Minnesota State High School Mathematics League





Issue #50, March 3, 2025

Here's Newsletter #6 for the 2024 – 2025 season. Five Meets done; one State Tournament to go!! Good Luck to everyone who qualified

In this newsletter, notice these items

- 1. A message from Executive Director Tom Young
- 2. A message from Head of Problem Writing Team Colin Gardner Spring
- $\textbf{3.} \quad \textbf{Ads for State Tournament T-Shirt Design and Video Contest}$
- 4. Dates for SMI 2025 and Schedule
- 5. Looking ahead at the schedule for the state tournament
- 6. T-Shirt Design winner
- 7. Problem Corner

1. A Message from Executive Director Tom Young

Congratulations!

You successfully completed another Math League regular season! And some of you still have the state tournament March 10th! Woo hoo!

Based on the preliminary responses to our coaches' survey our new format, where all students take three events, was a hit. Out of the 39 responding coaches only four felt we should go back to the old way of doing things.

However, there was some worry that three events had too many topics to study each time. Do you agree? If you haven't taken the survey, follow the link 2024-25 Coach Survey and tell us what <u>you</u> think. Your opinions help shape the future of the league and how we conduct business next season and beyond. Don't forget to have students do the student survey at 2024-25 Student Survey

Another way to express your opinion is to attend the Summer Coaches conference which will be July 17 and 18th. It's a Hall of Fame year so if you have people you think should be inducted into the Hall of Fame, send their names to us.

A special thanks goes to Colin Gardner-Springer!

His efforts in rewriting the format from four events to three events, creating a new topic list, working tirelessly to select excellent problems, and spending many nights formatting those problems are to be fully appreciated. I have a glimpse of how much time he puts in but even I don't fully appreciate him as much as I should. Colin, I salute you! If you agree, send him an email <u>colin@gardner-springer.com</u>

Thank you, Kyle Bryant, for allowing me to crash the Meet Five party at Century high school. As a league we're going to have to re-examine participation in meet five. There seemed to be several instances where teams did not gather together. However, for those that did, I think the experience was much better. Here's a few pictures from Rochester.







Create a culture of coolness

2. A message from Colin Gardner – Springer

Another regular season is in the books! Thanks to all coaches for your part in making it a success, particularly with the significant format and topic changes this season.

I'd like to gratefully acknowledge outgoing problem writer Don Barry for his many years of contributions to the league in Minnesota, and a lifetime encouraging the development of top math students from across the country. Don is retiring after this season; I'll miss his creative, thoughtful, and unique problems. Here's one of his submissions from Meet 5 (which was Team #4):

The square shown below at left is cut along the lines indicated, and these pieces are rearranged to form a rectangle, shown below at right. If the square has area 125, what is the perimeter of the rectangle?



Thank you Don!

If you haven't already, please fill out the <u>2024-25 Coach Survey</u> and pass along our <u>2024-25 Student Survey</u> to your students. Survey submissions are due by March 10th (the day of the State Tournament).

A number of students expressed interest in either the <u>Summer Math Institute</u>, or in learning more about the <u>All-State Math Team</u>, but neglected to include contact information. Please share information about these opportunities with your students; we want to reach as many interested students as possible!

Reviewing some of the coach submissions so far, several of you expressed appreciation for the Sample Meets this season (with a few well-deserved critiques of typos which weren't caught soon enough). Please let me know if you're interested in reviewing potential new sample meets for the upcoming season: if I create another set I would appreciate more pairs of eyes on them beforehand.

Congratulations to the students and teams who will be competing at the State Tournament in a few weeks, and to the students and especially coaches statewide who have made this season another successful one! You make the league possible, and are paving the way for future success by our young problem solvers. Thank you!

I hope to see many of you at the State Tournament!

Colin Gardner-Springer Head of the Problem Writing Team colin@gardner-springer.com





MN State High School Math League Math Team Video Contest

1st place: \$200 to school's math team 2nd place: \$150 to school's math team 3rd place: \$100 to school's math team

Video Guidelines:

Produce a 90 second video explaining why you like to be involved in the Math League. Videos might include: student interviews, teacher endorsements, sample problems, or video of practices/meets.

Video Entry Submission:

Videos are due to the Math League Office (mathleague@augsburg.edu) by March 4th, 2025.

• Videos contest entries must be sent and approved by the school math team coach.

• Winning schools will be notified by March 7, 2025.

• Winning video will be shown at the State Tournament on March 10, 2025, uploaded to the Math League website, and may be used for recruitment efforts

Cleverness Appreciated!

MN State High School Math League 2025 State Tournament

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Q VISA Gift Card and a Free T-sh



nter:

Submit a one-color a for the t-shirt front.

design should include the

MN State HS Math League State

ament March 10, 2025

al consideration given to clever destruction bat incorporate to League's 45th year and 45² = 2025

ct that

- your design by Feb. 8 to: mathleague@a
- Ac file format: pdf only
 - name, grade and school in the em
- Winner w

Inclue

fied by Feb. 11th via

Aission.

Email mathleague@augsburg.edu with questions

4. Summer Math Institute

SMI: June 22 – June 27, 2025

Summer Math Institute Lineup (subject to minor changes)

		7 th through 9 th graders	10 th through 12 th graders
Monday	Morning	String Polyhedra, Creating Puzzles, Ambigrams	Visualizing Big Data
Monday	Afternoon	Visualizing Big Data	String Polyhedra, Creating Puzzles, Ambigrams
Tuesday	Morning	The Wonders of Desmos	Intriguing Number Theory
Tuesday	Afternoon	Intriguing Number Theory	The Wonders of Desmos
Wednesday	Morning	The Wonders of Desmos	Intriguing Number Theory
Wednesday	Afternoon	Intriguing Number Theory	The Wonders of Desmos
Thursday	Morning	Creating Integer Sequences	Counting and Combinatorics in the AMC
Thursday	Afternoon	Counting and Combinatorics in the AMC	Creating Integer Sequences
Friday	Morning	Creating Integer Sequences	Counting and Combinatorics in the AMC
Friday	Afternoon	Counting and Combinatorics in the AMC	Creating Integer Sequences

Featured Instructors: Scott Kim, Annie Perkins, Ben Orlin

Go to our web page (mnmathleague.org) and click on STUDENTS > SUMMER MATH INSTITUTE for registration form

5. Looking ahead to State Tournament Schedule

Invitational & State Tournament Schedule

 8:30am - 9:45am Invitational stude If no invitational, 	Check-in nts checked in and ready to checked in and ready to go	Atrium o go with pencil at 9:15 in cafeteria (no backpacks) by 10am		
9:15am - 9:45am	Invitational	Cafeteria		
10:00am - 10:30am Welcome Auditorium • Perfect Scores • Season Information • Regular Season Awards • Coaches should double check their scores throughout the day • Logistics of the Day • Good Bye & Good Luck!				
11:00am - 11:15am • Students will stay	Event A / seated between events A	Cafeteria and B.		
11:30am - 11:45am • Solutions for A &	Event B <i>B will be posted.</i>	Cafeteria		
 11:45am - 1:00pm Lunch Challenge Window open for events A & B 12:45pm - 1:05pm 				
1:15pm - 1:30pm • Solutions for C w	Event C <i>ill be posted.</i>	Cafeteria		
1:45pm - 2:15pm • Challenge Windo	Team Event ow open for events C & Tea	Individual Home Rooms m Event 2:20pm - 3:00pm		
2:30pm - 4:15pm	Awards	Auditorium		

- Introduce Honorary Judges
- Math Bowl & State Tournament Awards

Winning T-shirt design by

Gunnar Erickson

Grade 12 Cambridge-Isanti High School



Problem Corner an effort to spur conversation If you'd like to contribute a problem or send in a solution, email tomyoungmathman@gmail.com Student solutions encouraged!

Newsletter Puzzler #49

No submissions yet! Help create new mathematics

Now the question is: how many 4 - triangle patterns will tessellate an equilateral triangle with 16 sub triangles?

Here's one way. Are there others? And what about the 5 case? Six? More?



Newsletter Puzzler #50

Naturally, if you were examining a problem in two dimensions, the logical extension is to attempt to realize a 3-dimensional analogue.

See the following attempt

Fundamental Building Blocks of squares and cubes

Thomas Young October 7, 2024 tomyoungmathman@gmail.com

Define a Fundamental Building Block (FBB) of an n x n square to be n cells that, when copied n - 1 times, can be manipulated to tile the n x n square. It is worth noting that the FBB need not be contiguous.

Similarly, an FBB of a n x n x n cube is n smaller cubes that, when copied $n^2 - 1$ times, can be manipulated to tile the n x n x n cube. It is worth noting that the FBB need not be contiguous.

FBBs of n x n Squares (2 dimensions)

For example, in a 2 x 2 square there are 2 FBBs, illustrated below

The two FBBs of a 2 x 2 square are



Because each can be copied and together with the copy can tile a 2 x 2 square



Lemma:

An n x n square will always have at least one FBB, that being an n x 1 contiguous group of cells.

Note: the orientation of the FBB is not deemed to differentiate. An n x 1 FBB is the same FBB as a 1 x n.

Conjecture:

n x n squares, where n is a prime > 2, have only one FBB, namely an n x 1 contiguous group of cells.

This has been shown true for 3 x 3, 5 x 5, and 7 x 7 squares via computer program. See OEIS 363381

See OEIS 363381 also for the 60 FBBs for a 4 x 4 square, and the 102 FBBs for a 6 x 6 square.

Unsolved:

The number of FBBs for n x n squares where $n \ge 9$ is unknown

FBBs of n x n x n Cubes (3 dimensions)

Lemma:

An $n \ge n \le n$ cube will inherit the 3D cubic versions of the $n \ge n \ge n$ FBBs. The cubic $n \ge n \ge n$ FBBs can make an $n \ge n \ge 1$ wall that can be appended n = 1 times

For instance, in a $2 \times 2 \times 2$ cube, the two FBBs of the 2×2 square, filled to three dimensions can make a wall which can then be duplicated to fill the cube



Conjecture:

for $n \ge n \le n$ a cubes, where n is not a prime > 2, there exists at least one FBB unlike the inherited two – dimensional FBBs.

For example, in a 2 x 2 x 2 cube, this is an FBB unlike the two inherited ones



Images made at https://toytheater.com/cube/

In a 4 x 4 x 4 cube, it will inherit 60 FBBs from the 2D 4 x 4 square. For instance



However, for example, in a 4 x 4 x 4 cube. this is an FBB unlike the inherited ones



Here is another FBB for a 4 x 4 x 4 cube



Unsolved: *The number of FBBs for an n x n x n cube, where n > 2, is unknown.*

I hope this motivates researchers to further study FBBs. Tom Young The number of FBBs for a $2 \times 2 \times 2 = 3$



The number of FBBs for a $3 \times 3 \times 3 = 3$?

