Minnesota State High School Mathematics League

Newsletter

Issue #40, December 6, 2023

A message from the Executive Director, Tom Young

Hello all! Two regular season meets down, three to go!

Here's Newsletter #2 for the 2023 – 2024 season. In it, notice these items:

1. A message from Colin Gardner Springer
2. Meet Dates for 2023 – 2024
3. Meet Dates for 2024 – 2025 We want your input!! Take a survey!!!!
4. Summary of Math League All State Team performance at HMMT
5. Wayne Roberts' new book
6. Nuts and Bolts for this season
7. ***Plan for next year for Math League 2.0***

Challenge Process Clarification

The challenges should be handled in this manner:

1. Challenges of mistakes made by the coach should be fixed by the coach. Coaches will be notified after an audit of answers is conducted.

2. Challenges of whether the response is an acceptable form of the answer should not occur as all answers are integers in the 2023 – 2024 season. No other answer should be deemed acceptable. However, the student can challenge and the challenge should be sent to the League office.

3. Challenges due to problems with the scoring website should be sent to the League office.

4. Challenges as to a different answer due to a unique interpretation of the question should be sent to the League office.

Process for submitting a challenge to the League office:

All coaches in the Division should be made aware of the challenge. A short explanation as to the reason for the challenge, should be emailed to mathleague@augsburg.edu and to all schools in the Division by noon on the day specified in the end-of-meet email. The student should write the explanation but may need a coach's assistance.

The League will make every effort to rule on the challenge within 2 – 3 days. Schools in the Division will be notified as to the final ruling. Scores will be adjusted as necessary.

Only students who challenge a solution can be awarded points. If a student does not make a challenge, yet that student's answer is judged to be correct, that student who did not challenge will NOT be awarded the point(s) for a correct solution. Therefore, it is wiser to challenge than not.

Given this challenge process, and to insure the most uniformity, Coaches should mark answers correct only if the student answer matches the answer provided in the League answer key. There is some latitude given to the coaches when they verify student scores. If a student includes units in the answer, the answer can be marked correct. If for some reason there is a phantom character causing the computer system to mark a correct answer as incorrect, the coach can mark it as correct.

1. A message from the HPWT (Head of the Problem Writing Team) Colin Gardner-Springer

Coaches:

Please remind your students to read problems carefully, and especially to verify that their answer is exactly what was asked in the question.

As an example, problem C1 on Meet 2 asked for a number n where cos(2θ) = n/25. The correct answer was n=7, since it turned out that cos(2θ) = 7/25. However, a sizable portion of students gave the answer 32, presumably correctly arriving at the correct 7/25 answer but then automatically adding numerator and denominator.

We want to give credit, and are not trying to trick anyone, but when the question asks for n and the answer blank says "n=", that's the value which needs to be entered.

As coaches, try to avoid giving generalities like "whenever your answer is a fraction you should add the numerator and denominator", since that isn't always the case. We sometimes provide the denominator as a clue to students: if they get a fraction with a different denominator they probably made a mistake and should check their work!

Last newsletter we introduced this year's problem writing team, but I'd be remiss if I didn't also thank our equally important proofreaders - Martha Knutson and Tom Young. Their feedback and attention to detail make the final product immeasurably better, catching nearly all typos, errors, and ambiguities before they could become an issue. Martha in particular has been doing this since the early days of the Math League. I hope they'll both continue for many years to come.

Finally, here are a few hints for Meet 3:

Event A - Know how to solve systems of two equations in two variables, and word problems that lead to such systems.

Event B - Finding the area of a regular hexagon is relevant to one problem here (and another in the Team round).

Event C - Know the trig values of common angles. The Law of Sines also makes an appearance.

Event D - You'll need to solve an equation involving square roots. Familiarity with exponent and log rules are critical for some of the harder problems.

Best of luck; we'll see you in the New Year!

Colin Gardner-Springer

2. Meet Dates for 2023 - 2024

Meet 1	November 6, 2023	
Meet 2	November 27, 2023	
Meet 3	December 18, 2023	
Meet 4	January 22, 2024	
Meet 5	February 12, 2024	Required to meet as a Division in person
Tournament	March 11, 2024	NOTE: Change in site – tournament will be held at Spring Lake Park HS

3. Meet Dates for 2024 – 2025

Since we are doing a facelift of the League's events, it is worth examining the meet dates for next year. Currently, we plan on the following schedule

2024 - 2025
November 4, 2024
November 25, 2024
December 16, 2024
January 27, 2025
February 10, 2025
March 10, 2025

But we are considering this schedule

2024 - 2025
November 18, 2024
December 9, 2024
January 13, 2025
February 3, 2025
February 24, 2025
March 24, 2025 (possibly March 17 depending on school availability)

We want your input!!

Please take the survey at

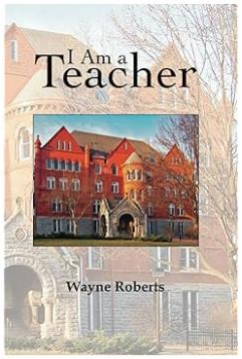
Meet Dates Survey

4. Minnesota All State Team update

Two weeks ago, eleven Minnesota All-State Math Team members representing nine different schools traveled to Harvard and MIT for the Harvard MIT Math Tournament. This tournament, which annually draws thousands of students from all over the world, is put on by the math undergraduates at Harvard and MIT including several MN All-State Alums. The Minnesota team finished in 3rd in the team event out of 130 teams and 9th in the sweepstakes round ***making this one of our most successful tournaments ever.***

The students also enjoyed ***meeting 12 team alumni for lunch and a tour of both campuses*** the day before the contest. Our next contest is at Carnegie Mellon University in April-- Stay Tuned! "

5. Wayne Roberts' new book



Get your Copy Now!!

Find it on Amazon at [Wayne's Book]

Highly recommended!!

6. Odds and Ends for this season

a. Addressing Winter Break Conflicts

If a school does not meet during the December 18th week, that school can administer Meet 3 on Thursday the 14th or Friday the 15th . Exceptions like this reinforce the importance of the Code of Conduct that students need to adhere to.

b. Divisions can decide which of the four ways to administer a meet.

The method chosen may vary from meet to meet, but note.

Schools are required to gather together at Meet 5.

The four ways to administer a meet are:

i. Gather as a division at a common site and administer the tests the "old" way. The "old" way is defined as giving students a paper copy of the tests, correcting them at the site, and coaches entering the scores via the scoring website.

ii. Gather at individual schools and administer the test the "new" way. The "new" way is defined as giving students a paper copy of the tests, allowing them to enter their answers online via the scoring website, and coaches verify the scores after the events are finished.

iii. Gather some of the schools at a common site and allow the other schools in the division to gather at their own school and use a "hybrid" method to deliver the meet. Schools gathered at the common site will use the "old" way while the schools gathering at their own school will use the "new" way.

iv. Gather schools at a common site and allow the schools to use the "new" way to administer the meet. This can be done if the division is confident that the site has sufficient Internet capability and the students have the device capability to do the meet online the "new" way.

c. Given that schools will be doing meets in different ways and at different times, coaches should stress the importance of not discussing the problems until all schools are finished. Coaches can, however, release solutions when all schools in the division are finished.

d. All events A through D and the team event are NO calculator. Also, all answers will be integers. Coaches should stress this with their students. An integer is defined as a number from the set {… -3, -2, -1, 0, 1, 2, 3…}. Answers written in the form of a fraction will not be correct. For example, 6/2 will not be considered correct nor will 3/1.

7. New Competition Structure for 2024 – 2025 and beyond

Overview: Due to the pandemic and the shifting nature of the League Operations the League Office thought it was necessary to evaluate our current operations to see if they fit the reality of today. In order to get the best data, the League Office distributed a survey that went out to all coaches, hosted an in-person retreat with 15+ coaches and the Executive Committee, and dedicated the majority of the Coaches Conference to this topic. Based on the robust discussions over the last few months, the Executive Committee drafted this proposal which the Board approved October 1st. These changes will go into effect in the 2024 – 2025 season

Timeline: These changes, adopted by the Board, will be implemented for the 2024-2025 school year.

Part 1: The structure of meets will be changed from 4 individual events to 3 individual events, ***with all students participating in all individual events.***

Rationale:

- Allows 9th and 10th grade students more access for advanced questions.
- Keeps the time frame for In-Person Meets the same
- Eliminates the disparity of choosing different events for different students.
- Retains the process of selecting the scoring team ahead of time.
- Allows for easier substitutions when students are absent.

Specific Details:

- The 3 individual events will each have 5 questions.
  - Each question will be worth 1 point.
  - There will be two "quickie questions" per event.
  - Power scoring will still be in place.
- Coaches will still need to set their scoring team prior to the Meet start.
  - No more than 6 of the 8 scoring team members shall be beyond the 10th grade (as is currently the case).
- Team Event Scoring
  - There will be 6 questions on the team event.
  - Each question will be worth 5 points.
  - A perfect team score at one meet will be 150 points.
- The topic list will be revised and submitted to the board for approval at a future meeting.
- Additional practice materials will be created, perhaps including a reorganizing of the problem archive.
- Coaches might be able to select a Junior Varsity team in the scoring system (implementation pending)

Part 2: Implement a "Guess the Interval" for Meet 1 and Meet 5.

Rationale: This event will increase competition fun for all students and the team aspect and bonding amongst students.

Specific Details:

- The League Office will create and provide an overview, scoring instructions, and instructional video on how to implement it.
- This will not be a part of the scoring system.
- This event will be available as an in-person, virtual, and hybrid version for Meet 1.
- This event will take place live at Meet 5.

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 #39's question is similar to the problem simmering throughout Russian mathematical circles: Can an equilateral triangle be divided into n identical shapes?

See references on next page

Puzzle #39 OEIS A363381

Consider an n by n array of unit squares. How many ways can the n x n array be broken into n groups of n unit squares where each of the n groups is identical but whose orientation within the array may be different? Note: if there are multiple ways to orient a certain grouping, the grouping is only counted once.

For instance, given a 2 x 2 array of unit squares, there are two ways to group the unit squares into 2 groupings of 2 unit squares in each grouping. Using letters to represent the squares, they are

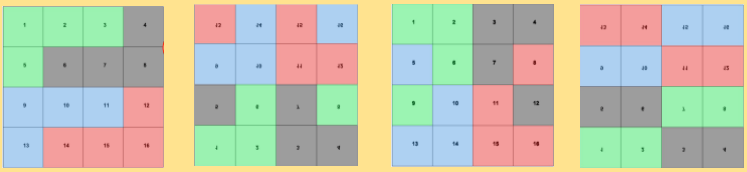
FF or FH
HH HF

Note: FF and FH
HH FH

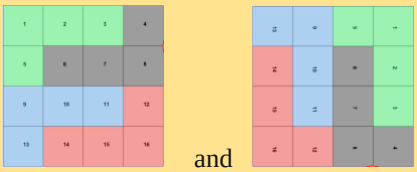
are considered equivalent because this fundamental grouping in the array is a 1 by 2 bar that can be oriented different ways but therefore are only counted once.

For another example, given a 4 x 4 array of 16 unit squares, how many ways can the 16 squares be grouped into 4 groups of 4, where each group is identical?

Here are some such groupings



NOTE:



and

are considered equivalent because the fundamental grouping is L-shaped but can be oriented different ways. It is therefore only counted once.

It turns out there are 60 ways to group a 4 x 4 array. See OEIS page A363381 at https://oeis.org/search?q=a363381&go=Search

Open question: In how many ways can an n x n array where n >= 9 be grouped into n identical groups of n unit squares?

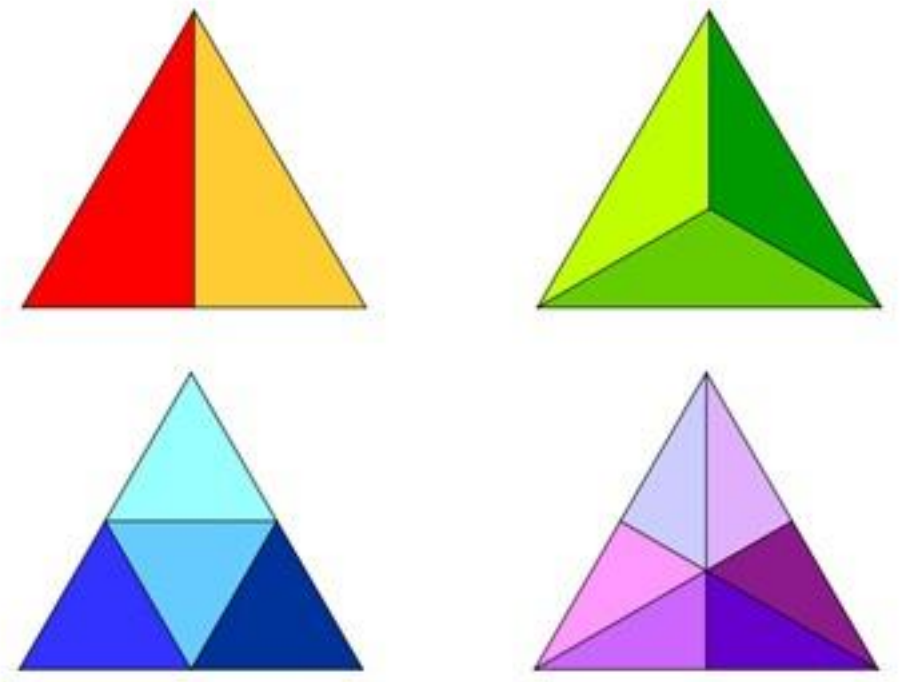
Prime conjecture by Andrew Young: For n = prime > 2, there is only one way to group the squares. Can you prove this for all primes?

Puzzle #40

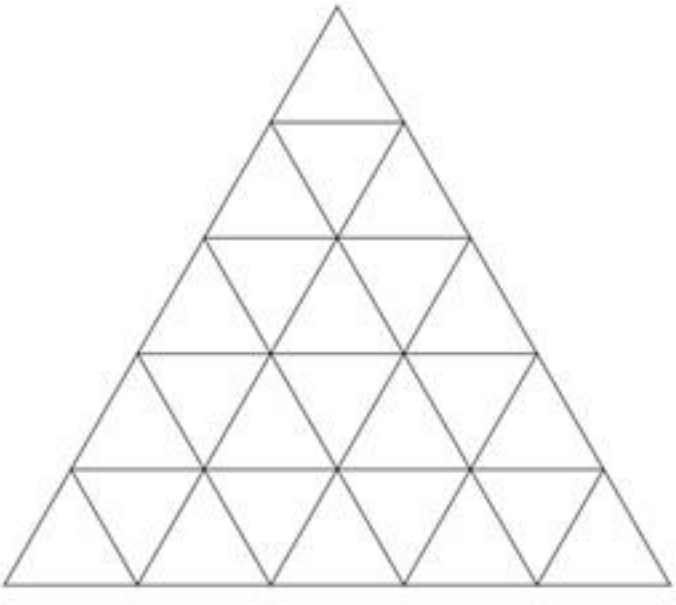
from https://vk.com/@granisarov-na-skolko-ravnyh-chastei-mozhno-razrezat-pravilnyi-treugolni

How many equal parts can a regular triangle be cut into?

It is very easy to cut a regular triangle into two, three, four and six equal parts:



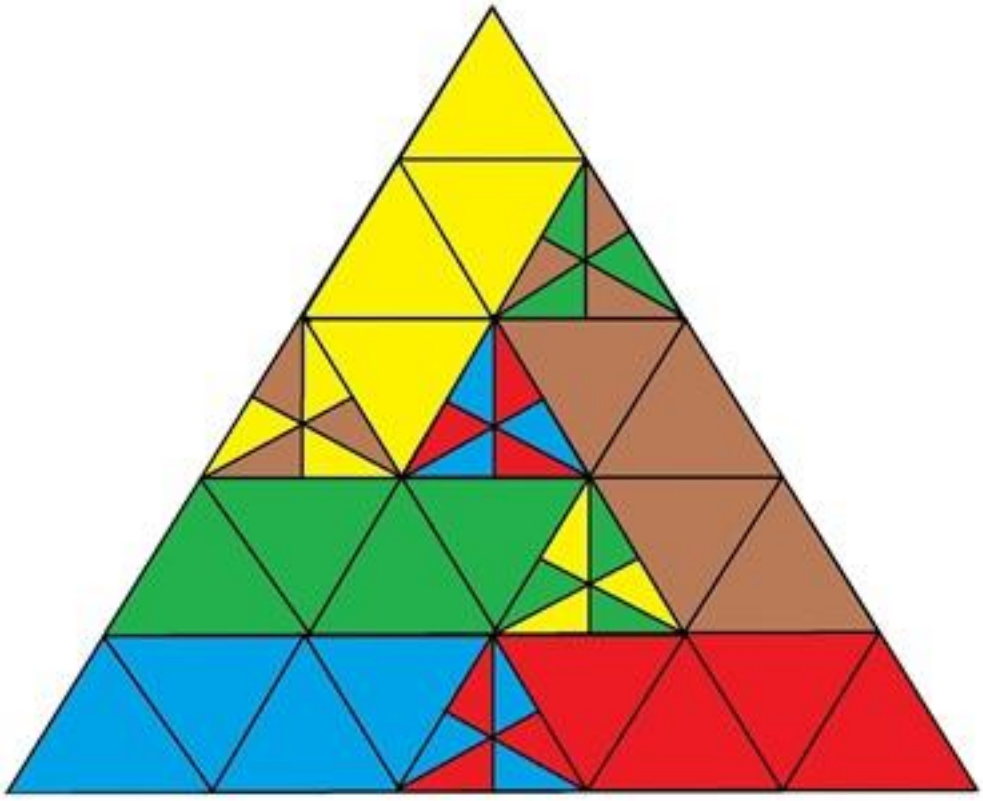
Similar to cutting into 4 parts, you can divide the sides of a regular triangle into n equal parts and cut it into many smaller triangles as in the figure:



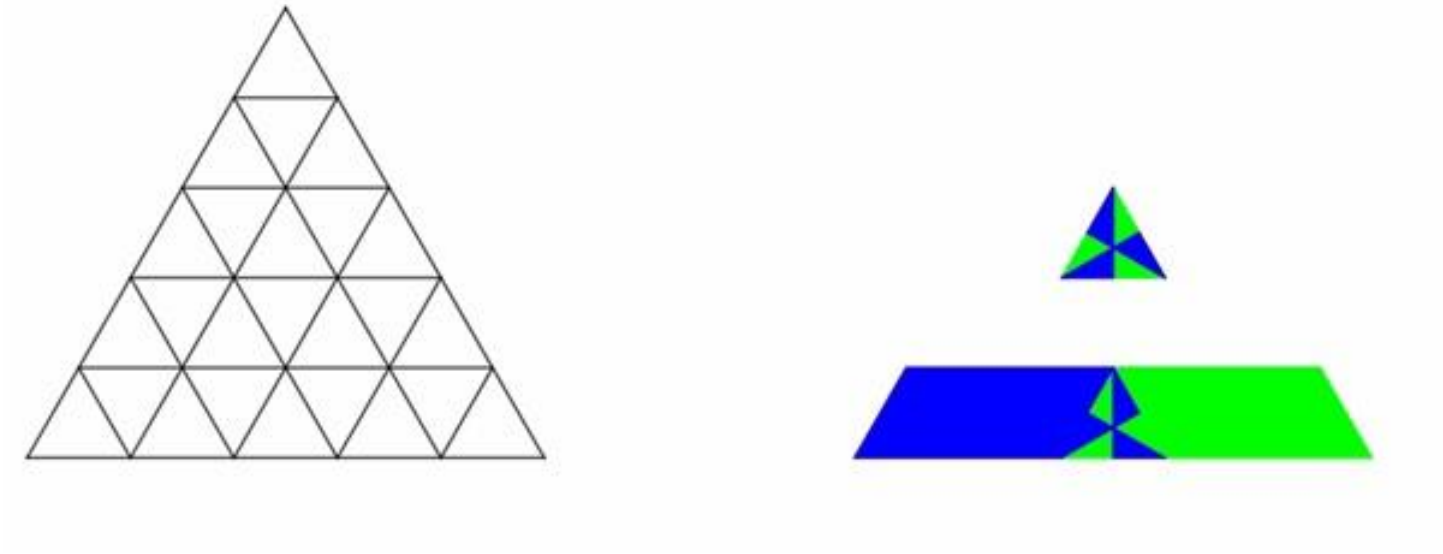
How many pieces will we cut into in this case? Since the sides of small triangles are n times smaller than the sides of a large triangle, then, as is known, their area is n^2 times smaller, and since they completely replace the triangle, then we have only n^2 small triangles.

But we can cut each small triangle into another 2,3 or 6 parts! This means that we can cut a regular triangle into n^2, $2n^2$, $3n^2$ and $6n^2$ equal parts.

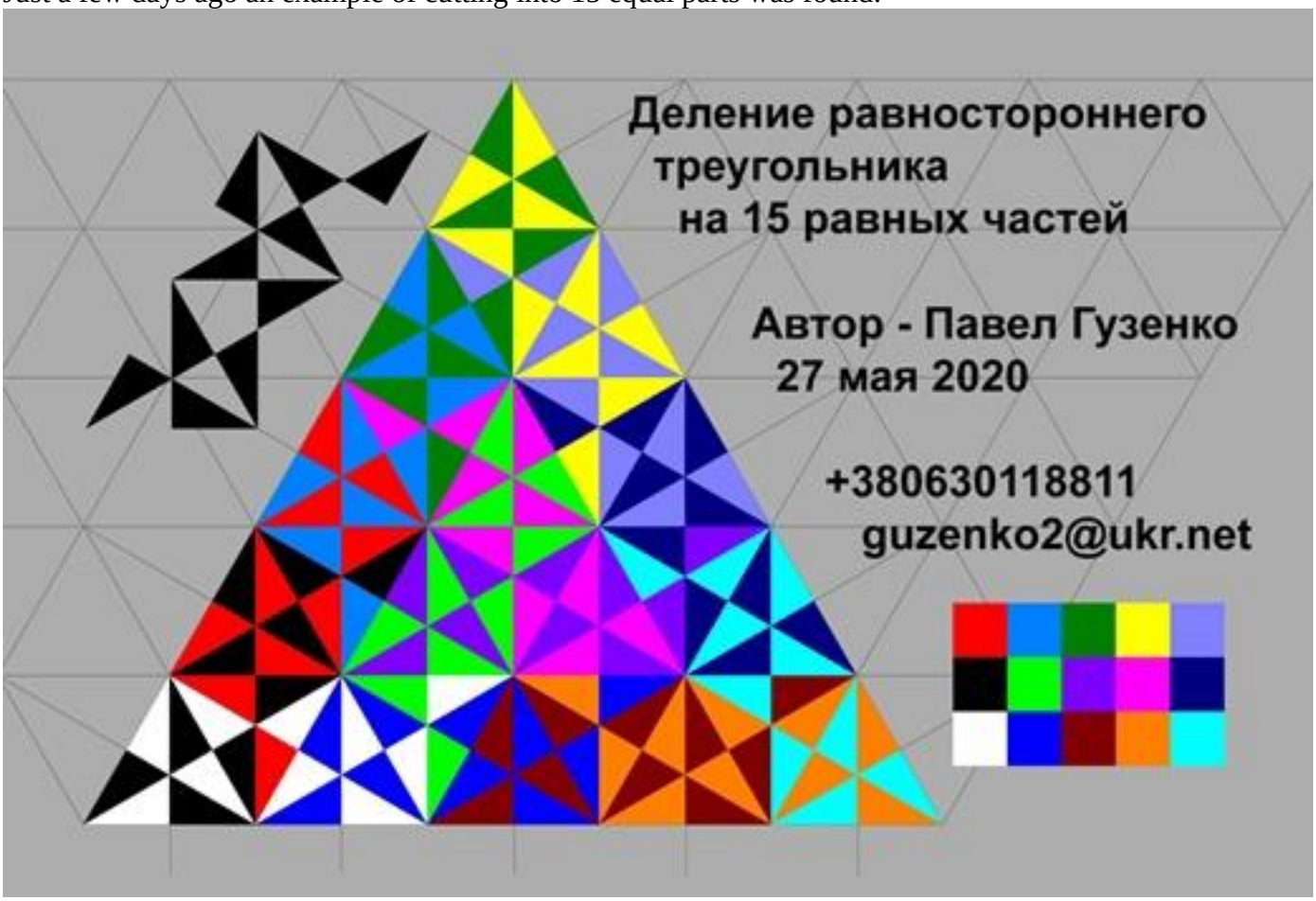
What about, for example, five parts? In 2015, Mikhail Patrakeev managed to come up with an amazing way:



Here the cutting parts are not related figures, but they are equal in the sense that if we draw each of them on transparent paper, then they can be combined with each other (to do this, the paper may have to be turned over).



Just a few days ago an example of cutting into 15 equal parts was found:



The most amazing thing is that modern mathematics knows practically nothing more about this problem. It is not known whether it is possible to cut a regular triangle into 7 or 11 equal parts, and the answer to a similar question about 5 already connected equal parts is also unknown.