Pedagogical Inquiry Grant Final Report:

Implementation of Whitman's Reimagined Organic Chemistry Laboratory I Curriculum

Jonathan Collins and Arlen Abbey '26, Type B: Departmental Inquiry Project

Overview of Work Performed

Work on the project began with identifying and hiring a student worker for the summer. Arlen Abbey '26 was selected based on his performance in Chem 251 and 252 during the 2023-2024 academic year. He along with Prof. Jonathan Collins constituted the working group for the duration of the project. Work progressed more or less in accordance with the schedule laid down in the original proposal. The first week involved organizing the order in which work would be done on the different labs. The proposed experiments were divided into three categories: labs that would be brought forward from the previous version of Chem 251 with minor updates, labs requiring major overhaul or improvement, and labs that would have to be fully developed for the new course.

Labs requiring minor updates
Lab 3: Computational modeling
Lab 5: Acid-catalyzed dehydration and GC analysis
Labs requiring major overhaul or improvement
Lab 1: Simple and Fractional Distillations
Lab 2: Extraction of a mixture, TLC, Recrystallization, mp
Labs requiring full development
Lab 4: S_N2 prep of butoxynaphthol
Lab 6: Kinetics of S_N1 solvolysis

The labs requiring full development or major overhaul were prioritized given that they would require the most work to prepare for the Fall 2024 semester. One major outcome of the work period was the establishment of a coherent system for dividing student work in multiweek labs. The addition of more such labs was an outcome of the previous PIG (Reimagining Whitman's Organic Chemistry Laboratory Curriculum, 2023). During the development of each of the above labs, care was taken to determine how instructional elements, student work, and data processing would be distributed across each multiweek lab. This was critical given limitations of time, instrument throughput, and access to the Sci 276 computational lab for data processing. A revised semester schedule based on this division is presented below. The different components of multiweek labs are designated with lab number and the letters "a" and "b". Each pair of connected labs has its own writeup in the lab manual (i.e., Lab 2a and 2b are presented separately). This will help to clarify student expectations for a given week and allow instructors to better refine their prelab materials. The prelab quizzes and conclusions sheets are assessment items whose placement is dependent on division of material in the multiweek labs.

Week	Dates	Lab	Prelab Quiz (PQ)	Conclusion Sheet (CS) and Notebook Check
1	**Sep 2 - 6**	**No Lab (Class begins on Tuesday of this week)**		
2	Sep 9 - 13	Check-in and build sample glassware		
3	Sep 16 - 20	Lab 1ab: Simple and Fractional Distillations	PQ #1	
4	Sep 23 - 27	Lab 1ab: GC on distillation fractions & analysis data in Excel - SCI 276		
5	Sep 30 - Oct 4	Lab 2a: Acid-Base Extractions, Thin Layer Chromatography (TLC)	PQ #2	CS #1, Notebook Check #1
6	**Oct 7 - 11**	**NO LAB - OCTOBER BREAK**		
7	Oct 14 - 18	**Lab 2b: Extraction of a Mixture & Recrystallization**		
8	Oct 21 - 25	Lab 3: Computational Modeling - SCI 276	PQ #3	CS #2
9	Oct 28 - Nov 1	Lab 4a: Planning a reaction & Introduction to ChemDraw - SCI 276	PQ #4	CS #3
10	Nov 4 - 8	Lab 4b: SN2 Reaction - Preparation of Butoxynaphthol		
11	Nov 11 - 15	Lab 5: Acid-Catalyzed Dehydration and GC analysis	PQ #5	CS #4
12	Nov 18 - 22	Lab 6a: Kinetics of SN1 solvolysis (experimental work)	PQ #6	CS #5
	Nov 25 - 29	**THANKSGIVING BREAK**		
13	Dec 2 - 6	Lab 6b: Kinetics of SN1 solvolysis (Data Analysis) - SCI 276		Notebook Check #2
14	Dec 9 - 13	Check out		CS #6

All labs were fully developed and functional for Fall 2024. This was the primary aim of the proposed work. Further, each of lab uniquely identified above (e.g. 1ab, 2a, 2b, etc.) was written up over the course of the work period (total of 10 documents, 3-5 pages each). Even labs requiring only minor updates were rewritten to make them consistent with the new lab format (style and substance).

Additional Outcomes

Two additional improvements were added to the proposal over the course of the summer. First, the rewriting and testing of the labs presented an opportunity to curate sets of ideal data for each experiment. These data were placed into instructor/teaching assistant preparation documents. Knowledge of what a successful experiment looks like is a tremendous aid to those teaching the lab. This also greatly aids in developing post-lab assignments (conclusion sheets). These experimental data were enhanced with instructor notes and helpful suggestions for running the lab. Historically this information was accumulated by individual faculty over time, now it is standardized for the course. The second additional outcome for the work period was the installation of two new gas chromatography instruments (GCs). Acquiring funding for these instruments was highlighted in the final report for the previous PIG. The two preexisting GCs were also in need of maintenance and updates. Setting up the four GCs (two new and two old) required approximately a full week of work by both Jonathan Collins and Arlen Abbey. This included setting up a new computer, updating software, running new gas lines, and replacing some components of the GCs to make them compatible with one another. The outcome was a unified GC workstation that can fully accommodate the needs of Chem 251 and 252 into the foreseeable future.

Future Development of Chem 251 and 252

The newly designed and developed labs for Chem 251 are currently running in the Fall 2024 semester. Prof. Biswas, Götz, and Juhasz are the instructors of record and will continue to provide feedback on the new labs and work together to develop other unified course materials (prelab quizzes, conclusion sheets, etc.). Arlen Abbey ’26 has been hired by the Chemistry Department to work as a laboratory TA on Tuesday afternoons (first lab section of the week). This will provide needed support for instructors implementing the labs on scale for the first time. Prof. Collins (on sabbatical 2024-2025) has also made himself available to assist in the implementation of the new labs.

In the future, Professors Biswas, Collins, Götz, and Juhasz plan to apply for a final PIG to overhaul Chem 252. Given the success of the Chem 251 development, it is anticipated that this final PIG will also include a request for funding for a student assistant.