notebook:

Each team will share an electronic research notebook (using Evernote) that contains the description of their research plans, laboratory work, their data and analysis, their interpretation of results, and their report. The instructors will create and share a notebook with team members. Laboratory notebooks are an essential element of a research program (see discussions on laboratory notebooks in the course textbooks). At the very minimum, a laboratory notebook should be detailed enough that another researcher with a comparable level of training can: (1) repeat the experiments described, (2) understand the logical progression of thought that motivated each experiment to be performed, (3) find references to prior work that informed how each experiment was performed, and (4) understand the outcome of each experiment. ChemDraw should be used to draw structures, schemes, and mechanisms in the notebook.

Within the research notebook, the lab team will create a several notes for each class session using the format and organization given here:

1. Week 01 Code of Conduct for Team
2. Week 02 Plan
3. Week 02 Experimental Notebook
4. Week 02 Reference 1
5. Week 02 Reference 2
6. Week 02 Technique - Thin Layer Chromatography
7. Week 02 Technique - Preparing and Submitting NMR samples
8. Week 03 Plan
9. Week 03 Experimental Notebook

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68. Week 07 Report

Plan Notes:
Your research plan will describe both the *activities* you plan for the next session and a *rationale* for the plans you propose. It should be evident from your plan that you have analyzed and interpreted results from previous lab sessions, consulted appropriate reference materials, carefully and realistically thought through the timing of laboratory procedures, and delegated the work to the individual(s) who will carry them out.

Weekly Research Plans will be submitted by **Sunday evening at 11:59PM** prior to your next lab session. The instructors will do our best review and comment on your plans in a timely manner and provide feedback on the quality of your plan before your lab session. **If you need**

materials or equipment that you do not know to be available in the laboratory, make your request using the Google Form linked to the Moodle page.

The weekly research plans will be structured in the following way (include section headings).

Title: Week 02 Plan

1. **Summary** - Summary of what was accomplished in the previous lab session. Could include:
    a. A reaction scheme with a brief written summary/analysis.
    b. Annotated spectral data with a brief written summary/analysis.
    c. Images of TLC plates (annotated) with a brief written summary/analysis.
    d. A written description of what happened.
2. **Plan** - Describe what experiments or processes you plan to carry out in the next session.
    a. Provide conceptual information about any new reaction (hand drawn or computer drawn mechanism, information about the reaction conditions, etc).
    b. Provide literature precedent to any new experimental procedure. A .pdf of any precedent literature should be provided as a Reference Note (see below).
    c. Convert the literature experimental procedure into a step-by-step list of instructions/operations (this information will help you identify what materials you will need and what techniques you will need to employ).
    d. If the experiment requires a technique you have not yet used this semester, write a step-by-step procedure for the technique, save it as a Technique Note for this week (see below), and link it to the step-by-step plan.
    e. A sketch or image of an experimental set-up for new techniques could also be valuable in this section.
    f. Describe safety considerations for the your proposed laboratory work.
3. **Delegation of Responsibilities** - Team members will assign themselves a specific role each week on a rotating basis.
    a. **Documenter** - Each week one team member will have the sole responsibility of documenting all experimental work. Use the format, content, and style of the example (more information below). This team member will not do experimental work during the lab session.
    b. **Primary Experimentalist** - This team member will perform the experimental work in the laboratory and will direct the Support Experimentalist.
    c. **Support Experimentalist** - This team member will do experimental work in support of the Primary Experimentalist.

Experimental Notebook Notes:

This note in your research notebook will describe your experimental work. Some (sections 1-4 below) of your experimental notebook will be prepared before you begin experimental work in the lab (this should be done before the lab session). The remainder of this note will represent a **living record** of what you actually do in the laboratory. It is the role of the Documenter for the week to prepare the Experimental Notebook before the lab session and to maintain a record of all of the science that takes place in the lab **as it is performed** by the Primary and Support Experimentalist. The goal for this section of the notebook is that someone with a comparable level of training could understand the logical progression of the experiment, repeat the experiment, and get the same results. The section will contain structures and schemes (prepared in ChemDraw), raw and annotated data (TLC images, IR data, NMR data, etc). These images and files can be dropped directly into the notebook where they are described.

Each compound that is prepared will get a **unique compound reference number** that has the following structure: XYZ-W##-## where XYZ are the first initials of each lab team member (John, Joy, Tomas would be "JJT"), W## is the week number (week 1 would be "W01") and ## is the compound number (first compound made would be 01, second compound made would be 02, etc). This labeling system will be used to identify compounds in spectral data files.

The Experimental Notebook will be structured as described here with section headings (see the example provided):

Title: Week 02 Experimental Notebook - Title/Description of Experiment

1. **Date:** MM/DD/YYYY

2. **Reaction Scheme:** ChemDraw Scheme of the reaction that includes the chemical formula and molecular weight of the primary staring materials and product and a summary of the conditions over/under the reaction arrow.

3. **References:** Citations for any references used as precedent for the experimental work. This could be literature articles or procedures from your own work or that from other groups in this class. **All citations should be linked to the actual reference.** Each reference will be included as a .pdf or note as a Reference Note (see below).

4. **Reagent Table:** This table will list all reagents in the left hand column and will have *at least* the following columns included to the right of the the reagent names: **Molecular Weight or Reagent Concentration**, **Calculated Amount** of reagent needed, **Actual Amount** of reagent used in the reaction, **Moles** (or Millimoles) of the reagent calculated, **Mole Equivalents** of the reagent calculated, **Solvent** identity and calculated volume in which the reagent is dissolved during the procedure. Other columns can also be added if needed such as reagent density or percentage by mass. **This table should be nearly complete before experimental work begins.** Only the **Actual Amount** column should be blank when lab work commences.

5. **Procedure:** The procedure section should be subdivided into sections (reaction, purification, analysis, etc). The procedure should be written by the Documenter as the experimentalists perform the experiment (this section should be blank before experimental work begins). Experimental work should be described as numbered lists of operations performed. Annotated images of TLC plates, raw and annotated spectral data, calculations, photographs of the experimental setup and the chemical yield of any products should be included in this section.

6. **Analysis and Wrap Up:** This section should describe the analysis of the data and the meaning that was derived from all the information collected during the reaction. Things that could be included here are annotated spectral data with proposed product structures, analysis about how pure the product is, if the reaction did not yield the desired product one could discuss what did form or what did happen, and this section should include a description of what the next step should be (this section could be used as a starting point for your next plan).

Like a paper laboratory notebook, **you should not delete and replace what is recorded** in your experimental notebook. Also like a paper laboratory notebook, experimental work should be kept separate from other work in the notebook. As you work in a notebook, a record of the changes made is logged and is auditable, however, making such changes confuses the actual flow of events during experimental work. Care should be taken to retain all that is written in the notebook during the course of an experiment even if it is recognized to be in error after the fact. Sometimes the most important discoveries are made when a mistake is made in an established procedure and a different and important result is observed. If the actual series of events leading to such a discovery is obscured by editing the record of events, such discoveries cannot be replicated and represent lost opportunities to advance our understanding. **If you find that there is an error, you should add a comment describing the error and add corrected information with your initials and the date when the changes were made.**

Reference Notes:

Title: Week 02 Reference - Full Reference Citation

Each reference note should include the complete reference. If it is a literature article the article itself and its supporting information (if used) should be included in the note. If this is an experimental note from another group is should be linked or a copy of the note should be included.

Technique Notes:

Title: Week 02 Technique - Technique Name (TLC, Liquid-Liquid Extraction, etc.)

As your group uses common laboratory techniques, a document describing how the technique is employed should be written. You can get information about how to perform techniques from videos (from the Moodle page or other sources), textbooks, or other reputable sources. You will only need to include a technique note the first time you encounter a technique and then you can simply provide a link to the existing note. These technique notes will save you time during the experiments because you can say in your experimental notebook, for example, TLC analysis with 10% Ethyl Acetate in Hexanes and then show the image of the results with annotation rather than describing every step needed to run the analysis. Some techniques will be repeated many times and it is worth your time to carefully write up how to perform them.

Report Note:

You will work with two teams this semester, one for the first half of the semester and one for the second half of the semester. After that last lab session with your team (dates indicated on the schedule below) you will submit a report that will be the final note of your research notebook with that team. Your report should be the polished product of multiple drafts with careful editing. The report will include:

1. **Title**
2. **Group Members**
3. **Background:** A description of the goals of your work that includes a figure with the desired product and a retrosynthetic plan.
4. **Results:** A description of the research that you carried out. This section will have at least a 'forward' synthetic scheme with reagent summaries over the arrows and yields and text describing the results of your experimental work.
5. **Discussion:** Discuss the success or failure of your strategy, how you make sense of your results (what do they mean?) and make suggestions for next steps.
6. **Experimental:** Provide experimental protocols for all successful reactions that produced products that you could characterize (IR, NMR).
7. **References**

The style (but not the structure/organization) of the report should follow that of the *Journal of Organic Chemistry* (JOC). Before you begin, read several articles from JOC and note the conventions applied. Ask yourself: what are the style and format conventions for schemes and figures? What are the conventions used in experimental procedures? How are references formatted? How are compound numbers used in the schemes and text? What information is provided in the results? What information is provided in the discussion? What kind of background information is provided?

Skill Building Sessions

The course instructors will lead skill building sessions on topics related to the course throughout the semester. These informal sessions will take place during the first 30 minutes of class meetings. The needs of students will determine the topics of the skill building sessions offered this semester. To recommend topics for a Skill Building Session, complete a Skill Building Session request Google form (on Moodle). A YouTube playlist with videos of Skill Building Sessions is available (linked here and to the Moodle page). Videos of the sessions offered this semester will be added to this library for future reference.

Final Exam

A final exam will be given on the dates indicated on the course schedule. The instructors will allow students to sign up for any exam time offered to the extent possible based on space limitations. The final exam will have three parts: a written portion (1 hour), a laboratory practical (1.5 hours), and a course assessment portion (required but anonymous and ungraded).

Teamwork and Participation

Modern research is a collaborative process and interpersonal skills and community-minded behavior are extremely important. It is well-established that teams with diverse members are more effective at solving complex problems than groups composed of individuals with more in common. To effectively work on a diverse team, all members must treat one another with respect and be deliberate about structuring group interactions in such a way that all members are given safe opportunities to share their ideas and question the ideas of other group members. Because consensus is often very difficult to reach even in a small group, the **rule of consent** is often a valuable alternative. To apply the rule of consent, **every member** of the team must verbally consent to move forward with an idea (even if is not their preferred idea). If any member of the group does not consent to a plan, the group should continue to discuss the relative merits of alternative paths forward until consent of all members is reached.

As described above, team members will rotate through the roles: Documenter, Primary Experimentalist, and Support Experimentalist. All team members will work together on developing weekly plans and while writing reports. The Documenter should prepare the experimental notebook prior to coming to the next lab session. The Primary Experimentalist has the responsibility for directing the team's activities in the lab.

You will assess your own ability to work with your team and will assess your teammates' abilities at three points for each team (six times total for the semester). We will be using the "CATME Smarter Teamwork" tool for learning about how to function better in teams and learning about how to better assess our own teamwork behaviors. Before you are allowed to complete your

first teamwork survey you will complete a brief tutorial and practice session with the software. You will be prompted by email when it is time to complete your assessment surveys and will have one week to complete the survey after the request is sent.

Working effectively in groups requires careful attention to your own behavior and how you are interacting with your teammates. Even when everyone is trying, sometimes conflict becomes a part of working in team. In some circumstances, conflict can push members of the team to explain their points of view and leads to productive conversations to advance the group. In other cases, conflicts can become barriers to progress if the conflict cannot be resolved. In this class, group conflicts that become barriers to progress can be anonymously reported by any member of the group to the course instructor. No additional information will be collected at the time of the report. In such cases, the whole group will be invited to have a conversation with the instructor to share their points of view and decide together how to resolve the conflict and get the group rolling again.

Attendance

Your attendance at every class meeting is expected. If you must miss class for a college-sanctioned event, coordinate with your lab team and communicate with the instructor to determine how you can contribute to the continued progress of the team.

Academic Accommodation

If you have a disability and need accommodation in order to fully participate in this class, please identify yourself to Erin Salva, Director of Student Accessibility and Support Services (427-5145, salvae@kenyon.edu).

Title IX

Kenyon College seeks to provide an environment that is free of gender bias, discrimination, and harassment. If you have been the victim of sexual harassment/misconduct/assault, interpersonal violence, or stalking we encourage you to report this. If you report this to an instructor, we must notify Kenyon's Title IX coordinator of any information about the incident that you provide. Use the following links for more information: (1) Sexual Misconduct & Harassment Policy: Title IX, VAWA, Title VII; (2) Discrimination & Discriminatory Harassment Policy; and (3) ADA/504 Student Grievance Procedures.

Academic Integrity

“Kenyon College is, at the core, an intellectual community of scholars – students and faculty – engaged in the free and open exchange of ideas. Critical to this lively exchange and deep engagement with ideas is the academic integrity of our work, both inside and outside the classroom.” In short, all materials submitted for credit must be your own work. We hold you responsible for ensuring each other's honesty; if you know of a violation, please relay your concerns to us, the Office of the Provost, or the Dean of Students.

Schedule

Week 1 (9/2) - First Team (1/7)

1. Pre-class:
    a. Read Syllabus and Experimental Handout (Moodle)
    b. Bring goggles (every time)
    c. Bring laptop or tablet (every time)
    d. Load chemistry software on appropriate electronic devices (instructions on Moodle)
2. Class session outline:
    a. Administration
        i. Safety Training/Forms
        ii. Course Overview (Philosophy, Goals, Course Structure, Expectations, Evaluation)
        iii. Hood assignment (by team)
        iv. Lab Drawer Check-in (by team)

    b. Research Goal
        i. Overview of project for semester
        ii. Theory of first step
        iii. Begin brainstorming ideas for subsequent steps.

    c. Team Work Time
        i. Software loading - SciFinder, ChemDraw, Delta
        ii. Prepare lab notebook for Week 2
            1. Plan
            2. Experimental Notebook
            3. Reference
            4. Technique
        iii. Skill Building Sessions

1. Using online resources
2. Ask the instructor

Week 2 (9/9) - First Team (2/7)

1. Pre-Class
    a. Study procedures and techniques you will need for next time
    b. Study the theory behind the reaction involved
    c. Write a weekly plan in your research notebook before Sunday at midnight
    d. Request any needed materials or equipment using the Google Form (Optional)
    e. Request a Skill Building Session Topic (Optional).
    f. Review instructor comments on your plan before coming to class and make any needed adjustments to your plan.

2. Class Session
    a. Skill Building Session
    b. Lab Work
    c. Planning for Week 3

Week 3 (9/16) - First Team (3/7)

1. Pre-Class
    a. Complete CATME Survey (request sent by email)
    b. Study procedures and techniques you will need for next time
    c. Study the theory behind the reaction involved
    d. Write a weekly plan in your research notebook before Sunday at midnight
    e. Request any needed materials or equipment using the Google Form (Optional)
    f. Request a Skill Building Session Topic using the Google Form (Optional)
    g. **Review instructor comments on your plan** before coming to class and make any needed adjustments to your plan.

2. Class Session
    a. Skill Building Session
    b. Lab Work
    c. Planning for Week 4

Week 4 (9/23) - First Team (4/7)

1. Pre-Class
    a. Study procedures and techniques you will need for next time
    b. Study the theory behind the reaction involved
    c. Write a weekly plan in your research notebook before Sunday at midnight
    d. Request any needed materials or equipment using the Google Form (Optional)
    e. Request a Skill Building Session Topic using the Google Form (Optional)

f. **Review instructor comments on your plan** before coming to class and make any needed adjustments to your plan.

2. Class Session
    a. Skill Building Session
    b. Lab Work
    c. Planning for Week 5

Week 5 (9/30) - First Team (5/7)

1. Pre-Class
    a. Complete CATME survey
    b. Study procedures and techniques you will need for next time
    c. Study the theory behind the reaction involved
    d. Write a weekly plan in your research notebook before Sunday at midnight
    e. Request any needed materials or equipment using the Google Form (Optional)
    f. Request a Skill Building Session Topic (Optional).
    g. Review instructor comments on your plan before coming to class and make any needed adjustments to your plan.

2. Class Session
    a. Skill Building Session
    b. Lab Work
    c. Planning for Week 6
    d. Outline and Begin Work on Report (delegate)

October Break

Week 6 (10/14) - First Team (6/7)

1. Pre-Class
    a. Study procedures and techniques you will need for next time
    b. Study the theory behind the reaction involved
    c. Write a weekly plan in your research notebook before Sunday at midnight
    d. Begin writing writing your report
    e. Request any needed materials or equipment using the Google Form (Optional)
    f. Request a Skill Building Session Topic (Optional).
    g. Review instructor comments on your plan before coming to class and make any needed adjustments to your plan.

2. Class Session
    a. Skill Building Session
    b. Lab Work

c. Work on your report
d. Planning for Week 7

Week 7 (10/21) - First Team (7/7)

1. Pre-Class
    a. Study procedures and techniques you will need for next time
    b. Study the theory behind the reaction involved
    c. Write a weekly plan in your research notebook before Sunday at midnight
    d. Work on your report
    e. Request any needed materials or equipment using the Google Form (Optional)
    f. Request a Skill Building Session Topic (Optional)
    g. Review instructor comments on your plan before coming to class and make any needed adjustments to your plan.

2. Class Session
    a. Skill Building Session
    b. Lab Work and clean up
    c. Lab drawer/bench transition
    d. Work on your report
    e. Meet with your new team, make a research plan, delegate responsibilities

Week 8 (10/28) - Second Team (1/6)

1. Pre-Class
    a. Complete final CATME survey for First Team.
    b. Complete your report from First Team by Sunday (10/28) at Midnight. (Write privileges to the notebook will be disabled after that time)
    c. Study procedures and techniques you will need for next time
    d. Study the theory behind the reaction involved
    e. Write a weekly plan in your research notebook before Sunday at midnight
    f. Request any needed materials or equipment using the Google Form (Optional)
    g. Request a Skill Building Session Topic (Optional)
    h. Review instructor comments on your plan before coming to class and make any needed adjustments to your plan.

2. Class Session
    a. Skill Building Session
    b. Lab Work
    c. Planning for Week 9

Week 9 (11/4) - Second Team (2/6)

1. Pre-Class
    a. Study procedures and techniques you will need for next time
    b. Study the theory behind the reaction involved
    c. Write a weekly plan in your research notebook before Sunday at midnight
    d. Request any needed materials or equipment using the Google Form (Optional)
    e. Request a Skill Building Session Topic (Optional)
    f. Review instructor comments on your plan before coming to class and make any needed adjustments to your plan.

2. Class Session
    a. Skill Building Session
    b. Lab Work
    c. Planning for Week 10

Week 10 (11/11) - Second Team (3/6)

1. Pre-Class
    a. Complete first CATME survey for Second Team
    b. Study procedures and techniques you will need for next time
    c. Study the theory behind the reaction involved
    d. Write a weekly plan in your research notebook before Sunday at midnight
    e. Request any needed materials or equipment using the Google Form (Optional)
    f. Request a Skill Building Session Topic (Optional)
    g. Review instructor comments on your plan before coming to class and make any needed adjustments to your plan.

2. Class Session
    a. Skill Building Session
    b. Lab Work
    c. Planning for Week 11

Thanksgiving Break

Week 11 (11/25) - Second Team (4/6)

1. Pre-Class
    a. Study procedures and techniques you will need for next time
    b. Study the theory behind the reaction involved
    c. Write a weekly plan in your research notebook before Sunday at midnight
    d. Request any needed materials or equipment using the Google Form (Optional)

e. Request a Skill Building Session Topic (Optional)
f. Review instructor comments on your plan before coming to class and make any needed adjustments to your plan.

2. Class Session
    a. Skill Building Session
    b. Lab Work
    c. Planning for Week 12
    d. Outline report and delegate

Week 12 (12/2) - Second Team (5/6)

3. Pre-Class
    a. Complete second CATME survey for Second Team.
    b. Study procedures and techniques you will need for next time
    c. Study the theory behind the reaction involved
    d. Write a weekly plan in your research notebook before Sunday at midnight
    e. Request any needed materials or equipment using the Google Form (Optional)
    f. Request a Skill Building Session Topic (Optional)
    g. Review instructor comments on your plan before coming to class and make any needed adjustments to your plan.

4. Class Session
    a. Skill Building Session
    b. Lab Work
    c. Work on report
    d. Planning for Week 13

Week 13 (12/9) - Second Team (6/6)

1. Pre-Class
    a. Study procedures and techniques you will need for next time
    b. Study the theory behind the reaction involved
    c. Write a weekly plan in your research notebook before Sunday at midnight
    d. Request any needed materials or equipment using the Google Form (Optional)
    e. Request a Skill Building Session Topic (Optional)
    f. Review instructor comments on your plan before coming to class and make any needed adjustments to your plan.

2. Class Session
    a. Skill Building Session
    b. Lab Work
    c. Check out of lab drawer

3. After Class
    a. Finalize report and submit before the final exam date for your lab section (see below)
    b. Complete the third and final CATME survey for your Second Team

Final Exam (Week of 12/16)

Tuesday Section (234.01) - Tuesday, December 18th at 1:30PM

Wednesday Section (234.02) - Friday, December 21st at 1:30PM

Thursday Section (234.03) - Wednesday, December 19th at 8:30AM