

**Division of Academic Affairs**  
**Technology Fee – Project Proposal**  
**2015**

*Proposal Deadline: Wednesday, January 21, 2015*

***Project Proposal Type***

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***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***

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*<LabQuest2 data collection system for inquiry-based learning in biology laboratories >*

***Total Amount of Funding Requested***

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*<\$15,112.72 >*

***Primary Project Coordinator***

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*<Kari B. Clifton>*

**Division of Academic Affairs**  
**Instructional Technology Enhancement Project (ITEP) Proposals Template**  
**2015**

ITEP proposals must provide the following information:

**1. Project description.**

I am the lab coordinator for the lower division biology labs in the Biology department. I am moving toward creating a more interactive, inquiry-based curriculum in the general biology labs for both majors (BSC2010L) and non-majors (BSC1005L). Both courses are general studies courses. BSC2010L is Biology I- the first course taken by every biology major at UWF.

Vernier's LabQuest2 is a standalone interface used to collect sensor data with its built-in graphing and analysis application (<http://www.vernier.com/products/interfaces/labq2/>). The large, high-resolution touch screen makes it easy and intuitive to collect, analyze, and share data from experiments. It has a rechargeable battery. Over 70 sensors are available à la carte. This data collection system is widely used in STEM education programs; I have personally used it in the college laboratory setting at another institution.

The LabQuest2 system will allow students to design and test their own experiments in a way that is not possible with the equipment we have now. For example, we have a lab examining enzyme function. Currently, students set up a series of tubes with varying enzyme concentrations. They incubate them in a water bath for different lengths of time (this is so the plot makes a straight line on linear graph paper, but this idea is difficult to explain). They then read the absorbance of each tube in a bench top spectrophotometer. At the end of 2 hours and 45 minutes, the students have a few points to plot a single line. However, all they use is one data point to calculate specific activity of the enzyme. Rather than static measurement of a sample in a tube, the LabQuest2 unit with spectrophotometer sensor will allow dynamic measurement of a reaction in progress. The students conduct an experiment where they measure absorbance of an enzymatic reaction in real time. The slope of the line generated from the absorbances collected at intervals is equal to the reaction rate. Once the students are familiar with the basic idea, they design their own experiment to test some variable effecting the function of enzymes of their own choosing, such as the effect of temperature or pH. They conduct their experiment collecting data in real time, compare the reaction rates, and make some conclusions about the effect of their selected variable on enzyme function. The system has the added bonus of saving us some money, since the volume of substrate, etc. needed for the reaction is only 2 mls, compared to 5 mls (i.e., for each data point. So collecting 5 points requires 25 mls with current system, but only 2 mls with proposed system) for the table top spectrophotometers. The current experiment uses a substrate that costs \$444 for 10 grams! My experiment uses enzymes from potatoes. (It's the enzyme that makes food turn brown once it's been cut; it's related to dopamine – the brain chemical that will make you feel happy when you fund my proposal.) They will also learn to use Excel to

make graphs and calculate slope. If the students are more advanced they can learn how to statistically compare the slopes.

For BSC2010L we will use the gas sensors, biochambers, and dissolved oxygen probe for labs on cellular respiration/photosynthesis, in addition to the enzymology lab. In non-majors biology (BSC1005L) I will use them for cellular respiration/photosynthesis just as in BSC2010L. I will replace the existing anatomy and physiology lab, which currently consists of labeling diagrams and watching a video on digestion (featuring America's sweetheart, Olympic speed skater Bonnie Blair), with hands-on activities including determining heart and respiration rates, spirometry, and electromyography. I will use the pH sensor in the cell structure and function lab to examine properties of buffers. Since the LabQuest2 units are self-contained, battery operated, rugged, and water resistant, they can be used outdoors. I also plan to add an ecology lab to the non-majors course, so we can use them in the nature areas near the biology building to measure water properties of temperature, pH, and dissolved gases.

I am requesting eight LabQuest 2 Biology Packages with the deluxe sensor package, and 8 spirometer sensors, which are not included in the package. Each package comes with the data collection interface and 13 sensors. We have a maximum of 24 students per lab; this will allow students to work in groups of 2-3. I have found that in groups of 4 or larger someone ends up without something to do. A group size of three allows for one person to run the equipment, one to prepare samples, etc., and one test subject for those activities that require one.

**2. Description of project alignment with UWF Strategic Plan.**

The project most closely aligns with strategic direction 1 in that students are actively engaged when they are designing, conducting, or troubleshooting an experiment and evaluating high-quality data.

**3. Description of benefits provided:**

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

LabQuest 2 is a versatile data-collection device for STEM education. It allows real time data collection that facilitates inquiry-based activities in the lab and out in the field. It more closely mirrors the type of measurements students will encounter as scientists than many of the techniques we currently use in lab-in other words, it offers a more real-world experience. They will also get a better sense of how to apply the scientific method to address relevant questions.

*b) How the student experience will be enhanced.*

The inquiry-based process aims to enhance learning based on increased student involvement and leads to active construction of meaningful knowledge, rather than passive acquisition of facts presented by the instructor. Students will collaborate on designing experiments, conducting experiments, and gathering data. They may re-evaluate question based on new data and re-experiment or collect new data based on revised question. This technique has been shown to benefit students of multiple learning styles. It has also been shown to better help students build on previously learned knowledge than more traditional techniques.

c) *How assessment will be conducted.*

I have been tracking the overall performance of students in lab since my arrival by monitoring course grades and drop/withdraw/fail rates. A big contributor to student success depends on how interested the students are in the activities. Last semester the interest level was quite low; the favorite labs were simply the ones that took the least time. At the midpoint the students have responded well to the new labs introduced this term. Enthusiasm level is higher and weekly quiz grades have also improved. I give clicker quizzes each day in lecture for a participation grade; I survey the students twice per semester to gauge their interest in/perceptions about the lab activities, and the other lecture professors also give my survey to their students. I will expand my surveys to include specific questions about laboratory classroom technology.

d) *Which and how many students will be impacted.*

The number of students enrolled in BSC2010 (Biology I for majors) was 408 in Fall 2014 and is 144 for Spring 2015. BSC 1005 (General Biology for non-majors) has a total of 312 enrolled in lab this academic year (192 in Fall and 120 in Spring). We have experienced an increased demand for these courses, and we expect the numbers to grow significantly for the majors course. Additionally we will offer it in Summer sessions starting this summer; right now we plan for 48 students.

e) *How students with special needs or disabilities would be helped.*

Students with special needs may benefit from having a computer available to them during the laboratory sessions. The computer offers visual and tactile modalities to students; this may increase learning not only students with disabilities, but all students can benefit from stimulating additional senses. Additionally, it allows students to work at their own pace. This will be particularly important throughout the genome annotation phase of this program.

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

I hold weekly meetings with the IORs and TAs to review the protocols. When any new protocol is implemented, we actually carry out the procedure so the instructors become familiar with the equipment and protocols. There are also handouts for the instructors with detailed instructions for setting up and operating the system. Additionally, I provide written detailed experimental procedures which guide lab students through the calibration and use of the system to collect their data, and to analyze the data.

**4. Description of how the initiative has a potential scope within and beyond that of the proposing unit.**

Dr. Peter Cavnar plans to use this equipment in his cell biology labs to conduct cell metabolism experiments, measuring dissolved oxygen and carbon dioxide. He will also use the spectrophotometer sensor to monitor various types of chemical reactions in real time. He plans to use this sensor exclusively, in place of the table top units we currently use. Dr. Cavnar estimates an annual enrollment of ~ 144 students. Dr. Jane Caffrey has expressed interest in using the sensors for her Aquatic Botany and Estuarine Ecology classes.

**5. How will success be measured? Provide metrics.**

The following metrics will be used: 1) Are the students able to successfully use the LabQuest2 system? 2) Are the students able to design a feasible experiment using the data acquisition units effectively? 3) Are the students able to apply the scientific method – to develop testable hypotheses and design experiments appropriate to test them? 4) Are they able to draw accurate conclusions from their data, and generate further questions? 5) Are students able to effectively communicate and defend their ideas and findings in a scientific context?

**6. Description of resources for the project and projected ongoing resource needs (total cost of ownership for the life of the project) including:**

- a) *Any hardware requirements* – LabQuest 2 Deluxe package LQ2-BIO-DLX  
8@ \$1,678.00 = \$13,424.00  
Spirometer SPR-BTA 8@ \$193.03 = \$1,544.24  
Shipping \$144.48  
**Total cost \$15,112.72 (see attached quote)**
- b) *Any software requirements* – none.
- c) *Any personnel costs* – none.

**7. Provide the proposed timeline for the project with major milestones and project end dates.** I am ready to implement new laboratory protocols as soon as the equipment is purchased. Use of this equipment will be ongoing.

**8. Include a plan for sustainability of the project beyond the initial project period if applicable.**

The system has a life expectancy of 10 years with proper care and use. There is a limited 5 year warranty on the equipment, and a 1 year warranty on the battery. During the warranty period, Vernier will repair or replace the item if there is a defect in materials or workmanship. Outside the warranty Vernier will also perform repairs; according to their website they rarely charge for such repairs. For repair/replacement costs, as well as additional sensors, I have included the units in the equipment fees.

**9. Provide any resource matching which might be provided by organizations with appropriate commitment authority documentation.**

None

**10. Indicate which individual or group will implement the project (to help determine any additional costs and resource restraints).**

Dr. Kari Clifton is the laboratory coordinator for the Biology I and II labs for biology majors, and General Biology lab for non-majors, and is responsible for adapting and modifying existing experiments as well as designing new experiments to enhance the curriculum.

**11. Indicate a lead person (“Principal Investigator”) for the project for all communications and overall responsibility for reporting and fund utilization.**

Dr. Kari Clifton, Lecturer, Biology Department

**12. Project proposals should be succinct and submitted to the Technology Fee Committee by the deadline with a notice of submission to the chair and the dean or appropriately designated leadership in the unit (Center Director, etc.).**



**VERNIER SOFTWARE & TECHNOLOGY**  
 13979 SW MILLIKAN WAY  
 BEAVERTON, OR 97005  
 503-277-2299 fax 503-277-2440  
 EIN:93-1162373

**Quote**

Vernier Quote: 1028626 - 000  
 Customer: 714201

**Customer:** 714201  
 KARI CLIFTON  
 UNIV OF WEST FLORIDA  
 KCLIFTON@UWF.EDU  
 PENSACOLA, FL 32514-5732

Quote Date	01/21/2015	Expire Date	12/31/2015	Employee	gvanness	Ship Via	UPS	MOS	GROUND	Terms	NET 30 DAYS	Contact ID		Currency	USD
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Qty Ordered	Qty Shipped	Item Code	Description	Retail Price	Unit Price	Total Price
8	8	LQ2-BIO-DLX	BIO LABQ2 DLX PKG	1,730.00	1,678.00	13,424.00
			8 LABQ2			VERNIER LABQUEST 2
			8 TMP-BTA			STAINLESS STEEL TEMP PROBE
			8 HGH-BTA			HAND-GRIP HEART RATE MONITOR
			8 GPS-BTA			GAS PRESSURE SENSOR
			8 CO2-BTA			CO2 GAS SENSOR
			8 O2-BTA			O2 GAS SENSOR
			8 BC-250			250 ML SAMPLING CHAMBER
			8 BC-2000			2 L SAMPLING CHAMBER
			8 CON-BTA			CONDUCTIVITY PROBE
			8 PH-BTA			PH SENSOR
			8 COL-BTA			COLORIMETER
			8 EKG-BTA			EKG SENSOR
			8 RMB			RESPIRATION MONITOR BELT
			8 DO-BTA			DISSOLVED OXYGEN PROBE
8	8	SPR-BTA	SPIROMETER	199.00	193.03	1,544.24

**This quote is valid through 12/31/2015. Shipping cost is for complete shipment to one location.**

<b>Line Item Total:</b>	14,968.24
<b>Shipping:</b>	144.48
<b>Subtotal:</b>	15,112.72
<b>*Estimated Tax:</b>	0.00
<b>Total:</b>	15,112.72

Total Item Qty: 120

\*To be determined at invoicing where required