

UNIVERSITY OF LOUISIANA AT LAFAYETTE

STEP Committee

Technology Fee Application

**Improving Precision and Accuracy in
Analytical Chemistry Laboratory Courses**

Title

Hui Yan, Febee Louka

Name of Submitter
(Faculty or Staff Only)

Chemistry Department

Organization

Title: Improving Precision and Accuracy in Analytical Chemistry Laboratory Courses Date: 07/05/2016

Name (Contact Person): Hui Yan and Febee Louka

Address: P.O. Box 44370, Lafayette LA 70504

Phone Number: 337-482-9061 Email: huiyan@louisiana.edu

Department/College/Org: Chemistry

ABSTRACT (250 words or less):

The purpose of this proposal is to acquire micropipette and multimeter to improve precision and accuracy in Analytical Chemistry Laboratory courses: CHEM 222 and CHEM 430G. This two Analytical Chemistry lab courses provide experience in the application of Analytical Chemistry concepts by solving analytical problems and using modern chemical instrumentation. Several experiments in the courses are designed to measure and dispense small volumes of a variety of liquids with low concentrations. Current method was to use up to ten sequential dilutions of concentrated solution with regular sized volumetric flask to achieve the low concentration. This operation brings the experimental error ten times higher, which can be improved by using suitable microscale tools, such as micropipette. Micropipette has been used as a standard tool and serves as a critical part of many biology and chemistry laboratory procedures in both industry and academy. Currently, students in CHEM 222 and CHEM 430G do not have any precise volumetric tools at microliter scale. The acquisition of four sets of micro pipette with pipette tips and two multimeters would allow the students to have decent amount of training in transferring microliter scaled solution with micropipette, and to be better prepared for their career, due to this improved technology.

A. Purpose of grant and impact to student body as a whole

The purpose of this proposal is to acquire micropipette and multimeter to improve precision and accuracy in Analytical Chemistry Laboratories. The analytical lab courses (CHEM 222 and CHEM 430G) provide students with experience in the application of analytical chemistry concepts by solving analytical problems and using modern chemical tools and instrumentation, to obtain precise and accurate results. Accuracy reflects how close a measurement is to a true value, while precision reflects how reproducible measurements are. Several experiments in the courses are designed to measure and dispense small volumes of a variety of liquids with low concentrations. The smaller the volumes, the more difficult the measurement is, and yet the more important it is to do so accurately and precisely. As for our students, working with such small volumes would present serious challenges to them, because it is impossible to pour a few microliters of liquid into a graduated cylinder, and even small measurement errors can have huge consequences when measuring tiny volumes. Suitable microscale tools in volumetric measurement are necessary. Micropipettes are sophisticated instruments designed specifically to measure and dispense small volumes of liquids, as little as one microliter (one-thousandth of a milliliter). In the Analytical lab, we are replacing macroscale to microscale experiments. Such experiments will result in less hazardous waste, which are more economic as well as safe. The fact that CHEM 222 and 430G students do not currently have any precise volumetric tools at microliter scale, this results in low accuracy and less precise chemical measurements. This will be reflected on students' lack in training that is required for their future career. Therefore, it is critical that we improve our technology by implement micropipettes and their accessories into our analytical chemistry laboratory courses, given that most of our CHEM 222 and 430G students are biology, environmental, education, chemical & petroleum engineering, and pre-pharmacy or pre-med as well as forensic majors.

The micropipettes will be used by students in chemistry, biology, and pre-pharmacy majors every semester and will enhance their education in science by introducing commonly used techniques, and reinforce what they learned in previous chemistry laboratories. Two sessions in the fall and one session in the spring of 34 - 45 students take Analytical Chemistry Laboratories in room 206 of Montgomery Hall, and 6 - 9 students enrolled in instrumental analysis (lecture, lab and essay). Each section of the course is limited to 10-14 students because of safety concerns and the lab space. The waiting list for each of sections of these courses is the same as the number of students allowed in each session each semester. It is estimated that approximately 60 students will learn how to use those micropipettes and multimeter, so to improve the precision and accuracy of measurements. This will give them decent amount of training in transferring microliter scaled solution with micropipette since it is a critical part of many biology and chemistry laboratory procedures in both industry and academy.

In addition to micropipette, two Cole-Palmer multimeters (True-RMS industrial log) are requested from this proposal, as they will be used in the same experiments as those of the micropipette, as well as being used to measure Faraday currents. The specific multimeter have peak capture to measure transients as fast as 250 μs , be able to monitor and to graphically view logged readings without a PC. The implement of this Cole-Palmer 280 series multimeter will further improve the accuracy and precision of the measurement through real time analysis.

If the funds are approved, four sets of micropipettes with various volume range and pipette tips, and two Cole-Palmer multimeters will be purchased and placed into room 206 of Montgomery Hall. The

instructors and professors who oversee the laboratory will maintain the micropipettes and multimeters, and ensure that work for all students for many years to come.

B. Projected Lifetime of Enhancement

The projected lifetime of the instruments requested is over ten years.

C. Person(s) Responsible for:

Implementation: Hui Yan and Febee Louka

Installation: Hui Yan and Febee Louka

Maintenance: Routine maintenance covered by the Department of Chemistry

Operation: Faculty of the Department of Chemistry and Analytical Laboratory Students

Training: Faculty of the Department of Chemistry

Budget Proposal

- 1. Equipment \$3665.06**
- The list price of Reviteq MicroPette Plus Autoclavable Pipettor have 7 sizes, 0.1-2.5 μL , 0.5-10 μL , 2-20 μL , 10-100 μL , 20-200 μL , 100-1000 μL , and 1000-5000 μL with the list price \$75 each, four groups of students in Chemistry 222 will need one set for each group. The total for the Pipettor is \$2100.00.
 - Carousel Pipettor Stand for 6 Pipettors is needed to hold the micropipettes during the experiment, they cost \$50 each, a total of \$200 for four.
 - The list price for one Cole-Palmer multimeters (True-RMS industrial log) is \$567.95, a total of \$1135.9 for two.
 - Each of the multimeter needs a case (\$37.85) and calibration standards (\$76.73), a total of \$229.16 for two sets.
- Therefore, a total of \$3665.06 for equipment.
- 2. Software \$0**
- 3. Supplies \$1,438.50**
Various sizes of LineSCIOLOGEX MicroPette tips for micropipettes
- 4. Maintenance \$0**
- 5. Personnel \$0**
- 6. Other \$34.16 (shipping)**

shipping and handling \$34.16

TOTAL: \$5,137.72

Other Relevant Information

None

Previous STEP projects

Hui Yan has no prior involvement with STEP

Febee Louka "Economical Micro scale Equipment in Chemistry Labs" Spring \$16,843.40