Johnny (front, center) formed the Orange County Math Circle to involve young mathematicians in problem solving and community service. Here, OCMC volunteers gather at the 2010 Thanksgiving Math Tournament.

by Jonathan Li

Where Math & Service Meet

"Welcome to the 2010 Orange County All-Girls Math Tournament!" my voice boomed from the podium. My welcome was greeted with waves of high-pitched screams from 180 girls who flooded the gymnasium at St. Anne School. For a moment, I thought I had arrived at a Justin Bieber concert. But instead of sharing riveting pop music, I was here to spread the word of Fermat, Euler, and Gauss—and the young mathematicians in the audience couldn't have been more excited.

My path to that podium started many years earlier. After I participated in the Johns Hopkins Talent Search in fourth grade, my school allowed me to accelerate by taking high school math classes in fifth grade. Worried that I might run out of math classes, my mother searched for enrichment opportunities and found the San Diego Math Circle, a free problem-solving class for motivated, advanced math students held on Saturday mornings at UC San Diego.

I was in sixth grade when I attended for the first time, and I was captivated immediately. Mr. Richard Rusczyk, the founder of the San Diego Math Circle, taught us that true math is not memorizing formulas but implementing creative and original ideas. He taught us to approach problems with a combination of creativity, intuition, and discipline. As much as I loved his lectures, I also enjoyed socializing with 30 other like-minded students. Despite the long commute, attending the circle and sharing my solutions with my peers became one of my favorite activities. Later in the year, as my math skills improved, I also joined the Long Beach Math Circle, founded by Professor Kent Merryfield of Cal State University at Long Beach. Prof. Merryfield is also the head coach of the Southern

California American Regions Math League (ARML) Team, which trains top math students for the national ARML contest.

For the next three years, my weekends often involved driving 120 miles round trip to the San Diego Math Circle, or 110 miles round trip to the Long Beach Math Circle—and sometimes both in a single day.

Basic Training

By the time I entered high school in 2007, I was thinking seriously about bringing the math circle experience to my hometown in Orange County. I envisioned creating a student-run community-service organization where math enthusiasts could both explore advanced problem-solving topics and bring the math circle experience to underserved students in Southern California. By integrating learning and teaching, Orange County Math Circle (OCMC) members would work together to serve our community, strengthen math culture, and make math resources accessible to all.

With no facilities, no volunteers, no students, no money, and no experience in running a math circle, the idea of starting one seemed daunting. But what I did have was my passion for math, enthusiasm to serve, and determination to work hard.

While researching how to start a community service organization, I learned that the Davidson Institute was launching its Davidson Young Scholars Ambassador Program. I had been named a Davidson Young Scholar in sixth grade, so I was eligible to apply. I submitted a proposal outlining my vision for OCMC and was accepted into the program. Through online seminars, discussion forums, and individualized mentoring, I spent 14 months learning skills such as goal setting and proposal writing, leadership, advocacy, fundraising, and public relations. Step by step, I applied what I learned to get OCMC started. I created a mission statement, wrote a business plan, and invited some of

my mentors and teachers to join the OCMC Advisory Board.

As my training progressed, I began offering monthly lectures on topics such as number theory, probability, and geometry to about 20 students from seven different schools. My first class, held at Concordia University in Irvine in October 2008, was designed to prepare students for the upcoming AMC 8 exam. As time went on, my program began to attract a group of loyal students who then invited their friends to the Math Circle, and I spread the word through my networks in math communities. By the end of the school year, my classes were regularly filled with about 40 students.

Expanding Opportunities

After running OCMC myself for two years, I focused on building it into a community-service organization that would attract more student volunteers. I asked my ARML team members to help and posted calls for volunteers on the team forum at ArtofProblemSolving.com. At the end of September 2009, with

The OCMC is unique in that it is run by students. Here, Johnny teaches a math circle class.

11 volunteers from seven local high schools, we held our first organization meeting, where we decided to organize a math tournament: the Thanksgiving Math Tournament for students in grades three to six.

We decided to use MATHCOUNTS as our model, but added a few fun activities to make math a cool activity for younger students to enjoy. For example, we planned a Math Relay where teams of students would solve math problems in an outdoor relay format: a student from each team would run a 50-meter dash to a problem station to solve a problem and then return to tag the next student in line to continue. The first team to solve all 10 problems correctly would win the relay. I organized subcommittees for problem writing, grading, registration, promotion, and fundraising so volunteers could select activities that interested them. As more people learned about the tournament

After the 2010 All Girls Math Tournament, the OCMC saw a 150 percent increase in the number of girls participating in the math circle.

we attracted more volunteers. In the end, about 20 volunteers came out for the tournament, where more than 100 students spent a fun afternoon sharing the joy of mathematics.

Most of our volunteers had participated in MATHCOUNTS in middle school. MATHCOUNTS is a program for students in grades six to eight, but because most middle schools in Orange County have only grades seven and eight, most sixth graders don't get to participate. To offer younger students an opportunity to experience MATHCOUNTS while giving older students a chance to warm up for the real event, we created a MATHCOUNTS scrimmage.

The 2010 New Year's Invitational and MATHCOUNTS Scrimmage attracted about 100 students, and the Countdown Round was won by a fifth grader!

At that event, during a conversation with a group of parents, one mother told me, "My daughter is very good at math, but not too many girls at her school are interested." Over the years, I had noticed the small number of girls at all levels of math competitions. So for our next event, I proposed the 2010 All-Girls Math Tournament for girls in grades three through eight. Female OCMC volunteers overwhelmingly supported the idea, and many of them stepped up to take leadership for organizing the tournament. Highlights included a keynote speech by Dr. Natalia Komarova, a math professor from UC Irvine, and Lollipop Riddle Contests, where students worked in teams to solve math puzzles related to the number

Want to Join a Math Circle?

The National Association of Math Circles lists existing math circles in 31 states. Visit their website to see if there is a program near you: www.mathcircles.org/Wiki_ExistingMathCirclePrograms. Note that these programs have a variety of affiliations: many are affiliated with universities, some are based at schools, others are run by parents, and OCMC, of course, is run by students.

If no math circle exists in your area, consider doing what Johnny did: start your own! *Circle in a Box*, available in both print and PDF forms, offers suggestions for starting and sustaining a math circle, and even includes materials for math circle presentations, sample grant proposals, and templates for other administrative tasks.
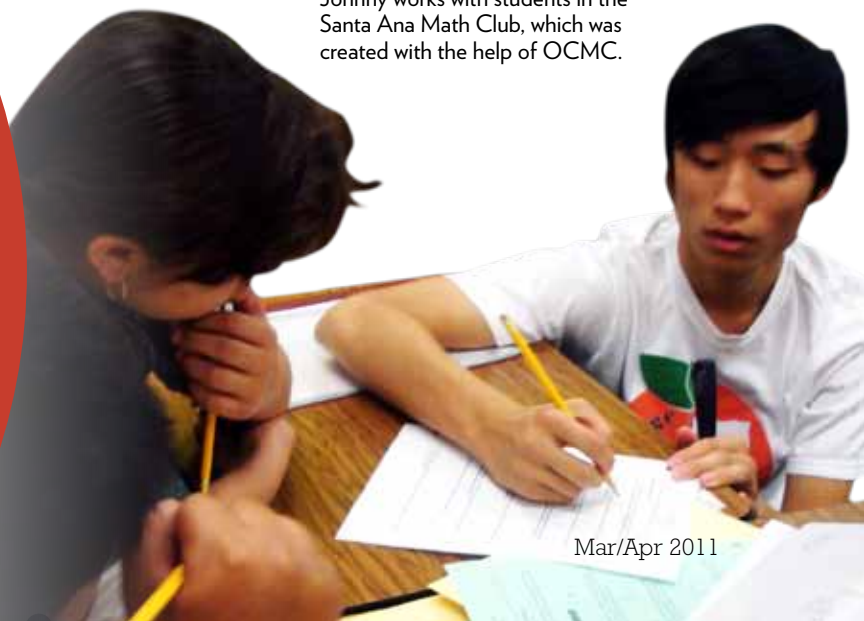
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Johnny works with students in the Santa Ana Math Club, which was created with the help of OCMC.

Math Circles: A Brief History

Mathematical enrichment activities in the United States have been around for at least 30 years, in the form of residential summer programs, math contests, and local school-based programs. The concept of a math circle, on the other hand, with its emphasis on convening professional mathematicians and secondary school students on a regular basis to solve problems, has appeared only within the past 12 years.

This form of mathematical outreach made its way to the U.S. most directly from Russia and Bulgaria, where it has been a fixture of their mathematical culture for decades. (The first ones appeared in Russia during the 1930s; they have existed in Bulgaria for a century.) The tradition arrived with emigres who had received their inspiration from math circles as teenagers. Many of them successfully climbed the academic ladder to secure positions within universities, and a few pioneers among them decided to initiate math circles within their communities to preserve the tradition which had been so pivotal in their own formation as mathematicians. The Mathematical Sciences Research Institute (MSRI) in Berkeley, California, became involved at an early stage by supporting the Berkeley Math Circle. Not long after, Steve Olson highlighted this math circle in his book *Countdown*, since a couple of members of the 2001 U.S. International Mathematical Olympiad (IMO) team attributed their success in part to the problem-solving sessions offered at Berkeley. In this and other ways, math circles began to attract national attention as a means for encouraging students to enjoy, explore, and excel in mathematics.

—from Circle in a Box by Sam Vandervelde (Mathematical Sciences Research Institute, 2007).

of lollipops in a bag. This tournament led to a 150 percent increase in girls' participation in our Math Circle program.

Our most recent undertaking has been to start the Santa Ana Math Club. While volunteering at the Santa Ana Math Field Day in June 2010, four OCMC volunteers and I had the opportunity to help over 400 low-income students participate in mathematical problem solving. After gaining support from the Santa Ana Unified School District, I wrote a proposal to the Mathematical Sciences Research Institute (MSRI) and was awarded a $2,000 grant to launch the project. Today, the Club has enrolled 84 students in grades four through seven, and each month, several OCMC volunteers spend a Saturday morning teaching classes to the members of the club.

Looking Back and Forward

Four years later, OCMC has evolved into a unique community for aspiring mathematicians. Our work pioneered a new model for math circles: in addition to providing opportunities for motivated pre-college students to explore advanced mathematics, we give them a way to become ambassadors who bring the beauty of mathematics to a broader audience.

Thanks to our more than 50 devoted volunteers from 30 schools, OCMC's lectures, tournaments, and special events have served more than 1,000 students from 75 schools. Our math tournaments have become annual events many students look forward to. When California's budget cuts forced schools to eliminate enrichment programs, OCMC became a destination for many students whose schools could no longer offer math clubs. We assembled OCMC math teams through which such students can participate in math competitions. Last year, our team placed fourth in the inaugural Caltech Harvey Mudd Math Competition. Recently, one of our teams finished first nationally in the Team Round and third overall at the annual Harvard-MIT Online Math Tournament.

While I have been honored to win many national math and science awards, creating OCMC is what I've found most rewarding and what I'm most proud of. Through the process, I learned the importance of compassion and leadership in pursuit of math that serves humanity. As much as I want to continue to lead OCMC through its expansion and growth, I know that my role will change when I enter college in the fall. With that in mind, I have been spending more time preparing younger volunteers to step up to leadership roles in OCMC. And then I will join OCMC's Advisory Board, where I hope to mentor aspiring young mathematicians for years to come. **i**

Jonathan Li is a senior at St. Margaret's Episcopal School in San Juan Capistrano, CA. He is a Davidson Fellow, an Intel STS Finalist, a United States Physics Team member, a Math Olympiad Summer Program (MOSP) participant, a three-time USAMO qualifier, and the captain of the Southern California ARML Team. As a cellist, Jonathan has played in All-State and All-Southern Honor Orchestras. At school, he plays varsity soccer, serves on the Honor Committee, and heads up Mu Alpha Theta and JETS Teams. He will attend Harvard in the fall.

For more information:

Davidson Young Scholars Program
www.davidsongifted.org/youngscholars

Mathematical Sciences Research Institute
www.msri.org

National Association of Math Circles
www.mathcircles.org

Orange County Math Circle
www.ocmathcircle.org