2010 Student Technology Fee (STF) Proposal Form

Title of Project:

Multichannel Pipettes for Integration of Multiwell Plate Reader into Microbiology Laboratory (BIOL 346) and Other Courses

Department/Organization: BIOLOGY
Name(s) of Project Applicant(s)
Name Marion Brodhagen MS 9160 Phone 650-2920
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Name MS
Name MS
Principal Contact person:
Name Marion Brodhagen Phone 650-2920
Amount Requested for Project:
Contribution by Requesting Organization:

Important notes:

• Before completing this form, please read the Proposal Form Instructions on the STF website: http://www.wwu.edu/stf/

• Beginning this year (2009-10), the Student Technology Fee Committee will no longer accept proposals for computer lab upgrades. Existing computer labs will now be upgraded on a rolling schedule, and the Student Technology Fee will continue to fund these upgrades. (The schedule for upgrading computer labs, when approved, will be posted on the STF website.)

I. Project Abstract

Give an overview of the existing environment, and summarize the items being requested. Briefly explain how the requested technology will:
• improve student access to technological resources, and/or
• enhance the quality of the student academic experiences through the use of technology, and/or
• increase the integration of technology into the curriculum.

This proposal requests funding for minor instrumentation that would greatly enhance the integration of technology into BIOL 346, a microbiology laboratory course. In 2007, the biology department was awarded an NSF MRI grant for the purchase of instrumentation to
enhance the cellular and molecular biology laboratory courses. Among these instruments is a multiwell plate reader. This is a spectrophotometer that measures optical properties of many small samples in high-throughput fashion (e.g., 96 samples/single plate [See Figure 1] read in less than five minutes). Samples are read in the same plates used to grow cultures, so no sample transfer is required. The plate reader itself is thoroughly up-to-date and efficient, as opposed to our existing classroom spectrophotometers that require the user to repeatedly transfer a bit of sample to a cuvette and read the samples one by one.

However, for uniformity and efficiency of sample loading, the plate reader requires the use of multichannel pipettes (Figure 2) to load the tiny sample wells. We currently have only one working multichannel pipette available for classroom use. Therefore, students cannot effectively use the plate reader unless I perform most of the plate preparation and inoculation ahead of time for them, which transforms the exercises from bona fide experiments into “cooking show” type experiences where they are mere observers rather than participants. I am requesting STF funds to purchase eight multichannel pipettes — enough to be shared among students in the classroom and permit them to design, set up, and carry out their own experiments using the multiwell plate reader. Our microbiology laboratory budget cannot cover the cost of these multichannel pipettes.

II. Relationship to STF Objectives and Impact on Existing Academic Programs

Describe your proposed project in detail. Tell us how it will provide positive benefits to specific courses or instructional programs.

1. From a student perspective:
   a. How would this project provide additional student access to technological resources?

The plate reader represents a standard feature of any working microbiological laboratory, and multichannel pipettes are standard peripheral equipment used with this instrument. Without the
multichannel pipettes, use of the plate reader becomes nearly impossible because each of the 96 wells of the plates must be filled accurately and uniformly with miniscule volumes, one at a time. It currently takes me several hours of prep time to pre-fill the plates for the students prior to each lab. Even with this amount of preparation, they still spend most of the two hours of their lab time inoculating the wells one by one while trying not to dribble inoculum into an adjacent well just a few millimeters away. The plate reader, used in this fashion, is anything but “high tech”. Multichannel pipettes will permit students to use the plate reader as intended – with little time spent on loading wells, and the majority of time spent designing their experiment and analyzing data.

b. How would this project broaden or enhance the quality of the student’s academic experience through the proposed technology?

I have incorporated the plate reader into fully ¼ of the laboratory course’s exercises. All of these exercises depend upon the ability to monitor bacterial growth rates by measuring the optical density of the cultures. Previously, these exercises were performed by growing bacteria in individual test tubes and comparing the population densities with an old-fashioned spectrophotometer - or with the naked eye! No replicates (or statistics) could be performed, and an analytical component to this exercise was lacking. In addition, the lab was decades out of date, as the use of multiwell plate readers for these experiments has been standard in microbiological labs since the 90’s or earlier. Now, students grow bacteria in the tiny indentations of multiwell plates. There are 96 wells per plate, and an entire plate can be measured in less than five minutes. Students compare growth of different bacterial species under various conditions. They can assess many replicates of each treatment – enough to perform simple statistical tests on their data and generate standard curves for the growth of each species. In this way, they practice and apply real-life analytical skills. Purchase of four sets of multichannel pipettes would permit the students to carry out the entire lab exercise on their own in a reasonable amount of time, and even design their own experiments and test their own hypotheses about growth conditions… rather than have pre-filled plates set out for them in what tends to be more a demonstration than a laboratory exercise.

c. How would this project integrate technology into coursework?

Incorporation of the plate reader into a significant portion of the existing laboratory course curriculum has already been done. To fully exploit the technological capabilities, students need to spend less time filling individual wells, and more time analyzing the powerful datasets they can generate with this technology. Where they previously could only compare results between single unreplicated samples, they can now analyze data from a set of experimental replicates. They can also read the same plates over time, generating time courses and evaluating the effect of experimental variables (such as antibiotics, temperature, pH, oxygen availability, or nutrient availability) on bacterial species at different stages during their growth. Students can then practice real-life analytical skills on large datasets by transforming the data, performing statistical tests, and generating growth curves.
2. From a faculty perspective, explain how this project will enhance your ability to help students meet their educational goals.

It falls within the mission of the Biology Department to help students develop their analytical skills. The use of the plate reader with multichannel pipettes will permit them to spend time learning to design and set up replicated experiments, and analyze the data generated from these studies. This instrument, if coupled with multichannel pipettes, will also permit students to experience a real-life microbiological laboratory setting. Western biology students are well-known across the nation for being well-trained in their laboratory courses, and this investment will help preserve our students’ solid and well-deserved reputation.

3. Will other departments be involved with this project? If so, please describe.

Not applicable – although we would be very happy to share the equipment with Chemistry students for use in CHEM 474 (biochemistry lab) or any other applicable courses.

4. Has any part of this project previously been funded by STF?

No X    Yes ☐   Please describe:

III. Utilization

Please list the anticipated number of times and duration per each use, per quarter, that the proposed technology will be used by students.

I have incorporated the plate reader into fully ¼ of the laboratory course’s exercises. BIOL 346 has an enrollment of 16-20 students/section/term, and we offer four sections/year. Thus, ~80 students per year will benefit from this equipment for 2.5 weeks, or for one-fourth of the duration of the term. The availability of multichannel pipettes also will permit us to update exercises in our Medical Microbiology course (BIOL 245), where 40 additional students/year will benefit from the technology.

Additionally, I teach BIOL 324 (molecular biology laboratory). A plate reader coupled with multichannel pipettes is standard equipment in molecular research as well. I can foresee using the equipment at least several times per term for standard assays (e.g. in measuring bacterial growth stages prior to making competent cells, or for measuring concentrations of DNA or cellular protein). Because BIOL 324 enrolls a minimum of 72 students/year, this would nearly double the exposure to the multiwell plate reader (and multichannel pipettes).

IV. Project Budget

This section details the estimated cost of the project. Include costs that will be covered—by your department or another source—for ongoing costs such as personnel or operating expenses.
To assist you in preparing your budget, please consult with relevant campus support departments (ATUS, Purchasing, Space Administration, etc.). For more information, see this page on our website: http://www.wwu.edu/stf/instructions.shtml

Please complete all of the following sections (attach Excel spreadsheet for any additional details).

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<th>Item</th>
<th>Quantity</th>
<th>Item Cost</th>
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</tr>
<tr>
<td>Tax (8.5%)</td>
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<td>$340</td>
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We recognize your proposed budget as an estimate. Final funding for successful projects will be established after thorough technical review; some costs may need adjusting due to price changes. The STF Committee may impose special conditions on a project; see the STF Program Description.

1. What funding is available from your department or other sources?
   None

2. Could this project be divided into discrete elements that could be funded separately?
   No X ☐ Yes ☐ Please summarize and prioritize project segments with cost estimate for each segment.

3. Are lab fees charged for any of the courses that will use this equipment?
   No ☐ Yes X ☐ If yes, please note: The total funding requested from the STF must reflect the amount collected from course fees for equipment replacement and/or equipment acquisition. All proposals asking for course fees will be reviewed by the Academic Budget Office.
Course fees currently are used for microbiological media, gloves, antibiotics, water analysis reagents, and other disposable reagents. We cannot cover this equipment within a typical quarter’s budget because there are not funds remaining after purchase of the minimum of supplies.

V. Impact on Existing Resources

The proposal should address your project’s potential impact on existing resources. Special attention should be given to impact on data transmission networks (e.g., sources accessed, networking equipment, etc.), and personnel (e.g., staffing, administrative support, faculty support, etc.).

Any proposal that includes the replacement of computers should specifically address the feasibility and cost effectiveness of upgrading the computers rather than replacing the computers.

1. Describe how existing equipment is used. Contrast this to projected use if your project was funded.

Currently, use of the plate reader requires extensive pre-lab setup by staff or by me. Multichannel pipettes would eliminate the need for several extra hours of manual labor during two weeks of each term.

2. Is similar equipment or technology available elsewhere on campus—such as the Student Technology Center, Classroom Services, Video Services, Western Libraries, a college lab? If so, please describe why the existing equipment does not meet the needs outlined in this proposal.

There is no such equipment elsewhere on campus.

3. If this project involves the replacement of equipment:

   a. Describe the “before and after” configuration changes. A spreadsheet reflecting these changes may be attached.

      Not applicable

   b. Describe the costs and benefits of replacing vs. upgrading (if applicable).

      Not applicable

4. Will this equipment be available to students outside your department?

   No ☐   Yes X ☐  If the proposed technology will be used by students outside of your department, please describe how they would gain access, how the availability of the equipment will be publicized, the hours/week when the equipment will be available, and any costs that would apply.
We will place the multichannel pipettes on the list of equipment available via the biology stockroom to undergraduate and graduate students at Western. As with all other equipment checkout, multichannel pipettes will be requested via submission of a standard form to stockroom staff.

5. Does this project involve the check-out of equipment to students?
   
   No ☐ Yes X ☑ If yes, please discuss whether or not the Student Technology Center could be assigned this task.

The STC would not be an optimal repository for this equipment because -- unlike our stockroom/lab prep staff -- STC staff would not be intimately aware of the specific days/weeks during which various Biology lab courses would need all four pipettes.

6. Does the department have adequate operating funds to provide ongoing maintenance and support?

   No ☐ Yes X ☑ Please describe.

We have a Repair and Replacement budget from which we could extract funds for maintenance.

7. Does the department have adequate personnel funds to provide ongoing staff support for this project?

   No ☐ Yes X ☑ Please describe.

Biology stockroom/lab prep staff will house and monitor the multichannel pipettes. They will also perform routine maintenance (including sending to the manufacturer for routine calibration, if necessary). This is already done for hundreds of single-channel pipettes used by students in the department and does not represent a significant workload increase.

VI. Space and Site Information

This section addresses any space alteration or site preparation necessary for the proposed project. Site alterations include painting, holes in walls, security systems, carpeting, construction, lighting changes, or conversion of a lab or office.

Special Note: If this project requires any site preparation, or if this project uses any space not currently under your department’s control, you must submit a draft proposal to Space Administration by November 25, 2009. Space Administration and Facilities Management will conduct a site survey and respond back to you concerning project feasibility, cost,
Proposals for projects that involve any site preparation will be considered only after the required site surveys by Space Administration and Facilities Management have been completed.

1. Location for installation of equipment or technology.
   No installation required.

2. Is site modification required?
   No x    Yes □
   If yes, please describe (electrical, air, painting, lighting, security, network access, etc.).

   Not applicable

3. Will this project use space not currently assigned to your department or area?
   No x    Yes □
   Please describe.

   Not applicable

VII. Project Schedule

This section describes your overall implementation schedule. Project awards will be announced by the end of spring quarter. It is anticipated that projects would be substantially completed by the end of the calendar year. If there is any site preparation involved, please align your project schedule with the schedule provided by Space Administration and Facilities Management.

No site preparation required

VIII. Constraints

This section should list any external or internal factors that could affect your project schedule, project objectives, or the project budget (e.g., if external approval is required for curricular changes, or if funding must be received by a certain date).

1. Please describe any constraints to this project.

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Funding must be received by August 2010 in order to purchase equipment for use during the Fall 2010 term.
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IX. External Funding

This section must be completed for any projects over $100,000. For project budgets of this scale, the applicant should investigate opportunities for obtaining external funding for all or part of the proposed project.
1. Describe the external organization(s) able to provide funding in support of this project.
   
   Not applicable

2. Describe the funding cycle for these requests (submission dates, projected award dates).
   
   Not applicable

3. Indicate the amount of external funding that would be requested.
   
   Not applicable

4. In cases where joint funding is requested, what will happen if the STF award is made and the external grant is not awarded?
   
   Not applicable

5. Has a grant proposal already been submitted for all or part of the proposed STF project?
   
   We purchased the corresponding plate reader via external funds from the National Science Foundation’s Major Research Instrumentation program in 2007.