The Mobile Mathematics Circle

By D. Flath and V. Prokhorov

1. Introduction

For two years a free problem solving program called "The Mobile Mathematics Circle" has been offered to secondary students from Mobile County. The students are instructed in a variety of problem-solving topics that they would not encounter in the usual high school mathematics curriculum. The participants meet one evening per week at the University of South Alabama. Professors Daniel Flath and Vasiliy Prokhorov of the Department of Mathematics and Statistics of the University of South Alabama were the principal organizers and teachers during the 2000-2002 years of the Mobile Mathematics Circle. Funding has been provided by the Alabama Space Grant Consortium, the USA Foundation, and the Department of Mathematics and Statistics at USA.

2. Goals and Topics

The core goals of the Math Circle are:

(1) To increase the knowledge and conceptual understanding of students in mathematics.
(2) To help students develop creative thinking and problem solving skills.
(3) To excite the minds and spirits of young students to pursue further study in mathematics and science.
(4) To provide enrichment in mathematical topics, to stimulate interest in mathematics, and to help prepare students for future study of mathematics.
(5) To end the isolation of young students by bringing them together to discuss, argue, and collaborate.

(6) To offer guidance from working mathematicians.
(7) To educate students regarding careers in mathematics and science.

The format for the sessions has always been the same. The students are given a handout consisting of 15 to 20 problems on a common topic. They are challenged to work on them, one problem at a time. Students volunteer to present solutions, suggest ideas that might lead to solutions, or they may ask questions. Students are free to collaborate, and are welcome to come to the board to write out their thoughts for all to see. They are not shy about thinking out loud, and have become more and more active as they gain experience in the Math Circle. As the students work and comment, the teachers in the room may move about to talk with individual students. The fact that student participants see a new side of mathematics in a fun environment excites us as professional mathematicians. It is a thrill to watch their growing confidence in grappling with unfamiliar problems.

The problem solving topics taught so far are as follows:

Induction. Method of Induction, Induction and Guessing by Analogy, Classical Elementary Problems.
Combinatorics. Permutations and Combinations, Strategies and Tactics of Counting.
Number Theory. Prime and Composite Numbers, Divisibility Theory, Remainders, The Greatest Common Divisor, The Euclidean Algorithm, Some Applications of Number Theory.
Inequalities. Fundamental Ideas, The AM–GM Inequality, The Triangle Inequality, Remarkable Inequalities.
Games. Who will win and how? Pseudo-Games, Symmetry, Winning Positions, Finding of Winning Positions.
Graphs. The Concept of a Graph, Degree of a Vertex, Eulerian Graphs, Isomorphism, Trees, Euler's Theorem, Oriented Graphs.
Invariants. Parity, Remainders as Invariants, Assorted Problems, Colorings.
Recreational Problems. Constructions and Weighings.
Optimization Problems. The Principle of the Extreme.
Geometry. Geometric Constructions.
Selected Olympiad Problems. Manhattan and Mobile Olympiad Problems.
Pigeonhole Principle. Basic Pigeonhole, Intermediate Pigeonhole, The Pigeonhole Principle in Geometry, The Pigeonhole Principle in Number Theory.
Logic Problems.

3. Invited Speakers

Some meetings of the Math Circle are conducted by invited, distinguished mathematicians brought in specially to work with the students in the Mathematics Circle. Five university professors with experience directing mathematics programs for high school students and olympiads were invited to present talks to the students of the Circle. These professors have extensive experience in problem solving at the top level of high school math competitions, including the International Mathematical Olympiads. They have viewed and assisted the birth and growth of many mathematical programs for high school students in the US and abroad.

In 2001, two meetings of the Circle were chaired by internationally distinguished visitors. The first speaker, Dr. Dan Shapiro of Ohio State University, manages the Arnold Ross Young Scholars program, an intensive summer math program for high school students. His talk, "Scissors Congruence," was informative, entertaining, interactive, and thoroughly enjoyed by all those who attended. The second speaker, Titu Andreescu of the University of Nebraska, is coach of the American High School Mathematics Olympiad team and director of American Mathematics Competitions. He gave two talks on problem solving. The first, on Induction, was advertised to teachers and faculty. The second talk, entitled "Some of My Favorite Problems," was given principally for the Math Circle itself, but attracted a huge crowd of students interested in Olympiad competitions.

In the second year, the Math Circle had three outside speakers The first, Dr. Pantelimon Stanica of Auburn University at Montgomery, gave a talk on problem solving. His talk was entitled "If everything else fails, generalize!" His interesting and varied collection of problems really excited the students. The second speaker, Dr. Philip Kutzko of the University of Iowa, is a world leader in research on the interface of number theory and group representation theory. He has been an invited speaker or visiting professor at some of the most prestigious mathematics departments in the world. His talk on "The Chinese Remainder Theorem: A modern look at some ancient Chinese mathematics" was well received by the math circle students. Dr. Kutzko directs a successful program at the University of Iowa to recruit minority American students for an intensive undergraduate summer program in mathematics and for the PhD programs in mathematics and statistics. While he was here, he advised the Math Circle organizers on minority recruiting and met with Ms. Celia Rochelle, the University of South Alabama's Manager of the Office of Minority Student Affairs. The third speaker, Eddie Cheng of Oakland University, is the Asso-

ciate Director of the Oakland Summer Mathematical Institute, a six-week summer math residential program for academically talented high school students. He presented the interesting talk, "Be Greedy," related to some optimization problems.

4. Mobile Math Olympiad

There are a number of interesting and fun mathematics events, including mathematical competitions and olympiads, for high school students in the United States of America. Over the past 100 years, throughout the world, the word "Olympiad" has come to mean the particular type of competition where complete essays are expected for every problem and adequate time is offered to participants to make a thorough investigation. The Bay Area Mathematical Olympiad, the Colorado Mathematical Olympiad, the USAMO, and the Manhattan, Kansas, Mathematical Olympiad are the largest mathematical competitions in the United States today.

The Mobile Math Circle held a Math Olympiad, open to all high school students, on March 5, 2001 in which 15 students competed. The Olympiad was sponsored by the Alabama Space Grant Consortium and the Department of Mathematics and Statistics at the University of South Alabama, to bring mathematical stimulation and challenge, free of charge, to all interested local high school students. Moreover, the Olympiad was held for the purpose of selecting two students (to be accompanied by one professor) to participate in the Kansas State University Mathematics Olympiad on April 7, 2001, and to give the Math Circle students an opportunity to try out their newly developed problem solving skills. The first place winners in the Mobile Math Olympiad were Math Circle students, Pearl Flath (Alabama School of Mathematics and Science) and Chad Versiga (Alma Bryant High School). The trip to Manhattan, Kansas, proved to be very educational for these Mobile Mathematics Circle students, one of whom (Pearl Flath) won first place in the Kansas State Mathematics Olympiad. Book awards were also presented to the second and third place Mobile Math Olympiad winners. In 2002, two travel scholarships were awarded to Math Circle students, Brantley Beaird (UMS-Wright Preparatory School) and Jenny Scott (Alabama School of Mathematics and Science), to participate in the Kansas Mathematics Olympiad 2002. They were selected on the basis of their performance (first place) on the Second Mobile Mathematics Olympiad, held on March 4, 2002.

5. Details

The Mobile Mathematics Circle has had a very successful two years. Over the summers of 2001 and 2002, letters were sent to mathematics teachers in the Mobile area, advertising the Math Circle opportunity for the Fall and the Spring. Posters were printed and distributed and an article in the Mobile Press Register was published. The Dean of Arts and Sciences at USA, Professor J. Friedl, sent very kind words of support to the organizers.

Ms. Elizabeth Hohn, the Mathematics supervisor for the Mobile County Public Schools, helped publicize the organizers' activity, which she strongly supported, among her faculty.

The Mobile Math Circle has received very favorable publicity. In 2002, an article on the Math Circle was published in the University of South Alabama Midweek Memo. Moreover, in December 2001 the Dean of Arts and Sciences at USA ranked the Mobile Math Circle among the College "Highlights of the Year".

The Mobile Mathematics Circle meets every Monday evening, 7:00 p.m. - 8:30 p.m., from mid-September through April. There were a total of 26 sessions in the first year and 24 sessions in the second. A total of 79 students came to at least one session in the first year and 59 students attended at least one session in the second year. Ten different local high schools were represented. Approximately 10 to 20 of the students were regulars each year. Seven teachers have attended at least one session, and the organizers have discussed problem solving with several of those who have expressed interest in doing more problem solving with their own classes. We have occasionally seen undergraduate students and a few parents. Drs. Flath and Prokhorov have been assisted with running the Math Circle by Dr. Francis Jellett, a professor at USA, and Mr. Michael Fletcher, a teacher at Davidson High School. Drs. Flath, Prokhorov, Jellett and Mr. Fletcher made trips to seven local high schools to meet with counselors and teachers, for the purpose of publicizing the Math Circle and encouraging participation.

6. Future Plans

After three years of experience is gained in working with students through the Circle and in participation in established olympiads, the organizers plan to organize a South Alabama Mathematics Olympiad to be held on the campus of the University of South Alabama. Moreover, once the Mobile Mathematics Olympiad is better known, the organizers plan to add a middle school level to the competition.

In summary, the Mobile Mathematics Circle has met and exceeded the organizers' expectations for its first two years. There

seems to be a real opportunity to develop the Mathematics Circle and the Mobile Mathematics Olympiad into a permanent and important program for South Alabama high school students.

The Mobile Mathematics Circle has a website accessed by a link on the USA Department of Mathematics and Statistics home page:

http://www.southalabama.edu/mathstat

Department of Mathematics and Statistics
University of South Alabama
Mobile, AL 36688-0002, U.S.A.