Division of Academic Affairs
Technology Fee – Project Proposal
2014

Proposal Deadline: Tuesday, January 21, 2014

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

Teaching Molecular Engineering and Interactions to Students of Physics and Chemistry Using Current Technologies

Total Amount of Funding Requested

$ 19,400

Primary Project Coordinator

Chandra Prayaga, Department of Physics

Division of Academic Affairs
Instructional Technology Enhancement Project (ITEP) Proposals Template
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ITEP proposals must provide the following information:

1. **Project description.**
   Title: Teaching Molecular level Engineering and Interactions to Students of Physics and Chemistry Using Current Technologies

   Introduction: Investigating and understanding molecular level interactions has been one of the fundamental problems of Physics, Chemistry and Materials Science. Probing these interactions at the molecular level is made possible with the use of the Langmuir-Blodgett (LB) Trough, a research instrument which utilizes breakthrough technologies in several fields, which, till recently, has been an expensive instrument available in only a few research labs around the world. Recent advances in materials technology, sensor technology, and computer technology have made this instrument available at a reasonable price and accessible to students working in teaching labs with modest budgets. The Physics department, UWF, had purchased an LB trough 20 years ago for nearly $ 45,000 with a special grant from the National Science Foundation, and the instrument was being used only for special research purposes.

   The intent of this proposal is to implement the novel idea of using the technologies incorporated in this instrument for instructional purposes, in the field of molecular engineering and interactions.

   Three events lead to the current proposal:

   A. The original LB trough in the Physics department has now reached the end of its life, and cannot be repaired any more.
   B. As mentioned above, similar instruments, which are the products of current technologies in materials, sensors, and software, are now available for the more modest price of around $ 15,000, which brings this front-line research instrument within the grasp of a modest funding proposal.
   C. The Physics department has taken a decision to include inter-disciplinary research experiences, which are at the intersection of Physics, Chemistry and Materials Science, in the curriculum of all Physics majors.

   It might be added here that, as a result of the implementation of the third item above, Physics majors taking the Undergraduate Research course during the past three years have been publishing their research work in the nation's largest Physics conference – the Annual Meeting of the American Physical Society – famously known as the "March Meeting". Some of these publications did come from the use of the old LB trough, which now no longer works. (See Publication listed at the end of the proposal)

Exploring new applications of instructional technology: The use of the instrument includes training in using the latest advances in materials technology, sensor technology, software technology, and most importantly, "Molecular Technology". Students will learn to manipulate materials at the molecular level, by the use of this technology, and design new types of materials on their own. Hitherto, this instrumentation and technology has been restricted to research use. Now, it is feasible to include this technology of "Molecular Engineering" as part of the curriculum of a student in Physics and Chemistry. This project represents the use of Molecular Technology in instruction, in a way that has not been explored.

Lead to Systemic Proposal for "Molecular Engineering Laboratory": Following this initial setup of a Langmuir-Blodgett trough, and depending on the success of this project, a more extensive Molecular Engineering Laboratory with several such instruments will be established with funds from a Systemic Proposal, which will lead to student lab setups in Molecular Engineering, catering to students from physics and chemistry courses at the freshman level, through capstone projects at the research level.

Implementation: The implementation of the project is in four stages:

- **A.** Acquire the Langmuir Blodgett Trough
- **B.** Set up the instrument and test it
- **C.** Use the instrument in the Modern Physics Lab course (PHY3106L taken by all Physics majors) and in the Undergraduate Research Courses (PHY4905L taken by all Physics majors)
- **D.** Use the instrument in interdisciplinary UG student research projects which include students from Physics and Chemistry working together. (Support letter from Dr Tim Royappa, Chemistry, attached to this proposal)

Timeline:

Acquiring the instrument:	3 months
Setting up and testing:	15 days
Use of instrument for Instruction:	Starting summer 2014, every semester by Physics and Chemistry students

Budget:

Instrument cost:	$ 16,000
Starting chemicals	$ 1,000
OPS funding for student trainees	$ 2,400
(2 students x 10 hrs/week x $ 10 per hr for initial setup and testing 3 months)	
Total	$ 19,400

2. Description of project alignment with UWF Strategic Plan.

The level of technology, in the fields of materials science, engineering and computers that is involved with the instrument, and the fundamental level of instruction that is possible with it, make the instrument a highly attractive facility for the recruitment, high-quality learning, and successful degree completion, as well as successful progression towards higher studies for our students in Physics and Chemistry.

The project therefore aligns with the following UWF Strategic Directions and UWF Priorities:

Strategic Direction 1: Enhanced Student Access, Progression, and Learning and Development

> UWF Priority 1.1. Foster student learning and development to include the knowledge, skills, and dispositions that optimize students' prospects for personal and professional success.

Strategic Direction 2: Distinctive Teaching, Scholarship, Research, and Professional Contributions

> UWF Priority 2.1. Respond to the changing needs of the region, state, and nation by investing strategically to support innovative instruction and high-quality, relevant, and distinctive academic and research programs.
>
> UWF Priority 2.3. Build a vibrant culture of scholarship and research that aligns with UWF's strengths and capacities and supports UWF's mission, vision, and values.

3. Description of benefits provided:

a) Ways in which student access to technology will be enhanced:
The instrument is designed using the latest materials technology, sensor technology, and software technology. The students will be exposed to the technology in several different fields.

b) How the student experience will be enhanced:
Student learns to use this sophisticated front-line research instrument, understands molecular interactions at the fundamental level, and has the prospect of participating in national conferences in physics and chemistry and materials science, depending on performance

c) How assessment will be conducted:
Students submit lab reports containing detailed lab procedures, data acquisition methods, data presentation and analysis. These will be graded based on rubrics allocating specific portions of the grade to each part. Students also prepare a PowerPoint presentation of their experimental work, and present it to their peers and instructors. This will also carry part of the grade. This will be the assessment procedure for the Modern Physics Lab course. In the Undergraduate Research Course, in addition to these sections, the highest grade is for students whose work is of such high quality as to deserve presentation at a national conference.

d) Which and how many students will be impacted.
Physics: 30 – 40 students during the academic year, from PHY3106L, PHY4905L, and about 10 Physics students during summer semester (PHY4905L), every year.
Chemistry: about 50 students per semester from CHM 1905, CHM 3905, CHM 4905 and CHM 4912 (See support letter from Dr Royappa, Chemistry)

e) How students with special needs or disabilities would be helped:
Depending on the special needs, student may be able to specialize in certain aspects of the use of the instrument, for example, a student who cannot handle very fine sample preparation, may still be able to specialize in the computer interfacing, data gathering and analysis.

f) How training of students and faculty in the use of technology would be enhanced:
This instrument represents the highest quality of current technology in Materials Science and Sensors, and Computer based Instrument Control, Data Acquisition, and Analysis. Faculty would be using this technology to teach students the fundamentals of molecular interactions and materials engineering at the molecular level. Students would be trained in the use of this technology and the techniques of preparing ultra-thin films at the molecular level, and gaining insight into the interactions of molecules at the fundamental level.

4. How will success be measured? Provide metrics.

Success of the project is measured by the following metrics:

1. Has the instrument been set up, as specified?
2. Is the responsible faculty able to use the instrument as specified?
3. Is the instrument being used in the courses mentioned in the project proposal?
4. Are students able to use the instrument to obtain results which can be meaningfully graded as specified in the proposal?

5. 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 (which should comply with standards established by the ITPAC (Information Technology Planning and Advisory Committee).
No particular requirements. The instrument will come with a dedicated pc for instrument control, data acquisition and analysis. The instrument need not be connected to the university data network.

b) Any software requirements (which should comply with standards established by the ITPAC (Information Technology Planning and Advisory Committee).
-NIL

c) Any personnel costs – only OPS and other time-limited appointments, non-recurring.
- OPS costs $ 2,400 as given in budget

6. Provide the proposed timeline for the project with major milestones and project end dates.

Timeline:

Acquiring the instrument:	3 months
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Use of instrument for Instruction: Starting summer 2014, every semester by Physics and Chemistry students

7. **Include a plan for sustainability of the project beyond the initial project period if applicable.**
   Only costs after initial set up are replacement of consumable items such as chemicals and pressure sensors, which will be covered by the Physics Department materials fee for the labs

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

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

   Implementation by the Physics Department faculty, PI: Dr Chandra Prayaga

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

    Principal Investigator: Dr Chandra Prayaga

11. **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.).**
12. **Supporting Document:**

    A. **Text from email Letter of support from Dr Tim Royappa, Chemistry Department**

Tim Royappa 2:08 PM (2 hours ago)

to me

Chandra,

Your proposal to get a Langmuir-Blodgett (LB) trough with an ITEP grant is a sound idea. I think it will be very useful for teaching molecular and nanoscale engineering to Physics students. As you know, I used an LB trough extensively for my PhD research, and found it to be a very important instrument for that work. Fortunately, it was cheap and simple to use, so this will be helpful as you install it for use by your undergraduate students.

I think Chemistry students would benefit from this equipment, as well. Research students in CHM 1905,

CHM 3905, CHM 4905 and CHM 4912 (about 50 students per semester) would all be likely to benefit from having a modern LB trough on campus, since many of them carry out synthesis of novel molecules that may be incorporated into LB films. It would help them learn the importance of intermolecular interactions (both ionic interactions as well as dispersion forces).

Best wishes to you in your endeavors!

B. Publication from American Physical Society March Meeting:

Laser Induced Fluorescence Spectroscopy of a Langmuir Monolayer of C-16 Fluorescent Dipyrrinone Liquid Crystal

Christian Struebing, Giovanni DeLuca, Chandra Prayaga, Aaron Wade, Michael Huggins, Amy Renaud, Rebecca Chandler, March 18–22, 2013; Baltimore, Maryland

Responses to Review Comments by ITS:

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

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