

## Promoting SML and STEM\*

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**Abstract:** This presentation discusses issues related to the Student Mathematics League (SML) mathematics competition: promoting the competition, budget, and logistics; and uses plenty statistics to show that students at the level of precalculus or below can do well, and that the competition does promote students pursuing Science, Technology, Engineering, or Mathematics (STEM).

To increase students' interest in Science, Technology, Engineering or Mathematics (STEM) and implement the National Science Foundation project, Partnership to Increase STEM and Student Success, the authors have moderated the Student Mathematics League (SML) of the American Mathematical Association of Two Year Colleges (AMATYC) since fall 2002 at Oakton Community College. Oakton students' performance has improved gradually and significantly after its inception:

- Fall 2002, Oakton ranked 12<sup>th</sup> in the Midwest region, 87<sup>th</sup> among SML;
- Spring 2003, Oakton ranked 10<sup>th</sup> in the Midwest region, 70<sup>th</sup> among SML;
- Fall 2003, Oakton ranked 5<sup>th</sup> in the Midwest region, 67<sup>th</sup> among SML;
- Spring 2004, Oakton ranked 4<sup>th</sup> in the Midwest region, 53<sup>rd</sup> among SML;
- Fall 2004, Oakton ranked 2<sup>nd</sup> in the Midwest region, 33<sup>rd</sup> among SML;
- Spring 2005, Oakton ranked 3<sup>rd</sup> in the Midwest region, 28<sup>th</sup> among SML.
- Fall 2005, Oakton ranked 6<sup>th</sup> in the Midwest region, 44<sup>th</sup> among SML.
- Spring 2006, Oakton ranked 6<sup>th</sup> in the Midwest, 50<sup>th</sup> among SML.

To support the NSF Project and receive the budget for the SML activities, the SML at Oakton is registered as the STEM Club with the Board of Student Activities (BSA) at Oakton. Thus, besides sponsoring the SML math competition, the STEM Club also sponsors activities such as field trips to visit local business and companies, and seminars in STEM. The STEM Club also cosponsors the CEO, Scholar and Expert Forum, which invites nationally renowned CEOs, scholars and experts to talk about development and careers in STEM. This paper is to specifically address moderating the SML math competition.

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## Broad Participation

The objective of organizing an SML at Oakton is to increase students' interest in STEM and the number of students in pursuing careers in STEM. Thus our emphasis is to encourage as many students as possible to participate. The following measures have been taken to encourage broad participation:

- Consistently contacted all instructors in the department to gain their involvement and suggestions.
- Offered extra credit for one of the authors' students to participate. To do so, the author offers his students extra credit of 7 points plus the scores they earn on the competition. They also get 10 points for attending the CEO, Scholar and Expert Forum, followed by the Math Competition Award Ceremony. It needs a careful consideration on how much extra credit we want to offer. On one hand, we want the extra credit large enough to encourage them to participate. On the other hand, the extra credit should not change their course grade considerably. With a total of 500 points they can earn in the course, 17 points plus the score they can earn on the competition has been proved reasonable. In 2004, 50% of my 120 Precalculus students participated in the competition, and 17.5% of them received A's, and 20%, B's.
- Arranged the time for competition carefully: we examined the entire college schedule of all STEM classes to determine the best time for the competition. It has been 1pm-3pm on Wednesday in the fall and 1pm-3pm on Thursday in the spring. The following factors were considered:
  - There is at least one hour of the competition time that does not overlap with almost every STEM class.
  - Competition in afternoon is better because most classes are in morning. In addition, students having morning classes do not need to wait for too long for competition.
  - Choose Wednesday in fall and Thursday in spring: students prefer not to come to school if they don't have classes. Thus we chose the day that has more STEM classes than other days.
- Offer prizes for high scorers (we will discuss the budget later).
- Advertise the competition among clubs through the BSA.
- After Round One of the SML competition, create an e-mail list of Round One participants to promote Round Two.

The high participation is a main reason that Oakton students' performance has improved. In fact, students from classes at the level of precalculus or below made considerable contributions to Oakton's placement. A consequence is that many of these students continued participating in the future competitions and ranked better. We offer prizes for the top five scores and honorable mention for scores that are not the top five, but are in either the top 15% of participants or who have scores of 10 points or higher. Based on this award criterion, students at the level of precalculus or lower have been doing well. It is interesting to see that, in the past six semesters, among the total of 111 winners, the performance of students at the level of precalculus or below is not much different from that of those at the level of calculus, with respect to the highest rank and the number of winners. However, the performance of students at the level of ordinary differential equations is significantly better.

	Sp'03	Fall'03	Sp'04	Fall'04	Sp'05	Fall'05	Sp'06	Total
Highest rank of Precalc. or below	6 <sup>th</sup>	5 <sup>th</sup>	3 <sup>rd</sup>	3 <sup>rd</sup>	1 <sup>st</sup>	5 <sup>th</sup>	5 <sup>th</sup>	
# of winners of Precalc. or below	3	4	1	5	3	1	5	22
# of winners of Calc. I	2	0	3	4	2	2	4	17
# of winners of Calc. II	4	1	3	4	2	2	0	16
# of winners of Calc. III	1	8	0	0	1	3	1	14
# of winners of Linear Algebra	2	0	2	0	0	0	0	4
# of winners of Ordinary Diff.Equa.	8	5	2	0	7	6	0	28
# of winners of other classes	4	1	3	2	6	4	3	23
Total winners	24	19	14	15	21	18	13	124
# of participants	80	96	81	89	80	107	95	628

## Budget

Since the STEM Club has been registered with the BSA, the budget has been funded through the student activities fee. The budget covers the following items:

- Prizes: Top five scores of each round receive medals. The top six scores of the total of Round One and Round Two receive US Savings Bonds in the following amount: First Place receives the face value of \$100 US Savings Bonds; Second and Third Place prizes are \$75 each; Fourth, Fifth and Sixth, \$50 each. The actual cost of prizes has been \$200 because there has not been a tie in the past. In addition, the top ten annual scores receive a paper weight engraved with the winning message. Although the cost for prizes is not high, the prizes are not an essential incentive as some students chose not to participate in the Round Two competition because of time conflicts. We intend to increase the amount of prizes to attract high scorers back for the second round.
- Gifts: In addition to prizes, each winner receives a small gift of \$5. Instructors who have students participating in the competition also get a gift.
- Certificates: Each participating student receives a certificate of participation and winners receive a certificate of award, which are signed by the dean of Mathematics and Technology of Oakton. We designed the certificates and color-printed them at our print shop. The printing cost was absorbed by the division budget.
- A Plaque for a speaker at the CEO, Scholar and Expert Forum and the Math Competition Award Ceremony. Although our speakers are very prominent, almost all of them they have generously contributed their time. Our distinguished speakers have included:
  - Leon Lederman, 1988 Nobel Laureate in physics, spring 2006.
  - Manyuan Long, Professor of Genetics and Evolution, University of Chicago, fall 2005.
  - Larry Cioffi, Senior Project Executive, IBM Global Services, spring 2005.
  - Henry Lee, Vice President and Director, Account Management and Resource Planning, Global Software Group, Motorola, Inc. fall 2004.
  - Yvonne Richardson, Director of Operations Program Management for the Hospital Products Division of Abbott Laboratories, spring 2004.
  - Dan Winslow, vice president and actuary of Trustmark Insurance Company, fall 2003.
  - Bob Sompolski, Dean of Mathematics and Technologies, Oakton Community College, spring 2003.
- Refreshments: Refreshments are provided at award ceremonies.

Therefore the budget for the SML competition is very affordable. For Round One, it is about \$400, and for Round Two, roughly \$700.

## Logistics

We have dealt with many logistical items, which are listed below for reference.

- Competition questions: SML provides competition problems and answer keys. This is the most important support from the SML and makes moderating the competition much easier.
- Criteria of selecting winners: At Oakton, winning scores are 10 points or higher, or among the top 15% of all participants.
- Registration with SML: based on the SML rule, each college participating in the SML math competition needs to register each year. More information can be found at [www.amatyc.org](http://www.amatyc.org).
- The date of the SML math competition at your college: each year, the SML specifies the period of competition for each round. Organizers need to determine the date for his or her college. Another factor affecting the competition date is the availability of rooms.
- Reserve a room for competition: after the date has been determined, organizers need to reserve rooms for competition. At Oakton, we need to make room reservations at least six months before the competition to get the desired date and time. The rooms we reserved are like ballrooms that need to set up for the competition. To keep students working quietly and independently, students are seated at each end of a table and adjacent students are back to back (see Appendix I, Math Competition Room Setup). The aisles are in line with the doors so that they can be evacuated easily in case of emergency. The Math Competition Room Setup needs to be submitted to the Facility Department one week before each competition.
- Reserve rooms for the award ceremony. Do not schedule the ceremony date too soon because you need the time to grade the answer sheets, order gifts and prepare certificates of participation and winners. At Oakton, the date of ceremony has been about one month after the closing date of the competition. Reservations usually need to be made six months before the ceremony.
- Invite a speaker for the award ceremony: generally, it takes at least six months to contact potential speakers. Although a speaker is not necessary, a speaker can attract more audience promote STEM.
- Form an SML at your college: at Oakton, we registered it as the STEM Club with the BSA. We also need to follow the rules of BSA to renew the Club every year for its financial support.
- Submit and present the budget request to the BSA in September each year. Advise the STEM Club officers to do so.
- Order gifts for winners, proctors, volunteers, and instructors who encourage their students to participate. Consider ordering the gifts at once for both rounds for a good discount price. Usually, you will need at least one month to receive the merchandise.
- Confirm proctors for the competition in October for Round One Competition and in February for Round Two. At Oakton, including me, we have four proctors. A division secretary will be very helpful since one is usually available and can help enter participants' information and scores after competition.

- Announce the competition. For our students, we included the information of the competition and extra credit in the class syllabi. For other students, we sent a memo to math instructors and student clubs. We also made announcement on the BSA web page.
- One week before the competition, duplicate competition problems, answer sheet, registration form (see Appendix Two) and scratch paper. We provide each student with three pieces of scratch paper.
- Right after the competition, ask a division secretary to enter the registration forms into a spreadsheet and create an e-mail address book. This would take about a week depending on the number of participants.
- Once you get the answer key from the SML director, grade the answer sheets as soon as possible. Once the answer sheets are graded, ask the secretary to enter them into the spreadsheet with the students' registration information. By this time, winners will have been identified.
- Order a plaque for the speaker and prizes for winners. It takes at least a week to get the order.
- Make announcements for the award ceremony. Again, send a memo to all math instructors and student clubs.
- Invite your dean, chair, or vice president, and math instructors to attend the award ceremony. Remind your speaker and obtain your speaker's biographical sketch for his or her introduction. Have someone who can take pictures.
- Prepare the ceremony program.
- Update your web site with the competition information.

### Promoting STEM

As we mentioned, our objective for facilitating the STEM Club is to increase students' interests in STEM and the number of students pursuing degrees and careers in STEM. For this objective, we collect the data of students who participated in the SML math competition on gender, ethnicity, and academic interests. The following data was collected in 2005:

	Sp 2005	Fall2005	Annual Total
<b>Male</b>	52(65%)	77 (72%)	129(69%)
<b>Female</b>	28(35%)	30 (28%)	58(31%)
<b>Total</b>	80	107	187
<b>Academic Interests</b>			
STEM	57(71.2%)	81(75.7%)	138(73.8%)
Business	7(8.8%)	7(6.5%)	14(7.5%)
Health Careers	2(2.5%)	4(3.7%)	6(3.2%)
Education		3(2.8%)	3(1.6%)
Other	14(17.5%)	12(11.2%)	26(13.9%)
<b>Ethnicity</b>			
White	23(28.8%)	38(35.5%)	61(32.6%)
Asian	40(50%)	48(44.9%)	88(47.1%)
Hispanic/Black	3(3.7%)	3(2.8%)	6(3.2%)
Other/Unclaimed	14(17.5%)	18(16.8%)	32(17.1%)

The SML math competition is a good activity for promoting STEM. The survey indicated that it attracts STEM students. Some students told us that they have gained confidence in STEM because of the SML math competition. Our other surveys also indicated that the speech at each award ceremony increased their interests in STEM. Most of the math competition winners continued pursuing STEM studies after they transferred. Here are some examples:

- James Arnemann, math major, transferred to University of Illinois at Urbana-Champaign (UIUC).
- Varkey Purathur was interested in medicine. After continuously ranked high in the math competition, he transferred to UIUC to study electrical engineering.
- James Szczypta, computer engineering, transferred to UIUC.
- Kangsan Kim, chemical engineering, transferred to University of California-Berkley.

What we have learned from our experience include:

- We should encourage more participation of students at lower level of mathematics.
- We designed our own registration form. It has been modified gradually in the past seven semesters. What we present here in Appendix Two can meet our needs.

Our future plan to promote the SML include

- Offer the competition on our Ray Hartstein Campus.
- Offer a competition review workshop.
- Encourage more students from lower level classes to participate.

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- Peggy Swedroe, division secretary, for her support on monitoring competitions, handling registration, creating an e-mail address book, and entering participants' registration information and scores into a spreadsheet, and taking pictures in the past seven semesters.
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- Bea Cornelissen, manager of community programs, for her assistance on ordering gifts.
- Ann Marie Barry, director of student activities, for her advice on the STEM Club recognition process with the BSA every year.
- Terri Quam, specialist of facility utilization and student activities, for her assistance on room reservations.
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- Professor Nancy Ressler, for her involvement in award ceremonies.



**Appendix Two:**

**The American Mathematical Association of Two Year Colleges (AMATYC)**

**Student Mathematics League Mathematics Competition**

**REGISTRATION FORM**

**Please print**

First Name \_\_\_\_\_

Last Name \_\_\_\_\_

Social Security Number: \_\_\_\_\_ - \_\_\_\_\_ - \_\_\_\_\_ Phone: \_\_\_\_\_ - \_\_\_\_\_ - \_\_\_\_\_

E-mail Address: \_\_\_\_\_

Mailing Address: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

Math Class you are taking \_\_\_\_\_ Your Instructor's Name: \_\_\_\_\_

**Ethnicity**

- Black or African American       White or Caucasian  
 American Indian/ Alaska Native       Asian or Pacific Islander  
 Hispanic or Latino       Other or prefer not to answer

**Academic Interest:**

- Science, Technology, Engineering or Mathematics (STEM)  
 Other (please specify) \_\_\_\_\_

Gender:       Female       Male

*Please have an ID ready to show the test proctor.*