

Division of Academic Affairs
Technology Fee – Project Proposal
2016

Proposal Deadline: Friday, January 22, 2016

Project Proposal Type

Instructional Technology Enhancement Project (ITEP)

Focused projects proposed by an individual or small team with the intention of exploring new applications of instructional technology. ITEPs will typically be led by a faculty “principal investigator.” ITEPs are time-limited projects (up to two years in length) and allocations of Technology Fee funds to these projects are non-recurring.

Project Title

Gas Chromatography Enhancement for the Organic Teaching Laboratories

Total Amount of Funding Requested

\$19,260.00

Primary Project Coordinator

Dr. Christopher Nicholson, Assistant Professor of Chemistry

Gas Chromatography Enhancement for the Organic Teaching Laboratories

1. Project Description

Chromatography is an essential technique for both purification and analysis in Organic and Analytical Chemistry. So fundamental is the process of analytical chromatography that it is often the first instrumental technique taught during Organic Chemistry labs. As the Organic Lab curriculum at UWF has grown and matured the number of students served has increased substantially but the Gas Chromatography infrastructure supporting these students has not grown apace. The instrumentation used for these students represents hand-me-down instruments from government agencies which, while effective on a smaller scale, have become inefficient and temperamental on the enhanced scale to which they are currently used. Each semester is a struggle to ensure that at least one instrument is operational to a level that will support the more than 100 students who rely on it for reaction analysis. This project aims to replace the hand-me-down units which are maintenance intensive and often non-functional with modern, reliable isothermal instruments which can reliably support more students with greater efficiency.

In addition to the unreliability of the aged instruments currently in use, the technology they employ is woefully out of date. In an age when emphasis is on preparing students for modern workforce demands, the existing instruments rely on paper chart recorders to collect and present data. This data is very challenging to analyze and can not be readily processed using Excel or other modern data analysis software. To remedy this the second aim of this project is to procure two computers and the relevant software to collect chromatography data in the computer and export it as data files which students can analyze outside of laboratory hours.

Modernization of this instrumentation will result in better data, an improved learning experience, and enhanced report writing and analysis. Each of these will benefit students taking the laboratory as they enter the workforce prepared to use more modern instrumental methods and generate professional reports using data collected through those modern instrumental methods.

2. Alignment with UWF Strategic Plan

The project is aligned specifically with UWF Priority 4.1 from the University of West Florida Strategic Plan.

UWF Priority 4.1 addresses the infrastructure of UWF toward the attainment of other strategic priorities. In the chemistry department, a significant portion of the infrastructure is the instrumentation used for analysis of the products of experiments. Modernizing the instrumentation base within the department contributes to the ability of the department to properly train a modern workforce, enhance retention of students through labwork, and offer the faculty a new tool with which to design experiments to enhance student learning.

The improvement of the Gas Chromatography infrastructure will benefit the Organic, Analytical and Inorganic course labs. Many of these skills are used directly in industrial positions meaning that an improvement in our infrastructure will directly translate to more employable students for regional industrial interests. For students motivated toward graduate or professional schools a better understanding of Gas Chromatography analysis will serve to elevate them above their peers and make more competitive candidates. Finally, as Gas Chromatography is a fundamental technique, better understanding at the Organic Chemistry level will elevate the understanding of students in higher level courses, thus elevating the quality of the department by raising the bar for students matriculating through the upper division course offerings.

3. Description of Benefit Provided

a. Ways in which student access to technology will be enhanced

Students in the laboratory will work directly, hands-on with the instrument in multiple courses depending on the extent of their Chemistry education. Students will become versed in digital data collection and analysis techniques. This new technology asset will allow for better critical thinking skills and interpretation of complex data sets. At present students using related instruments are only provided data on paper chart strips to the age of the instruments being used.

b. How the student experience will be enhanced

Student understanding of Gas Chromatography will be enhanced because the instruments being purchased are not patchworks of parts from generations of hand-me-down instruments and as such the analytical process and data generated are clearer. The students will also be able to work directly with the instrument which they can not currently do. Finally, the data collection will be computer based which means students will be able to manipulate and analyze the data digitally and incorporate it into technical writing in ways not currently possible.

c. How assessment will be conducted

Assessment will be conducted via paper assessment surveys at the beginning of experiments as well as at the time of report submission. These surveys will gauge the level of impact the new technology has had on the student learning experience. Additionally, in advanced class a short survey will assess the impact of the technology at early points in the curriculum on student comfort and understanding at later points in the curriculum when the technology is used again. The long term study will be conducted using the online Qualtrics survey software on my.uwf.

d. Which and how many students will be impacted

Students impacted by the new Gas Chromatography instruments will be all students taking Organic Chemistry 1 Lab (~220 students per year) and Organic Chemistry 2 Lab (~180 students per year) as well as students taking Advanced Laboratory Techniques (~40 students per year) and Inorganic Synthesis Lab (~20 students per year). Additionally it would be possible to develop experiments that allow these instruments to be used in the outreach efforts the department participates in with the local International Baccalaureate program.

e. How students with special needs or disabilities will be helped

All Chemistry labs are ADA compliant. Students requiring additional assistance using the instrument will have access to trained TA's and Instructors who can assist in the use of the instrument and software.

f. How training of students and faculty in the use of technology would be enhanced

Students and faculty participating in this process will gain hands-on skill with the operation of advanced instrumentation and the corresponding data analysis. Experience with the collection, manipulation and presentation of complex data will prepare students to use other instruments with similar data collection programs. Through use in subsequent courses and experiments the quality of student training can also be evaluated to improve methods used to train students in the use of new technologies in the lab and the workplace.

4. How Student Success will be Measured

Student success in this project will be determined by assessment of the improvement in student learning by interaction with the new instrumentation and the data collected from it. Student perception of learning will be assessed through survey questions and the accumulation of experience will be evaluated by successive end of course survey tools. A primary marker of success will be student reporting of understanding after using the instrument for reaction analysis in each lab it is used for. Another primary marker of success will be scores focused on the use and interpretation of Gas Chromatography on individual experiment rubrics. A secondary metric of success will be student self reporting of increased comfort with the instrument over multiple courses throughout their academic career.

5. Resources Needed for the Project and Ongoing Resource Needs

The Gas Chromatographs each have a quoted price of \$5,500. This project will install two instruments to allow for the high volume of students participating in the lab experiments, so the budgeted costs of the instruments is \$11,000.00

Each instrument is quoted with an additional set of consumables such as syringes and septa. The kit for each instrument is \$580.00 for a total budgeted cost of \$1160.00

Each instrument requires a basic PC running Windows. The cost for each PC as estimated by Don Thompson is \$1200.00 for a total budgeted cost of \$2400.00

The data collection system for each instrument with software, analog to digital converter and instrument interface is \$2350.00 for a total budgeted cost of \$4700.00.

Ongoing resource needs such as carrier gasses would be the responsibility of the department. These are currently funded through laboratory fees and would be comparable on the new instrument to existing expenses. Future costs may be incurred if the instruments are to be interfaced with MeasureNet. Currently Building 58 is not MeasureNet equipped, but should the system be installed for upper division labs at some point these instruments can be integrated into that data collection system where the existing ones can not.

6. Project Timeline

- a. Spring 2016 - Orders placed for instrumentation and supporting computers
- b. Summer 2016 - Instruments set up, training complete with laboratory teaching faculty. Initial test use of the Gas Chromatographs with the Summer laboratory sections of CHM2210L during the Dehydration of methylcyclohexanol experiment and first assessments of students using the technology.
- c. Fall 2016 - Implementation throughout Organic 1 and Organic 2 Labs as well as Advanced Laboratory Techniques (CHM3740L) with existing and new experiments and assessment of the impact on Learning in subsequent semesters
- d. Spring 2017 - Extend implementation to Inorganic Synthesis Lab (CHM4610L) and continue in the Organic 1 and 2 sequence.
- e. Year 1 - Project review with impacted laboratory Faculty and TA's, review of existing experiments, brainstorming about further laboratory implementation. Assessment data from all impacted courses summarized in mid-project report
- f. Year 2 - Repeat c.-d. with full assessment for all impacted courses. Final project review with impacted faculty. Project report written detailing student learning impacted by the project.

7. Sustainability

Beyond the initial purchase of the instrument maintenance and sustainability costs will be similar to if not less than the existing costs to maintain the hand-me-down Gas Chromatography systems. No additional costs are anticipated and the maintenance burden will be dramatically reduced both by the nature of these as isothermal units and also the fact that as new equipment these do not come with the legacy problems of hand-me-down instruments.

8. Principal Investigator

Dr. Christopher Nicholson, Assistant Professor of Chemistry

Appendix One:

Sample student assessment instruments

Name: _____

Survey on the Key Concepts associated with Polarimetry

For each concept or skill below, indicate your level of current understanding according to the 5-point scale below.

5. I am very confident in my understanding of this concept or skill. I would be able to both apply and explain this concept or skill to other students at a similar academic level.

4. I am somewhat confident in my understanding of this concept or skill. I can understand and apply this concept or skill but may struggle in explaining it to someone else.

3. I have a limited understanding of this concept or skill. I am somewhat confident in applying the concept or skill, but would not be comfortable explaining the concept or skill to someone else.

2. I am aware of this concept or skill but feel unprepared to apply it.

1. I am unaware of the concept or skill in question.

Please mark one of the 5 options to represent your understanding of each concept:	5	4	3	2	1
1. Familiarity with the concept of boiling point					
2. Familiarity with the concept of separation of compounds					
3. Familiarity with the concept of polarity					
4. Familiarity with the concept of chromatography					
5. Ability to interpret graphical data					
6. Ability to compare integrated areas on graphed data					
7. Preparation of samples for Gas Chromatography analysis					
8. Analysis of a complex mixture through Gas Chromatography					
9. Incorporation of Chromatography data in written reports					

Gas Chromatography Report Rubric

<i>Criteria</i>	Excellent	Good	Fair	Unacceptable
Report Format	[2 pt] All sections of report present, writing is clear and legible, name, title, date all in proper location on notebook data sheets.	[1 pt] Organization of sections is poor, sloppy but legible handwriting	[0.5 pt] No discernible organization, handwriting illegible	[0 pt] Totally illegible. Name, Title, Date not on notebook data sheets.
Introduction	[2 pts] Purpose of the experiment is summarized, reaction and mechanism are properly presented.		[1 pt] Either written purpose or reaction information is too vague to be useful.	[0 pt] No introduction is provided at the start of the lab.
Safety & Hygiene	[2 pts] Safety information is properly summarized and all hazardous procedures and chemicals are noted.		[1 pts] Limited safety information included. Significant hazards present in the lab are unaddressed.	[0 pt] No safety or chemical hygiene information provided at the start of the lab.
Data & Calculations	[5 pts] All data are included (i.e. mass, volume, temperature, time) and all relevant observations are included (i.e. color, clarity, aroma). Any calculations relevant to the analysis are shown and correct.	[3 pts] Both data and observations are included but incomplete. Any calculations relevant to the analysis are shown. Errors may be present	[1 pt] Either data, observations, or necessary calculations are not included.	[0 pt] No data, observations, or calculations shown. No original notebook sheets are included.
Experimental	[3 pts] Procedure is properly summarized. Real data are included. Real observations are included. Proper sentence and paragraph format is observed.	[2 pts] Experimental with proper format is included, however actual data is limited or incomplete. Actual observations are included but may be incomplete.	[1 pt] A crude experimental is included that includes the procedural data, not students own data and observations. Experimental restates procedure and offers no new information.	[0 pt] No experimental section is included.
Results	[2 pts] Data and observations are used to concisely summarize the reaction.		[1 pt] Student demonstrates unsatisfactory chemical knowledge.	[0 pt] No results are included.
Conclusions	[2 pts] Analysis of the reaction complete and connections to larger body of chemistry made		[1 pt] Student demonstrates unsatisfactory chemical knowledge.	[0 pt] No results are included.

Gas Chromatography Report Rubric

GC Analysis	[2 pts] GC trace is presented with proper annotation and relevant analysis. Student shows mastery of GC data.		[1 pt] GC trace is included, but analysis is weak. Peaks are improperly compared.	[0 pt] GC data is not included or substantial errors present. Student demonstrates substantial lack of understanding.
Post Lab Question 1	[2 pts] All 9 correct reaction outcomes shown	[1.5 pts] 6 or more correct reaction outcomes shown	[1 pt] 3 or more correct reaction outcomes shown	[0 pt] No correct reaction outcomes shown
Post Lab Question 2	[.5 pts] Correct structure given			[0 pt] Incorrect or no structure given
Post Lab Question 3	[1 pts] Both products shown and properly names		[0.5 pts] Both products shown but unnamed OR only one product shown with name	[0 pt] No answer or incorrect answer given
Post Lab Question 4	[.5 pts] Correct product with correct stereochemistry shown			[0 pt] No answer or incorrect answer given
Post Lab Question 5	[.5 pts] Correct product with correct stereochemistry shown			[0 pt] No answer or incorrect answer given
Post Lab Question 6	[.5 pts] Student correctly explains the disparity between observed and expected boiling points			[0 pt] Student incorrectly describes the observation or provides no answer

11 ITEP Chris Nicholson (1)

ITS Review Comments

GENERAL COMMENTS:

None.

COMPLIANCE WITH STANDARDS:

No comments.

INFRASTRUCTURE ISSUES:

No comments.

PRICING/COST ISSUES:

No comments.

OTHER SUPPORT ISSUES:

No comments.

SUGGESTIONS TO PROPOSER:

No comments.

For questions regarding ITS comments, please contact:

Melanie Haveard, Executive Director and CTO

ext. 2540

mhaveard@uwf.edu