

MATHEMATICS CONTESTS – SECRETS TO SUCCESS

*T. Michael Flick
Xavier University
Cincinnati, OH 45207*

Mathematics contests have become very popular with many high schools throughout the country. Schools have a variety of contests from which to choose. Teachers of mathematics frequently ask questions like: Which contest(s) should my students take? How should the students be prepared? How can I help to insure the success of my students? How do I get students involved? What contests are available to our school? This article attempts to answer these fundamental questions and gives some keys to organizing a successful team for competition.

A Model for Success

Closely related to the success of a school in mathematics contests is the mathematics club. A survey of schools exhibiting success on the Ohio Council of Teachers of Mathematics (OCTM) annual state-wide mathematics contest has shown that over 80% have a mathematics club or a mathematics team that practices contest problems on a regular basis. A model for success has been built by examining top scoring schools from the past six years on the OCTM's annual contest. A survey of score sheets from the OCTM's contest shows that about 1/2 of the top 20 schools are repeat winners from previous years. So why do these schools exhibit such success?

The Math Team

The model for success begins with a strong mathematics curriculum and the formal organization of a math team. This means formal practices and a commitment from interested students. As in a successful athletic team, structure, discipline, practice, and fun are the keys to success. The model program holds practice sessions twice each week for one hour from October through April. During these practices, team members solve contest-like problems and compete against each other as intramural teams. Each team consists of 3 students with the sum of their individual raw scores being the day's team score. Each team of students chooses a name like The Pythagoreans, The Asymptotes, The Integrals, etc. with which to identify. Team scores are posted for both individual and cumulative results in the

classroom. The entire team competition lasts one month and begins anew with teams re-selected by the students or assigned by the club moderator/coach.

Once this process is established, student interest and peer pressure will get team members to want to attend practice. The process will also attract new members. Further, the mixture of practice sessions with actual contests will enhance student interest. It is important for the faculty moderator to emphasize that to compete is to win. Individual and team scores should not be overemphasized.

School success is not being number one. Success is getting involved and competing to the best of one's ability. To quit or not compete for fear of losing is a greater waste than a marginal score. The difference between a high score and a marginal score is small. In comparison, the difference between a marginal score and not competing is so great that it cannot be measured.

In most schools a few team members will surface who consistently perform at a high level. The team advisor must be careful not to discourage the weaker team members. Contest success involves teamwork.

Types of Contests

Mathematics contests can be categorized into four groups: National/State 'League' Contests, National/State Contests, State Level Contests, and Local Contests. Table 1 lists abbreviations and addresses related to contests.

Table 1

Ohio Mathematics League (OHML)

P.O. Box 132
Canal Winchester, OH 43110

American Scholastic Mathematics Association (ASMA)

Box 563
Wheatley Heights, NY 11798

Atlantic Pacific Mathematics League (ATPAC)

P.O. Box 11242
Elkins Park, PA 19117

American High School Mathematics Exam (AHSME)

Dr. Walter E. Mientka
American Mathematics Competitions
Department of Mathematics and Statistics
University of Nebraska
Lincoln, Nebraska 68588

Ohio Council of Teachers of Mathematics

Dr. T. Michael Flick
State Contest Coordinator
Xavier University
14 Alter Hall
3800 Victory Parkway
Cincinnati, OH 45207

League Contests

These events consist of six rounds of 6 or 7 problems of varying difficulty. The tests or 'rounds' are supplied in sealed envelopes that are to be stored and opened the day of the contest by the club advisor. These 'rounds' are administered monthly between November and April on the specified dates. The tests are scored by the club advisor, with a supplied answer key, and results are mailed to the League office. The ATPAC and the ASMA are national contests with a few hundred team participants from all over the country. The OHML and other Mathematics Leagues, Inc. tests are state-wide contests with county and state level competition. Each of the leagues publishes a score summary and a newsletter after each 'round' of competition.

The American High School Mathematics Exam

The AHSME is a one-shot national/state level test administered at your school in early March. Results are published by state and even broken down by school size and type. National and regional results are published. The AHSME also serves as a qualifying test to select students to take the American Invitational Mathematics Exam (AIME). Few schools have even one student who qualifies for the AIME. However, national results are published. Finally, those students who score sufficiently high on the AIME are invited to take an even more difficult test called the USA Mathematical Olympiad (USAMO). National results for this test are also published and high scorers are chosen to study and represent the United States in the International Mathematical Olympiad (IMO). Needless to say, the AHSME is the first step along the long and interesting road to the IMO. The AHSME should be made available to all interested students. The AHSME has considerable support and awards some outstanding prizes that include cash, college scholarships, books and magazines, pins, and certificates.

The OCTM Math Contest

The annual OCTM mathematics exam is a regional and state-wide contest.

The test is offered on a Saturday morning at the end of February at about 20 test sites located throughout the state. Unlike many other mathematics contests, the OCTM allows the use of hand-held calculators. Problems on this one-shot test are primarily modeled after traditional textbook problems from algebra and geometry. Results from the OCTM are mailed to each participating school and a state-wide score sheet is published listing only the top schools and individuals in the state. Low individual and team scores are not made public but are supplied to the respective team advisor. Prizes for this competition include cash, plaques, certificates, and pins.

The American Regions Math League

The results for high scoring students on both the AHSME and the OCTM are used by the OCTM Contest Coordinator to invite students to be members of the Ohio Team in the annual American Regions Mathematics League (ARML) competition. The ARML competition is held at Penn State University for Ohio students. In early June, teams representing the various states meet for a weekend of competition and fun.

In addition to the contests named, there are many local events sponsored by colleges and universities, businesses, clubs and associations, as well as school districts and individual high schools. These contests tend to involve fewer students and are excellent for promoting teamwork and student involvement. Watch the mail for invitations to such events – they arrive regularly.

Student Practice and Success

Perhaps the most difficult aspect of the team process is the generation of practice contests. In the model program, practice sheets similar in format to the ‘League’ contests are generated by the moderator. That is, a 6 or 7 question sheet is prepared using questions modeled after those of actual contests (See Figure 1). The practice test should last about 30 minutes with the remainder of the time devoted to showing solutions to the problems. Previous contests are available from most of the contest sponsors. For example, previous AHSME’s are published in book form by the Mathematical Association of America, OHML’s are published in book form by Mathematics Leagues, Inc., and Creative Publications publishes a book of contest problems called *Mathematics Contest Problems*. In addition, many of the exercises in standard textbooks make excellent practice problems.

When beginning a mathematics team, it is important to register for and

follow through on both 'League' and individual contests. Remember, participation is success. A good high school curriculum that consists of college preparatory and honors Algebra 1, Algebra 2, Geometry, and Precalculus/Trigonometry, supplemented by contest practices, will produce satisfactory results.

Getting Started

How do you get started? How can you get students interested in the mathematics team if your school has never had such an activity in the past? The answer depends on your own personality and that of your department members. The following procedure can be used as a guideline:

1. Have all college preparatory and honors teachers announce the formation of the competition team. They should give a little background on the kinds of events in which you want to participate as well as the location and time of the meeting. An announcement should also be made the day before and the day of the first scheduled meeting.
2. At the introductory meeting, (a) explain to the students the kinds of competitions that are available; (b) discuss the benefit to students (prizes, scholarships, development of problem-solving skills, etc.); (c) get their input as to what contests seem interesting to them; (d) explain the need for commitment on both their part and that of their coach/moderator; (e) set a schedule for formal practices; (f) ask those present to spread the word to other students.

At the first practice session, explain that in the beginning one or two problems correct out of 6 or 7 is normal. Explain that by the end of the year they will be averaging 4 or 5 correct out of 6 or 7 problems. Getting off to a good start is important. The coach must continually promote a positive and enthusiastic atmosphere in order to develop a strong student mentality about contests. Each student should only feel that he is in competition against himself. That is, the student only should be trying to better a previous contest score. One does not develop flawless problem solving skills and mathematical insight overnight – including the coach!

Summary

In summary, every school mathematics program can support and benefit from participation in mathematics contests. Contests are a way to develop

students' interest in mathematics and are a way to encourage their active participation in the field. Properly used, mathematics contests help develop problem-solving skills and mathematical insight. Involvement is the key to success. (By the way, the answers to the contest in Figure 1 are 8, -3 and 4, 1, 70, 4, 1/8 and 1/10.)

References

- Dalton, LeRoy C., and Henry D. Snyder. *Topics for Mathematics Clubs*. Reston, VA: National Council of Teachers of Mathematics, 1974.
- Gruver, Howell L. *School Mathematics Contests*. Reston, VA: National Council of Teachers of Mathematics, 1968.
- Mathematical Association of America. *The Contest Problem Book IV*. Washington, D.C.: Mathematical Association of America, 1983.

Figure 1

GAUSS HIGH SCHOOL PRACTICE CONTEST 1

NAME _____

TIME LIMIT: 30 minutes

SCORE _____

1) ¹ If $4^{12} = x^x$, find x .	1)
2) ² Find two integral values for x , from -10 to 10, inclusive, such that $x^4 + 4x^3 + 5x^2 - x - 12$ has a numerical value that is a perfect square.	2)
3) ³ $(x-2)$, $(x+2)$, $(2x+5)$ is an arithmetic sequence. Determine x .	3)
4) ⁴ There are between 50 and 100 books on a shelf. Exactly 20% of them are textbooks. Exactly 1/7 of them are novels. Exactly how many books are on the shelf?	4)

5) Find the sum of the coefficients in the expansion of $(5x - 1)^9$.	5)
6) ⁵ Which terms must be removed from the sum $\frac{1}{2} + \frac{1}{4} + \frac{1}{6} + \frac{1}{8} + \frac{1}{10} + \frac{1}{12}$ if the sum of the remaining terms is to equal 1?	6)

- (1) Sample problem from ATPAC contest 6, March 25, 1981.
(2) Sample problem from ASMA contest 6, March 21, 1985.
(3) Sample problem from OCTM contest, February 23, 1985.
(4) Sample problem from OCTM contest, February 23, 1985.
(5) Sample problem from AHSME contest, February 26, 1985.
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1991

The number 1991 is a palindrome whose divisors: 1, 11, and 181 are also palindromes. The following equations contain palindromes (some are underlined).

$$1991 = \underline{19 \cdot 91} - \underline{19} + \underline{9 \cdot 9 \cdot 1} + \underline{199} + \underline{1}$$

$$1991 = \underline{199} + \underline{991} - \underline{119} + \underline{9} + \underline{911}$$

$$1991 = \underline{19(1 + 9 + 91 + 9)} - \underline{9(1 + 9 + 1)}$$

$$1991 = \underline{911^2 + 19^2 - 991 \cdot 911 + 991^2 + 919^2 - 9 \cdot 11 + 1 + 1 + 1991 + 1 - 11 \cdot 19 + 91^2 - 919 \cdot 911 - 919 \cdot 991 - 119^2}$$

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