

Math and Science Skills Center—Annual Report 2006-2007

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The Math and Science Skills Center at Kenyon College has completed its third year very successfully setting attendance records for both semesters. Student visits to the Center numbered 582 in Fall 2006 and 566 in Spring 2007.

The Center, as envisioned, has a two-pronged purpose: i) to provide support for students in introductory science courses, and ii) to serve as a resource for non-science students attempting to fulfill the College's quantitative reasoning (QR) requirement. Attendance statistics from the Center's second year of operation prompted continued support for all introductory chemistry courses—Chem 121/122 (fall lectures), Chem 124/125 (spring lectures), Chem 123/126 (laboratories). In addition, support was extended to Organic Chemistry lecture (Chem 231/232) and laboratory (Chem 233/234). Support was continued for the QR courses: Biol 103 (Biology in Science Fiction) and Chem 108 (Solar Energy). In addition, the Center was staffed with peer tutors who had prior experience in 100 level courses in Biology (5 visits), Physics (3 visits), Mathematics (6 visits) and Economics (6 visits).

<i>Fall 2006</i>		<i>Spring 2007</i>	
Chem 121 Introductory Chemistry Chem 122 Honors Chemistry		Chem 124 Biophysical & Medicinal Chem 125 Nanoscience & Materials Chem	
Chem 123 Intro Chemistry Lab I		Chem 126 Intro Chemistry Lab II	
Chem 231/233 Organic Chemistry and Lab		Chem 232/234 Organic Chemistry and Lab	
Bio 103 Biology in Science Fiction		Chem 108 Solar Chemistry	
<u>64 sessions</u>	<u>582 visits</u>	<u>69 sessions</u>	<u>566 visits</u>
<u>108 individuals served</u>		<u>109 individuals served</u>	

Peer-tutoring at the Math and Science Skills Center is distinguished from assigned tutoring (by the Dean's Office or a department chair) by the supervision and training received by our tutors. Each student tutor was provided with a tailored manual and trained in a group setting—particularly, in the development of questioning techniques, the handling of sensitive issues, and in the identification of learning styles. At every tutoring session, an experienced supervisor (usually Barbara Reitsma, Assistant director of the Center) was present to observe, facilitate, or redirect the tutor/student interaction. Typically, staff meetings were designed to address observations that this supervisor had made during the previous weeks.

As was indicated last year, our peer-led tutoring sessions enjoyed a higher attendance level than any other mode of out-of-classroom support, including weekly recitation sections, and professors' office hours. "Word-of-mouth" and repeat visits amplified our early success. Students visiting the Center for help with lecture material often returned for help with laboratory work (or with classes not officially supported by the Center).

The Center hours were expanded this year to a total of 10 hours per week. The Center is open for two hours at a time: Tuesday & Thursday (11 am-1 pm), Tuesday, Thursday and Sunday (7-9 pm), and a few special sessions during finals week. The evening sessions are tailored to meet the needs of the most common MWF science classes. In the fall 15 tutors served the Center with 11 tutors working in the spring.

We see continued success in serving students in the QR courses. This is the first year that we have covered a QR course each semester. In the fall semester, the Assistant director of the Center participated in Biol 103, Biology in Science Fiction, as a lecturer and resource in preparing problem sets. We had 89 visits from the students in this class and served 49% of those enrolled. In the spring, we served students taking the Solar Energy course offered in the Chemistry Department. We had 82 visits from the students in this class and served 57% of those enrolled. In both cases, the course instructors strongly encouraged students to make use of the Center. These courses attract a very diverse population of students. Many science students take the courses because of interest in the course and few of these students request assistance from the Center. It is the non-science students taking these courses that will come to the Center. Often these students have fundamental problems (calculator use and understanding the meaning of a numerical answer) and require a different type of tutoring. It is interesting to note that the tutors especially enjoy working with these students.

Attendance by course data for all three years of operation is summarized on the attached sheets. This information shows how the Center has served an increasing number of students while also expanding the number of courses and disciplines served.

Other interesting observations:

1. We serve twice as many women as men.
2. We have provided assistance to at least 50% of the students in the QR courses served by the Center in the past three semesters.
3. Organic Chemistry students made great use of the Center during the fall semester, but visits were not as frequent in the second semester. We view this as evidence that the students are becoming more self-sufficient and less reliant on the Center.
4. We see 100% of the students in a course when the instructor requires the use of the laptop computers we make available during Center hours.
5. We continue to see high usage for the first year chemistry laboratory courses.
6. We had more visits from students in Chem 122 (honors) than Chem 121.

Overall we are very pleased with the continued progress the Center has made this past year. It is clear to us that the way courses are structured (especially quizzes and the nature of homework assignments) greatly influences how the students use the Center. We are becoming better known as a viable resource for students in the sciences. In addition, students are beginning to actively

seek positions as tutors in the Center and course instructors are more readily cooperating with and referring students to the Center.

MSSC Website

Throughout the second semester, the assistant director worked with our HHMI computing assistant Daniel Barich to greatly expand the usefulness of the Center's website. Among the additions are: a more positive 'mission statement'; 'Why Come to the Math and Science Skills Center'; pictures, schedules and areas of strengths of the tutors; information on the Quad workshops; links to websites frequently used by the students; additional practice problems in spectral identification; and links to departments and courses we serve.

Plans for Year 4 (2007-2008)

We will build on the successful 'client base' the MSSC has developed over the past 3 years. We propose to enhance the quality of tutoring services by having 'course specialists.' A course specialist is a tutor responsible for completing the homework for a given course during normal working hours of the MSSC. They will seek help from the course instructor should questions about the material arise and would be paid to attend the lecture if they so choose. This represents a change from the existing model in that the course specialist would be more familiar with specific assignments and better able to guide students in the MSSC.

Nine new tutors have been hired to supplement the returning seven tutors. We will have significant ability in not only chemistry, but biology, math, and physics.

Visibility of the MSSC will be increased by adding links from science departments and Academic Advising. We are already linked to the Biology Dept site.

Tutor training will be enhanced. We will spend more time in the fall discussing how best to assist students in learning concepts and applying them to solving problems. Bloom's Taxonomy will be discussed and we will practice applying the different levels of thinking to our work with students. Frequent areas of difficulty in problem-solving will be discussed and we will practice dealing with those difficulties. We will discuss the role studying and doing homework plays in learning. In addition, learning strategies (study skills) will be taught to the tutors for their benefit as well as to benefit the students we serve. While we understand that most students coming to the Center typically want only superficial help to solve specific problems, we would like to start offering assistance in the area of learning strategies directly applicable to science courses to interested students.

Quad Workshop program

As an extension of the Math-Science center, we developed the Quad Workshop to provide in-depth intensive training for a small group of students. The Quad Workshop was based on the model of the Gateway Science Workshops as developed and implemented at Northwestern University. The goal of the Gateway workshops is to increase the retention of students from underrepresented groups in introductory science, technology, engineering, and mathematics (STEM) courses. In the Gateway program, each workshop group consists of 5-7 students and one undergraduate peer facilitator. Each group meets weekly for two hours, working as a group to solve challenging and conceptual problems written by the instructor of the course. The problems are not handed in or graded; the benefit to the students is in the understanding, experience, and confidence gained in spending time grappling with important course content. To prepare for these sessions, facilitators have 1) taken the course before, usually with the optional workshop, 2) undergone pedagogical training in methods for facilitating student engagement with conceptual problems, and 3) meet weekly with the course instructor (as a group) to try out the next set of problems, ask questions, and review concepts.

For our experimental Quad Workshop at Kenyon, sixteen participants were chosen from an applicant pool of 24 students enrolled in Chemistry 124. Students of all backgrounds were welcome, but students from minority and economically disadvantaged backgrounds were personally encouraged to participate. Two student facilitators, who were Center tutors last year, led two groups of 8 students in six 1.5 hour workshops during the spring semester. Facilitators met with the course instructor six times to preview problem sets and discussed the results of the sessions. Attendance was excellent, with only one absence due to illness. Students' interest and attitudes remained positive throughout the semester.

Because the workshops were not available to all students in Chem 124, the problem sets were of an 'enrichment' type rather than directly related to course content. Some students told us they would have preferred that the time invested in the workshops be more directly related to the Chem 124 course content. In fact, we did suggest that the workshops may help their performance in the course.

We also made several observations regarding the structure of the Quad sessions. The students worked in the same groups of four the entire semester. We assigned different jobs (leader, scribe, encourager, nay-sayer) to the students each week in an effort to force all students to contribute to the group work. These roles did not always work well as planned, in that weaker students were left behind by the stronger students in the group. A possible reason for this breakdown is that the students focused on whether they got it 'right' rather than what they learned or the process involved in reaching the answer. This was not the intent of the exercises. The goal of these workshops was for the students to learn the process of working challenging problems as a team.

Student reactions to the program, as judged by a voluntary and anonymous evaluation, were generally positive. Students appreciated the practice of group work and enjoyed the content of a number of the sessions. While a number of students expressed that they would have preferred if the sessions more closely related the Chemistry 124, others recognized the value of the exercise and appreciated that some of the topics would be revisited in future courses (*e.g.* organic

chemistry). Nine of the participants said they would repeat the Quad workshop if given the chance and six said that they would not. We will seek to improve the program by making the content more applicable to course material and will take great interest in how student opinions change after the next Quad cycle.

The progress of our MSSC and the Quad program were reported by three Kenyon faculty (Ryn Edwards, Rob Onyenoke and Paula Turner) and Barbara Reitsma, the Assistant Center Director attending the conference "**Enriching the Academic Experience of College Students**" at the University of Michigan in May. Dr. Reitsma presented her work in the Math and Science Skills Center (PowerPoint presentation attached). In addition to seeing what programs other schools offer to their science students, she benefited from obtaining ideas for enhanced training for tutors and additional academic help for students.

Year 4 (2007-2008) plans for Quad Workshops

Based on our observations from this year we feel that we need to better target the vulnerable students who are working hard but are unable to thrive at the introductory chemistry level. These 'middle-of-the-class' students are interested in science, but need to put in significant effort for success in the course. We feel that we could easily lose such students as scientists without guided help. As such we will target motivated B/C students in Chemistry 121 as program participants.

We will modify the Quad brochure to reflect this and change our recruiting strategy. The brochure will more clearly state that the workshops will not mirror the topics in the course, but provide review and enrichment on relative course topics. This approach will also allow us to emphasize that specific course topics will not be explicitly addressed during the program.

The structure of the workshops will also change slightly, based on materials and recommendations of the NSF POGIL program. Process oriented learning activities (POGIL concept) will be added to provide background and reinforcement before the students work on the challenging problem sets used this year. Emphasis will be approximately $\frac{1}{2}$ organic chemistry, $\frac{1}{4}$ thermodynamics and $\frac{1}{4}$ kinetics. We will purchase workbooks from established POGIL programs to be used in the workshops. This design represents a change from the existing workshops motivated by the fact that the vulnerable students we most wanted to target with the program were left in the dust rather than being carried along by their peers when only challenging problems were used in the workshops.

We will again evaluate our progress and success at the end of spring semester 2008. The main question to be answered is "Did we indeed help the target audience strengthen their abilities in the areas covered?" The evaluation will include comparison of grades in courses, as well as a participant questionnaire designed by our program senior evaluator Sarah Murnen.