

UNIVERSITY OF LOUISIANA AT LAFAYETTE

STEP Committee

Technology Fee Application

Acquisition of Vernier Lapquest for Analytical Chemistry
Title

**Dr. Zachary L. Highland, Dr. Hui
Yan (co-PI), Dr. Gus Gallo**

Name of Submitter
(Faculty or Staff Only)

Department of Chemistry

Organization

Title: Acquisition of Vernier Labquest for Analytical Chemistry Date: January 10, 2018
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Department/College/Org: Department of Chemistry

ABSTRACT (250 words or less):

The proposed grant is for the acquisition of Vernier Labquest experiment stations for the purpose of improving technology and instrumentation in teaching analytical chemistry. With this grant many of the instruments in the analytical chemistry class, specifically for Chemistry 222 and 430, will be replaced with modern and advanced functionalized equipment. The proposed equipment will directly cover a majority of the topics and teaching instrumentation needs for Chemistry 222 and 430. In addition, a variety of chemistry classes will benefit from the addition of this equipment to the department of chemistry. Several other labs will have access to the equipment after the primary investigator trains the instructors. Approximately, 60 analytical chemistry students will have direct access to the use of the equipment that this grant will provide. Other labs may use the instruments as supplemental to their needs and could have an impact on at least 300 students per semester, after proper training of the professor of the class is completed. The acquisition of this instrumentation is meant to be the foundation for the analytical laboratory systems that can be expanded with future grants as educational and possible research goals present themselves for the advancement of the university and the state of Louisiana.

Proposal:

The proposed project will be to acquire six Labquest workstations to facilitate modern and accurate systems of measuring chemical reactions particularly those obtained from analytical chemistry experiments. At present, the university's analytical measurements are being conducted using non-standardized equipment, which are considered outdated relative to current standards of data collection for analytical chemistry. Under this proposal, six Labquest stations with sensors capable of monitoring chemical reactions will be procured. This capability will greatly improve the university's chemistry curriculum as it trained students and staff to meet today's analytical chemistry demands. Currently, instrumentation is separately employed for each measurement, whereas with the Labquest systems, multicomponent measurements can be simultaneously obtained and plotted over the course of an experiment. For instance, with the Labquest multi-sensing capability, an experiment can be designed to measure a flask's gas pressure while its temperature is being regulated. This experiment can be used in conjunction with a temperature probe and allow multicomponent analysis. By obtaining these systems most of the laboratories that are used in the Chemistry 222 course as well as the Chemistry 430 can be redesigned for the modern era of analytical chemistry. However, other laboratories within the chemistry department can use the equipment once the instructor has had direct training by the Primary Investigator. With the system's applicability to several laboratory classes, this equipment would be highly beneficial to around 300 students each semester through chemistry 112, 115, 212, 222, 233, 234, 311, 312, and 430 courses. The target primary users will be the 60 students enrolled in analytical chemistry classes. The instruments' portability allows it to be transferred to other laboratory classes/rooms where it is deemed necessary at a particular time. Instructors who would like to utilize the instruments must first undergo a proper and complete training on the instrument's handling and usage, which will be administered by Dr.

Highland. It should be noted that the equipment is first and foremost meant to enhance the teaching of analytical methods.

Teaching of appropriate and reliable analytical methods is of great importance for students majoring in the science and engineering fields. The requested instruments will improve the current curriculum of the analytical chemistry laboratories. Together with Labquest, several sensors that monitor temperature, pressure, pH, absorbance, current, voltage and conductivity will be purchased upon approval of this grant. Collecting this information is fundamental in analytical techniques used in chemistry that will further aid the students to achieve valuable insight into many analytical applications. For temperature, three temperature sensors will be used to accurately monitor temperatures of chemical reactions over time. Gas pressure sensors (3) will be used to monitor gas evolution as chemical reactions progress while ultra-violet and fluorescence spectrophotometers (2) will be used to monitor the formation and progress of reactions as they form colored complexes during a reaction. The pH sensor will be used to determine the acidity and alkalinity of laboratory samples, which have high applicability in general, environmental and educational chemistry experiments. Moreover, pH sensors will also be of great utility for precise monitoring of acid/base titration reactions, which the current chemistry laboratories are incapable of conducting. The use of an ORP, constant current, voltage and conductivity probe will allow measurement of electrochemical signals which are pertinent data for environmental and industrial chemistry, therefore benefitting not just the chemistry major students but engineering students as well. The mini gas chromatography instruments will be utilized for analysis of organic and some inorganic molecules for advancement of student's knowledge and understanding of structural arrangement and configuration of chemical compounds.

For convenient data retrieval, the Logger pro software will also be acquired. It is a site-licensed software that can be installed on computers at the University of Louisiana at Lafayette and on personal computers of students enrolled in the course. The use of this software will likewise facilitate data analysis that is necessary for interpretation of experimental results. Major advantage of this program is its compatibility with other programs such as Microsoft Excel or Kalida Graph, which permits data export if further data analysis and graph creation are to be performed.

For the utility optimization of the proposed equipment and sensors, additional equipment and supplies are added into the proposal for the support of the system. This includes: (1) An iMac for data analysis of the student's experimental data (The PI has numerous years of experience teaching data analysis using an iMac and compatible software). Microsoft office suite will be obtained from IT department for the use of data analysis; (2) Electrode supports to maintain and hold probe positions while various measurements are being carried out; (3) Cuvettes to serve as container for liquid samples for the conduct of spectrophotometry – Quartz type cuvettes are preferred because of its extended transmission range of 190-2,500 nm, taking into account light absorbance in the ultraviolet region, where most organic molecules absorb light energy; (4) A drop counter to automatically count the number of titrant drops needed to neutralize an analyte – drop count data can be easily plotted on pH or conductivity data. This is a novel way of performing titration experiments in which Dr. Highland is prepared to develop into a laboratory exercise.

Experiments will be designed to further develop and enhance the student's ability to solve chemical problems and challenges that face Louisiana and primary industries in Louisiana. Other departments can also benefit from the acquisition of this equipment as students enrolled in analytical chemistry course are not just chemistry majors, but also include engineering, environmental studies, biology, education, preprofessional, and environmental majors. Having a solid foundation of analytical chemistry is crucial over a wide variety of scientific and nonscientific disciplines. The ability to properly handle and process samples and conduct appropriate chemical analysis for identification of chemical

composition and chemical properties using reliable instruments is fundamental for success of many industries. Beyond sample analysis, the data obtained from this instrumentation will help students incorporate their knowledge from other disciplines such as statistics and computational data sciences. The goal of these classes is to develop the students' confidence to properly and accurately analyze and solve certain chemical problem.

Procuring this equipment will be a startup for upgrading major instrumentation in the University's analytical laboratory. The Labquest system was chosen due to the system's ability to be expanded. The instrumentation selected will serve as basis for expanding the analytical chemistry teaching laboratory and complement the students and faculty's research component. The system is designed to grow and expand in coming years as more grants are applied and additional equipment is identified. The benefit of procuring these equipment and instruments far outweighs their costs. For approximately \$20,000 an entire basic chemistry teaching lab can be set up to teach qualitative and quantitative methods of chemical detection and analysis with high accuracy and reliability. In contrast, a gas chromatograph instrument, which may cost approximately \$50,000 for a lower end research grade, have very narrow application, hence lesser impact on teaching. For laboratory teaching, fund allocation for highly expensive instruments will be extremely challenging. In this grant, lower cost instruments will be purchased for the primary purposes of teaching analytical concepts.

PRINCIPAL INVESTIGATOR and IMPLEMENTATION

During the course of this grant, several objectives will be monitored and evaluated: (1) The acquisition of the instruments; (2) Once the measurement devices are purchased, the laboratory procedures will be rewritten and new experiments will be developed to utilize the full potential of the probes. Experiments will be designed to further develop and enhance the student's ability to solve chemical problems and challenges that face Louisiana and primary industries in Louisiana; (3) Training of the instructors within the analytical faculty in the department of chemistry. Dr. Highland will hold several training sessions for the analytical faculty and develop instruction manuals for the new equipment. Dr. Highland has used this type of equipment previously during his teaching experience and has developed instructional videos on laboratory procedures as well as designed experiments during his time at LSU using the Labquest systems. With the knowledge learned during that experience plus knowledge gained from company representatives, in depth instruction manuals will be prepared. A binder with the instruction manuals will also be constructed for future reference.

The equipment will be housed in the analytical chemistry classroom at Montgomery Hall 218. Designated lab tables will be allocated for larger instruments, which will likewise serve as a station for a particular experiment. Dr. Highland will be responsible for the ordering of the instrumentation and will train faculty members on the proper usage and maintenance. Dr. Highland will work with Dr. Yan (co-PI) to coordinate the experiments around the new instrumentation and rewriting some of the curriculum around the experiments. Dr. Gallo will work to utilize the Labquest systems in organic, biochemical and other teaching laboratories. The chemistry department will be responsible for the upkeep of the equipment after the initial warranty has expired.

Due to the many components of this system, a quote is attached to this grant for the itemized list of equipment. As mentioned above this setup is the start up for a system that can be expanded as educational needs grow and develop within the science, and engineering departments.

Previous grants obtained from current investigator

Fall 2017 was the primary instructor's first semester at the University of Louisiana at Lafayette. For this reason, this is the professor's first grant at this university. However the professor continues to

plan and apply for grants in the upcoming years and is excited to seek future funding opportunities.

Budget Proposal

1. **Equipment** **\$ 19,167.76**

2. **Software** **\$ 249.00**

3. **Supplies** **\$ 700**

4. **Maintenance** **\$ 0**

2

5. **Personnel** **\$ 0**

6. **Other** **\$ 0**

TOTAL: **\$ 20,116.76**

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Quote

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 Zachary Highland
 UNIV OF LOUISIANA-LAFAYETTE
 c00408401@louisiana.edu
 LAFAYETTE, LA 70504

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Qty Ordered	Qty Shipped	Item Code	Description	Retail Price	Unit Price	Total Price
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6	6	TMP-BTA	STAINLESS STEEL TEMP PROBE	29.00	28.13	168.78
5	5	PH-BTA	PH SENSOR	79.00	79.00	395.00
3	3	GPS-BTA	GAS PRESSURE SENSOR	83.00	83.00	249.00
3	3	VP-BTA	VOLTAGE PROBE	12.00	12.00	36.00
3	3	CON-BTA	CONDUCTIVITY PROBE	95.00	95.00	285.00
3	3	VDC-BTD	VERNIER DROP COUNTER	99.00	99.00	297.00
3	3	CCS-BTA	CONSTANT CURRENT SYSTEM	59.00	59.00	177.00
3	3	ORP-BTA	ORP SENSOR	81.00	81.00	243.00
2	2	GC2-MINI	VERNIER MINI GAS CHROMATOGRAPH	1,999.00	1,999.00	3,998.00
2	2	WRT-BTA	WIDE-RANGE TEMP PROBE	82.00	82.00	164.00
6	6	ESUP	ELECTRODE SUPPORT	10.00	9.70	58.20
1	1	LP	LOGGER PRO 3 SOFTWARE	249.00	0.00	0.00
2	2	VSP-FUV	VERNIER FLUORESCENCE/UV-VIS SPEC	2,750.00	2,750.00	5,500.00
2	2	VSP-UV	VERNIER UV-VIS SPECTROPHOTOMETER	1,999.00	1,999.00	3,998.00
4	4	CUV-QUARTZ	QUARTZ CUVETTES (2)	189.00	189.00	756.00

Total Item Qty: 54

The prices listed on this quote are valid with complete shipment to one location. Any applicable tax will be based on the bill-to entity, the ship-to address, and the date of the shipment.

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