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GENERAL EDUCATION INITIATIVE www.udel.edu/ugs/gened/
INFORMATION TECHNOLOGIES www.udel.edu/present/

2007-2008 Instructional Grants

Projects which advance the General Education Goals by means of Instructionally-Enhanced and/or Technology-Enhanced Course Redesign

TEMPLATE FOR FINAL PROPOSALS

Final Proposal Deadline: Sunday, February 18, 2007

All final proposals should be electronically submitted as a Microsoft Word attachment by email: *mailto:instructional-grant@udel.edu*. Notice of receipt of final proposals will follow via email. Proposals will be reviewed by Center for Teaching Effectiveness and Information Technologies.

Title of Project	**General Chemistry Workshops**		
Principal Investigator	**James Wingrave**		
Rank	**Asst. Prof.**	**E-mail**	**Wingrave@udel.edu**
Department	**Chemistry & Biochemistry**		
Co-investigator(s)	**Bridget A. Brennan**		
Rank	**Graduate Student**	**E-mail**	**bridgetb@udel.edu**
Department	**School of Education and Mathematics & Science Education Resource Center**		
X ☐	***This project has been discussed with all department chairs of the Principal Investigator and Co-Investigator(s).***		

Nature of Project. Project will advance the following **General Education Goal**. *(select only one)*	
	Capstone – Goal # 7 is given priority in review of grant projects.
X	Quantitative Reasoning – Goal # 1 is given priority in review of grant projects.
	Student Multimedia Design Center – Goal # 1 is given priority in review of grant projects.
	Academic and Student Affairs – Goal # 7 is given priority in review of grant projects.
	Other *(please specify)* – Meritorious grant projects strongly

	supporting **one** General Educaton Goal will be considered.			
To advance the above **General Education Goal**, this project will use. *(select as appropriate)*				
	Problem-based Learning			
X	Active Learning Approaches, e.g., case studies, collaborative learning			
	Technology, e.g., WebCT, multimedia, emerging technology			
	Other *(please specify)*			
Course Number	**Course Title**	**Semester(s) Offered in 2007-08**	**Est. Students Per Semester**	**Percent Major**
Chem103	General Chemistry	Fall Spring	850 125	<5% <5%
Chem 104	General Chemistry	Fall Spring	125 350	<5% <5%
Chem 120	Quantitative Chemistry II	Spring	40	100%
Course fulfills the following University/College/Department requirements. Chem103/104 required for non-Chemistry science majors and a few non-science majors. Chem 120 is required for chemistry and chemical engineering majors.				

1. Description of Project *(2 page limit)*

Please describe nature of your project, stating the instructional problem(s) to be solved.

a. *How will the project impact student learning in the course?*
Address each question separately in preparing your project description.

b. *How will the project complement your current teaching activities (e.g. instructional approach, methods, pedagogy)?*
Address each question separately in preparing your project description.

c. *How will the project impact department / college / university objectives*
Address each question separately in preparing your project description.

d. *How will the project best utilize existing departmental resources (e.g. equipment, software, facilities, expertise, personnel)?*
Address each question separately in preparing your project description.

General Description:

Traditionally, chemistry students attend lectures and work chemistry problems outside of lecture in order to prepare to work problems on exams. While lecture is sufficient for some freshmen students, many students still cannot solve chemistry problems after attending lecture and practicing individually. Consequently, we instituted weekly Workshops during which trained undergraduate students facilitate students in collaborative problem solving. These workshops are modeled on the Peer-Led Team Learning (PLTL) instructional model in which experienced peers facilitate group problem solving (Roth, Goldstein & Marcus, 2001). Each course has ~12 weekly 90 minute Workshop meetings per semester with each individual Workshop Session having four to twelve problems, depending on the complexity of the individual problems. In the Workshop setting, students work in small collaborative groups (5-8 students) to explore and solve problems directly connected to current course content. The Workshops give students the opportunity to have guided practice with immediate feedback to correct misconceptions in a safe low stakes environment. Currently, the Workshops employ ~50 trained undergraduates who are paid a stipend funded by the Howard Hughes Medical Institute to facilitate Workshop sessions of up to 24 chemistry students.

While informal observations of Workshop Sessions and discussions with student participants do suggest that students gain in quantitative reasoning, the exercises are not designed to focus on enhancement of quantitative reasoning skills. We propose to revise existing problems and create new exercises that focus on quantitative reasoning for use in the fruitful collaborative setting these Workshops provide. We also propose to give more support to the undergraduate Workshop Leaders by creating detailed answer keys for the problems with notation of common misconceptions or problem areas.

We plan to engage ~5 experienced undergraduate Workshop Leaders in an advisory role and to employ a half time Chemistry Teaching Assistant. The chemistry graduate student will revise the current Workshop problems and create new problems as well as develop elaborated answer keys that note common mistakes to improve facilitation of the problem solving. The Chemistry TA will also observe the Workshops in progress to enhance her/his understanding of the Workshops, to identify aspects of problems that engage quantitative reasoning skills, and to evaluate the effectiveness of current and new problems. The advisory group will give advice and feedback based on their collective experiences and help the Chemistry graduate student more completely understand the nature of the PLTL method.

A. Impact on student learning in Chemistry

Quantitative reasoning allows students to synthesize a method to solve a problem that goes beyond memorized problem solving routines. The PLTL method is a student-centered learning approach that utilizes a low stakes collaborative environment to enable students to develop enhanced flexible problem solving skills. The Workshops are now an established and required part of these courses; students receive credit for completion of the Workshop problems during the weekly 90-minute sessions. However, the current problems are retired exam questions and not deliberately designed to enhance quantitative reasoning or for a group problem solving setting. Ultimately, the redesigned Workshop problems will help our students make the critical connection between the number crunching and the phenomena the equations model' that is the 'big ideas'. These problem solving skills are critical to success in chemistry. Students will also feel greater competency and satisfaction from their chemistry experience, and this may lead some to consider a chemistry major. Funding to support the revision of current problems as well as the development of new problems would improve effectiveness of the Workshop Sessions in facilitating the development of student problem solving skills and general quantitative reasoning. The undergraduate Workshop leaders will also gain

an enhanced understanding of the material and quantitative reasoning skills with proposed work.

B. Relationship to current teaching activities:

The goal of this project is to improve a current aspect of these chemistry courses. The project will enhance the effectiveness of Workshop sessions for the students and the Workshop leaders.

C. Impact on university objectives:

This project does directly address the general education goal of enhancing the quantitative reasoning skills of our undergraduate students and has the potential to reach nearly a thousand students each year. The Workshops definitely have the potential to facilitate our students along the path to becoming efficient, flexible and creative problem solvers.

D. Utilization of existing departmental resources:

The Workshops are currently part of the General and Analytical Chemistry courses. The undergraduate Workshop Leaders are paid by the Howard Hughes Medical Institute.

2. Implementation *(2 page limit)*

Support involved in project (e.g., User Services, CTE, Library, Media Services)	Assistance confirmed (name of personnel)
CTE	*Gabrielle Bauer*

a. *What is your timeline for development of the project (between July 1, 2007 and June 30, 2008)?*
Address each question separately in preparing your project description.

b. *What stumbling blocks do you anticipate which may hinder the success of the project?*
Address each question separately in preparing your project description.

c. *How will the project be sustained by your department / college upon completion?*
Address each question separately in preparing your project description.

A. Timeline for development:

Pre-summer 2007: Engage five undergraduate Workshop Leaders to play an advisory role during the Summer and Fall. Identify a chemistry graduate student who is excited about undergraduate chemistry education and available to work part time for one year.

Summer 2007: Obtain general feedback from the advisory group to more completely describe the needs in regards to Workshop problems and identify problems for the first round of revision and evaluation. Design a heuristic to guide the selection and revision of problems as well as the piloting and evaluation of new items. The project graduate TA in collaboration with the grant CoPI's will revise/create problems to pilot in the Fall semester. Additionally, the project TA will collaborate with the grant coPI's to create elaborated answer keys for the Workshop Leaders and to develop evaluation and assessment items. The project TA will have a laptop computer associated with the program to record the changes in the problems, do research related to the project, and capture and evaluate all of data generated by the project. The laptop computer will stay with the project.

Fall 2007: Pilot redesigned Workshop exercises. The project TA will observe the Workshops to evaluate the effectiveness of the problems in engaging the students in effective collaborative problem solving. The grant TA will also serve as a mentor and model for the Workshop Leaders engaged in guiding these Workshop exercises. The grant TA will elicit and capture feedback on the effectiveness of Workshop problems during the weekly Workshop Leader meetings. The Workshop Leaders will also meet in a focus group once or twice during the semester to share more information on the success of the new problems.

Winter 2008: Evaluate data from the Fall semester, revise problems as necessary and continue the design of new problems.

Spring 2008: Continue the development, implementation and evaluation of the Workshop problems.

B. Anticipated stumbling blocks:

No major stumbling blocks are anticipated; however, selection of the chemistry graduate student to work on this project is critical.

C. Plan for sustainability:

Since we are proposing to evaluate and revise/rewrite a substantial number of problems over three courses, we believe this project will take more than one year. The chemistry department has committed one half time TA to the project, if funded, for 2008-2009. Once the problem improvement project is complete, the Workshops will continue without the need for a Graduate Teaching Assistant. However, the Workshop program may employ an experienced undergraduate to act as a mentor for the Workshop Leaders and to collect feedback on problems on an ongoing basis to allow for continued refinement of problems.

3. Assessment *(2 page limit)*

An assessment guide is available at www.udel.edu/cte/eval.htm.

Support involved in project (e.g., CTE, Office of Educational Assessment)	Assistance confirmed (name of personnel)

a. *Describe how you will evaluate the students' learning. What assessment means will you use to evaluate student achievement of project goals (e.g. assignments, student work, portfolios, types of exams)?*
Address each question separately in preparing your project description.

b. *How you will determine the effectiveness of the project?*
Address each question separately in preparing your project description.

A. Evaluation of student learning:

Each Workshop session has several problems focused on two or three different concepts. As part of the program, a pre- and post-problem will be created for each of the major concepts covered in each Workshop Session. The pre-problems will be assigned as homework due at the start of each Workshop Session. The post-problems will be exam items. We may also collect the work from the collaborative groups as an ongoing formative assessment.

B. Evaluation of the project:

The project will employ both quantitative and qualitative methods in evaluating the success of the project in enhancing quantitative reasoning in our students. One qualitative pre/post measure will be to ask students about their personal problem solving heuristics. For example, we might ask at the beginning of the semester, "When you see a word problem how do you go about solving it? Please outline your steps." At the end of the end of the semester, we will return the paper and give students the opportunity to reflect on how their response to this query has changed as a result of their chemistry experience. These questions will give insight into growth in student thinking.

We will also observe Workshop Sessions and record field notes to gain insight into the effectiveness of the problems in engaging the students in collaborative problem solving. The large number of Workshop Sessions makes observing all or even most of the Workshop Sessions beyond the scope of this project; however, we will engage the Workshop Leaders in focus groups to capture their experiences with the revised/new problems.

We will also monitor growth in problem solving ability. In addition to the previously described pre-/post- items, we will end each Workshop Session with an individual problem solving exercise designed to stretch the students' problem solving abilities. We will develop a rubric to evaluate the students' problem solving progress across the semester. The combination of these data sources will provide a robust measure of the impact of the Workshops on students' quantitative reasoning skills.

Bibliography

Grosser, D. K., Stroker, V. S., Cracolice, M. S. (2001). *Peer-Led Team Learning General Chemistry*. Upper Saddle River, NJ: Prentice-Hall.

Grosser, D. K., Cracolice, M. S., Kampmeier, J. A., Roth, V., Stroker, V. S (2001). *Peer-Led Team A GuideBook*. Upper Saddle River, NJ: Prentice-Hall.

Roth, V., Goldstein, E., Marcus, G. (2001). *Peer-Led Team A Handbook for Team Leaders*. Upper Saddle River, NJ: Prentice-Hall.

4. Funds Requested - typically awards have not exceeded $20,000 *(2 page limit)*

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Address each aspect separately in preparing your project budget.

ITEM	AMOUNT REQUESTED	DEPT/COLLEGE actual and in-kind funds	EXPLANATION/JUSTIFICATION **James Wingrave** June 28, 2007
TOTAL of Budget Items	20,000		
Faculty summer S-contract	1,700		*Faculty summer total amount by rank including appropriate fringe benefits (8% no summer retirement) or (37% summer retirement) may not exceed $4,750 Asst; $5,410 Assoc; $6,300 Full Professor.*
Graduate stipend	11,750		Chemistry Graduate Teaching Assistant to do the majority of the problem development and evaluation
Graduate stipend fringe 4%			
Graduate student non-contract (no fringe), or undergraduate student misc wage (no fringe)	1,700 750		Summer pay for CoPI Pay for 5 member undergraduate advisory committee ($150 per student)
Consultant non-UD S-contract			
Consultant non-UD S-contract fringe 8%			
Equipment (itemize/detail)	2,000		Laptop computer to support the development and design of problems and to maintain all of the records related to the project to be used by the project TA. The computer will stay with the project as the project moves to the phase with departmental support.
Software (itemize/detail)	500		Software for creation of problems (to design figures, etc) and analysis of project data.
Supplies & Books (itemize/detail)	200 500	200	Photocopying of project related materials Books to serve as resources for problem development and books on

			PLTL and quantitative reasoning to serve as resources for workshop leaders.
Conferences & Travel (itemize/detail)			
Other (itemize/detail)	900		Food for advisory and focus group meetings and small thank you gifts for Workshop Leaders
Sustainability costs		11,750	Support for half time teaching assistant to finish project. Costs to be covered to sustain course and maintain equipment and software once grant funds are expended.
Pending support from other source(s)			
Prior grant(s) (2000-2006)	18,629.2		