Recruiting Students for Math Club

Think of ourselves as gardeners, not fishermen. Fishermen know what gets the fish. But a gardener provides the environment and enables plants to grow. With math team, don't try to just get the best students and win; instead, get as many students as you can, and do whatever is possible to make them better at math.
> — Ashley Reiter

Start in August. Veteran coaches know that to get students to join, you've got to get them hooked early. Some suggestions from successful coaches on how to stimulate interest at the beginning of the school year:
- Build a display case using math shirts and posters. Include memorabilia and photos from previous years' coaching sessions or competitions.
- Post intriguing math questions (involving specific school activities and situations) in hallways, the library and the cafeteria, and refer students to the first meeting for answers.
- Make a presentation at the first pep rally or student assembly.
- Approach students through other extracurricular clubs (science club, computer club, chess club).
- Inform parents of the benefits of math team participation via the school newsletter or parent-teacher organization.
- Create a math team display for "Back to School Night."
- Have former mathletes speak to students about the rewards of the program.

The importance of food. A student who turns out to be your most valuable team member may come to the first math team meeting not sure what it's all about, but definitely sure that she loves brownies. For that reason, all the publicity about your first meeting must include mention of the mouthwatering snacks you'll be serving. This is middle school, after all!

Approach the kids. Sometimes, though, just spreading the word and providing food won't be enough. You'll need to employ some better techniques to attract enough kids to make math club all that it can be. Here are other tactics veteran coaches use to get students involved:
- Ask a Student to Join – Approaching a student individually is blatant, but often successful. Sometimes a very shy student needs only to be asked. Also let students know they can come even if they have no desire to be part of the competition phase. (Remember, the ultimate goal is learning, not winning.)
- Ask a Group of Students to Join – There's strength in numbers! A student may join if she knows that her friends will be there. This is a way to encourage participation by under-represented groups.
- Enlist the Best Scouts: Other Math Teachers – Provide other teachers in your school with plenty of information about math team (the competitions, some resources, and your meetings). Visit individual classrooms if you can.
- Incorporate problems from math competitions into your class, and tell kids when you do. Provide other teachers with copies of the Problem of the Week. Get everyone in your school hooked.
- Tell Groups About Math Team – Speak at PTA meetings, Gifted and Talented meetings, Back-to-School orientations, etc.

It's for everyone. When an extracurricular math team is formed, all interested students should be invited to participate, regardless of their academic standing. The greatest benefits of math competitions are realized at the school level, so the more students involved, the better. Students should view their experience in a math club as fun as well as challenging, so let them know from the very first meeting that the goal is to have a good time while learning. And, if a student happens to win, well, that's fun, too, but it shouldn't be the goal.

Keep 'em hooked. Students will come to math club because they're intrigued or because they hear you're serving pizza… but students will stay in math club because they want to. Some students love math so much that providing challenging problems each week is all you have to do to keep them interested. Other students need to build to this level. **Provide a supportive atmosphere where all students feel free to take risks.** Publicize often, within the school and in the local newspaper. Have an end-of-the-year awards dinner, cookout or swim party. Field trips, bowling or skating outings during the year also build bonds. And be sure to stay in touch with your kids over the summer.

Extra tips. One coach starts the year off by having those who were math team members tell about their experiences from the previous year. Another approach is to have students sit in a circle and compliment the person on their right. This is done with different variations at each meeting. For example, it may be filling in a blank sheet for each student with positive comments. It all culminates with collecting compliment cards as a good luck token before a meet. Combine these types of opening ("So what did you do that was fun since the last meeting?") and closing activities and students get to know more about each other and build friendships and appreciation for each other.

When and How Often Should You Meet?

One of the big misapprehensions about mathematics that we perpetrate in our classrooms is that the teacher always seems to know the answer to any problem that is discussed. This gives students the idea that there is a book somewhere with all the right answers to all of the interesting questions, and that teachers know those answers. And if one could get hold of the book, one would have everything settled. That's so unlike the true nature of mathematics.
   — Leon Henkin

Start 'em early. In order to reap the full benefits of a math club, it is imperative to begin coaching early in the school year. On average, math clubs meet one or two times a week at the beginning of the year, and with greater frequency as competitions approach. There are lots of variations on this theme, but for most coaches, this is it. Dedicated coaches would love to meet every day, but students are in other activities, teachers have other responsibilities, and even managing to meet once a week with team members sometimes requires a lot of advanced planning. Sessions can be held before or after school, during lunch, or on Saturdays—whatever works best to minimize conflicts with other activities.

Alternatives. Sometimes it's necessary to practice at untraditional times. It can occasionally be difficult to have kids stay after school, or maybe you need additional practice time. Some schools have a math club class during the day. Some teams get creative by getting administrative approval for a math team homeroom on a daily or weekly basis. Other teams practice before school (with donuts, of course!). A few dedicated teams practice on Saturday morning. By exploiting the sacred tie between math team and food, you may even get kids to come in at lunch, if you can best the chefs in the school cafeteria. Another idea is to have special long practices (pizza scrimmages?) before meets or competitions. Finally, getting together over the summer with fun math (and non-math) activities will keep the team running.

To head off conflicts with other activities, you can do two things. First, talk to other club sponsors to create as few conflicts as possible. Second, start your meetings as soon as the school year starts—hook students *before* they even know that other clubs exist. And when the inevitable conflicts arise, **be flexible.** If you're cooperative before the big band concert, you can expect the music teacher to be reasonable when you'd like his drummer to anchor the math team. Sometimes team members are very busy, but they can contribute a lot by attending only the few meetings that fit into their schedule. Your most valuable member may be someone who alternates coming to math club with being a reading tutor.

Practice with other local teams on a regular basis. This cannot be stressed enough. Schedule math meets throughout the school year. The benefits are immeasurable, though the biggest benefit is minimizing the fear of competition. A student who practices at ten local meets before a big competition will have a huge advantage over the student who walks in cold. If your school doesn't do this already, request that your math supervisor start a math meet. Or start one yourself. Get the ball rolling by suggesting the framework for the event (problem sets, format, etc.), and contact coaches in your area to get them to buy into the idea. Find local coaches by searching the registration database on the MATHCOUNTS web site at http://mathcounts.org.

Before the meet. Many school districts hold a special day-long practice prior to competition. And some do this on a city-wide or district-wide basis. Check with civic and professional associations (like the Jaycees) or local businesses (like Target) for support and space. Ask your principal if funds are available for substitute teachers. Your gifted program can also provide funding.

Content and Format of Math Club Meetings

The greatest benefit is in preparing to compete, not in competing itself.
    — Nick Diaz

Practice is <u>why</u> we have math team. Have fun, do math. Don't worry about winning. Practices have an "A-ha!" factor: the problems are good, and although math class is <u>good</u>, math team is <u>better</u>.
    — John Benson

What to do. You'll learn quickly that it's not enough to just hand out a set of practice problems. Most coaches introduce a new topic at the beginning of each meeting. This may be a topic that you feel will be new to your students (factorials, for example), or one that you think will be motivating—most students are amazed to find out that the numbers from 1 to 100 can be added in less than 30 seconds! On another occasion, it might be time to review some basics, like the list of primes under 100. Following the presentation of that day's topic, give your students practice problems that involve the topic… but be sure to include other topics, as students shouldn't be allowed to forget what they're learned previously.

Mix 'em up! In MATHCOUNTS materials, problems are presented "shotgun" style. That is, the questions on a worksheet will cover many different topics. This is true, also, of practice tests from other competitions. While this may initially be bewildering to some students (and coaches), **resist the temptation to do only one type of problem at a meeting.** Eventually your students will start to recognize different types of problems ("Oh, this looks like a triangular number pattern!"), rather than think only in terms of the problems they've just been working on. Once you hand out a problem sheet, it is often helpful to have students read the entire page. Then,

1. Explain any vocabulary terms that are new or unclear;
2. Mark easy problems (for beginners) and challenging problems (for veterans); and
3. Highlight key phrases such as "express the answer as a mixed number".

To do, or not to do. Some coaches feel more comfortable working out the answers ahead of time. It is also valuable sometimes to deliberately *not* work the problems ahead of time. If there is a particularly challenging question, let your students see what you do when you don't know the answer right away. Modeling this behavior can be powerful. If you are lucky enough to co-coach, students will enjoy seeing the different ways two people approach the same problem. And, of course, it is very gratifying for the student to occasionally teach the teacher and point the way to a solution.

Step back. One of the first things your students will learn is that if a problem looks impossible, there's probably a different way of attacking it. Take time to teach and review various problem solving strategies. Students need to be as familiar with these techniques as they are with the multiplication tables. Create a bulletin board or poster where problem-solving strategies can be listed as students discover them.

Compete, for fun. Many coaches incorporate some degree of competition into meetings, with an emphasis on fun and success. Practice competitions is vital to prevent the dear-in-the-headlights effect. An informal approach—let the first group that correctly answers a question at a meeting be the first to get snacks. A more formal approach—keep a running tally of individual scores on practice problems. One teacher plays math baseball during summer get-togethers: answer a question correctly, advance one base; answer a real toughy correctly, hit a home run! Another plays math *Jeopardy!* with her students. Some (not all—no stereotyping here) girls shy away from competition. Possible solutions are to divide into small teams or pairs to compete, or have a girl versus girl round. (See the article *Teacher to Teacher: A*

Girls' Math Olympiad Team at http://www.nctm.org/mtms/1999/02/olympiad.htm from the February 1999 issue of *Math Teaching in the Middle School*.)

Maximum mileage. Some suggestions for getting the most out of practice problems at coaching sessions:
- Practice working in groups to develop teamwork, and encourage discussion of the problems.
- Encourage a variety of methods for solving problems.
- Have students write problems for each other.
- Practice oral presentations to reinforce understanding.
- Take advantage of additional coaching materials, such as previous years' competitions, to provide an extra challenge or to prepare for competition.
- Provide refreshments and vary the location of your meetings to create a relaxing, fun atmosphere.
- Invite the school principal to a session to offer words of support.

The essentials. Some basics that your students should know are percent equivalents and the list of primes under 100. (Don't assume that a student in the top math class will know that 1 isn't prime.) Play games, give quizzes, offer rewards … but make sure your kids know the basics. Coach Nick Diaz has compiled this information into *The MATHCOUNTS Bible According to Mr. Diaz*. This reference is available at http://www.unidata.ucar.edu/staff/russ/mathcounts/diaz.html.

What you need to know. Depending on the curriculum of your school district, there are some topics that appear on middle school math competitions that your students may not have seen yet but will definitely need. Among these are:
- simplifying radicals
- the Pythagorean theorem
- non-standard area formulas (rhombus, area of a square given the diagonal, etc.)
- triangular numbers (and other neat formulas like the number of diagonals, number of factors, sum of factors)
- 30-60-90 and 45-45-90 triangles
- not-the-usual divisibility rules (7,11, divisors of *abc,abc*)
- permutations and combinations, probability
- geometry theorems (medians, angle bisectors)

Still haven't found what you're looking for? Some coaches create custom worksheets using previous years' problems (either from their own library or by purchasing past years' materials). One source of problems is EducAide Software—they offer databases of math exam and competition questions. Visit them at http://www.educaide.com, or call 1-800-669-9405.

One-stop shopping. MATHCOUNTS maintains a variety of resources on their web site at http://mathcounts.org, including:
- a current events-based *Problem of the Week*, posted every Monday morning;
- the *Go Figure! Math Challenge*, where students can work problems from previous handbooks and competitions at their own pace;
- the *Meeting Place*, with discussion forums for students and coaches; and
- various sections of the school handbook, *MATHCOUNTS News*, school registration information, as well as other program information.

Teamwork

Together Everyone Achieves More. Math competitions provide opportunities for individuals to be successful, but they learn they can be most successful as part of a team. Good team building will keep kids on the math team. A coach is a cheerleader. A successful coach believes that a team plays together, has fun and develops teamwork. Team members bond as they share their special interests, their accomplishments, and even their stresses. If the coach models hard work, the team members will follow.

Encourage team members to look out for each other mathematically. On a soccer team, if someone needs help on corner kicks, it's to everyone's advantage if that person gets more practice. On the math team, try to get all the students to help you **coach to their weaknesses.** (Probability frequently falls into this category.) Your students should also **recognize each other's strengths,** to the point where they can divide problems on team rounds based on that knowledge. What about a team member with no outstanding strengths? One coach had a good job for a weaker member on a team of powerhouses—check the answers. This is *not* a cop-out job. A student may not know how to arrive at an answer to a problem but can usually check to see if it's right or check for careless mistakes.

Make former participants part of the team. Keep them informed via a newsletter and have them come back to share their experiences with current students. Ask them to participate in coaching sessions and special events. Have a recurring activity each year (maybe a picnic, or a bowling outing) where it's a tradition for the alumni to show up. They can share the future benefits of math team with your students—those dreaded SAT's will be a piece of cake after vigorous math team training!

Seeking help. Running a math club is a big job. Volunteer assistance can be used to enrich the program and to expand the program to more students. Fellow teachers can serve as assistant coaches. Individuals outside the school can also be helpful:

- **Math team alumni and high school students** are wonderful role models. Each can work with a small group of students. Their involvement also reinforces their own education.
- **Parents** may be willing to provide snacks for the group or provide transportation.
- **Community professionals** (including retirees) can be called on to speak to the club about careers that involve mathematics and to assist with coaching.

Resources

Your best asset. Math team coaches are a very sharing bunch. (In fact, most of the information presented here was borrowed from material written by a group of coaches.) Simply put, math team coaches at other schools are more like you than anybody else in the world. They teach math, they care enough to help their students, and they want to know the same things about contests, motivation and accomplishments that you do. Coaches are more than willing to share their ideas with you—seek them out. They'll likely become your best friends.

Two options for reaching MATHCOUNTS coaches are available at http://mathcounts.org:
- *The Practice Field*, a forum where coaches are invited to post and respond to messages on any topic, including how to solve difficult problems, how to organize math teams, etc. From the home page, enter the "Meeting Place."
- A database of all registered schools, which includes coaches' names, is available. Search for schools in your state, and contact them directly—mailing and e-mail addresses are provided, so contacting them is a snap. From the home page, click on the "Registered Schools" icon.

Check with local affiliates of NCTM, also. Many of them have a competition subcommittee, and they could connect you with coaches in your area.

World Wide Web. Here are a few math competitions that have a presence on the Internet. If you can't find what you're looking for at one of these sites, a little bit of digging on other math sites will turn up any resource you could possibly need for teaching middle school mathematics. But these sites are a good start.

American Math Competitions. www.unl.edu/amc/. AMC sponsors the AMC > 8, AMC > 10 and AMC > 12, in addition to the AIME and IMO.

Mandelbrot Mid-Levels. www.midlevels.org/. A middle school math competition that aims to "teach as much as it tests."

Math Contest Page. www.olemiss.edu/mathed/problem.htm. A collection of contests in mathematics. Students who submit correct answers can win prizes donated by Casio.

MATHCOUNTS. mathcounts.org. A middle school math contest for grades 6–8. This site includes a Problem of the Week, an interactive section (*Go Figure!*) where kids can solve problems, a Coaches' Forum to chat with other teachers, as well as lots of information about how to compete in their program.

Math League. www.mathleague.com. Math contests, activities, software and books for teaching math to grades 4–12.

Math Olympiad for Elementary and Middle Students. www.moems.org. Five monthly contests from November through March provide motivation for students to intensify their study of math.

USA Math Talent Search. www.nsa.gov/programs/mepp/usamts.html. A free math competition open to all U.S. high school students. Sponsored by mathematicians at the National Security Agency. The questions they use are at a fairly sophisticated level, but they're *good* questions.

Benefits of a Math Club

Learn math skills. Together, you and your students will learn to cut a Godzilla of a math problem down to size. You will be awe-struck when your students come up with their own elegant solutions. And you'll see true teamwork move from ideal to reality.

Game plan. The chart below is an amalgamation of what math team coaches have been saying for years. The "Goals" column focuses on the outcome that we want our math team to achieve. The "Motivation" gives the reason why a particular outcome is important. "Teacher Actions" give hints for what coaches can do to foster this goal. And the "Potential Effects" column shows the consequences.

GOALS	MOTIVATION	TEACHER ACTIONS	POTENTIAL EFFECTS
Community	Math team is a place for students to fit in	Foster a sense of team unity and acceptance of all students	Friendships established through the world of mathematics
Pride	Students experience some level of importance and satisfaction for a job well done	Provide lots of positive feedback	Confidence in math abilities, and perseverance in the face of challenges
Material Rewards	Extrinsic incentives for participation	Scholarships, calculators, trips, books, rulers, food…	Dependence on external motivation accompanying academic success
Pleasure	Students learn that doing math can be fun	Provide good math problems	Pleasure derived from thinking
Focus	Math teams have well-defined goals	Help students set realistic goals	A goal-focused approach to learning; understanding that slow but steady progress can lead to significant results
Fun	Math teams take trips, play volleyball, see movies, play cards, etc.	Make math team outings fun; provide lots of varied activities, not just math	Fond memories associated with math-related events
Role Models	Students behave as they see others behave (including adults)	Be an adult worthy of student respect	Students will become good role models
Team Bonding	Working toward a goal with other students and teachers	Facilitate the process of working together to achieve a goal	Skills when working in a group

Vocabulary

absolute value
abscissa
acute angle
additive inverse (opposite)
adjacent angles
algorithm
alternate interior angles
alternate exterior angles
altitude (height)
area
arithmetic mean
arithmetic sequence
base 10
binary
bisect
center
chord
circle
circumscribe
circumference
coefficient
collinear
combination
common divisor
common denominator
common factor
common fraction
common multiple
complementary angles
composite number
compound interest
concentric
cone
congruent
convex
coordinate plane/system
coordinates of a point
corresponding angles
counting numbers
cube
cylinder
data
decimal
degree measure
denominator
diagonal of a polygon
diagonal of a polyhedron
diameter
difference
digit
direct variation
dividend

divisible
divisor
edge
endpoint
equation
equiangular
equidistant
equilateral
evaluate
exponent
expression
exterior angle of a polygon
factor
factorial
Fibonacci sequence
finite
formula
frequency distribution
frustum
function
geometric sequence
height (altitude)
hemisphere
hexagon
hypotenuse
image(s) of a point(s) (under a transformation)
improper fraction
inequality
infinite series
inscribe
integer
interior angle of a polygon
intersection
inverse variation
irrational number
isosceles
lateral surface area
lateral edge
lattice point(s)
linear equation
median of a set of data
median of a triangle
midpoint
mixed number
mode(s) of a set of data
multiple
multiplicative inverse (reciprocal)
natural number
numerator
obtuse angle

octagon
octahedron
opposite of a number (additive inverse)
ordered pair
ordinate
origin
palindrome
parallel
parallelogram
Pascal's triangle
pentagon
percent increase/decrease
perimeter
permutation
perpendicular
planar
polygon
polyhedron
prime factorization
prime number
prism
probability
product
proper divisor
proper factor
proper fraction
proportion
pyramid
Pythagorean triple
quadrant
quadrilateral
quotient
radius
random
range of a data set
rate
ratio
rational number
ray
real number
reciprocal (multiplicative inverse)
rectangle
reflection
regular polygon
relatively prime
remainder
repeating decimal
revolution
rhombus
right angle

right circular cone	sphere	triangle
right circular cylinder	square	trisect
right polyhedron	square root	union
right triangle	stem-and-leaf plot	unit fraction
rotation	sum	variable
scalene triangle	supplementary angles	vertical angles
scientific notation	system of equations/inequalities	vertex
segment of a line	tangent figures	volume
semicircle	tangent line	whole number
sequence	term	x-axis
set	terminating decimal	x-coordinate
similar figures	tetrahedron	x-intercept
simple interest	total surface area	y-axis
slope	transformation	y-coordinate
slope-intercept form	translation	y-intercept
solution set	trapezoid	

Formulas

Circumference

Circle	$c = 2\pi r = \pi d$

Area

Square	$A = s^2$
Rectangle	$A = lw$
Parallelogram	$A = bh$
Trapezoid	$A = (b_1 + b_2)h$
Circle	$A = \pi r^2$
Triangle	$A = bh$

Surface Area and Volume

Sphere	$SA = 4\pi r^2$
Sphere	$V = \pi r^3$
Rectangular prism	$V = lwh$
Circular cylinder	$V = \pi r^2 h$
Circular cone	$V = Bh$
Pyramid	$V = Bh$

Pythagorean Theorem

Right triangle	$a^2 + b^2 = c^2$