



# Math Competitions: Summer Challenge

Happy Summer Break!

If you are reading this, then it is assumed you are proficient in all of your grade level skills mentioned in your summer math packet, are bored with them, and you're looking for a challenge. I highly recommend looking into math competitions. Please email me, Mr. Dalzell, if you have any questions: [mdalzell@sacredheartlynd.org](mailto:mdalzell@sacredheartlynd.org).

To be better prepared for this year's math competitions, you must:

- Achieve automaticity with base skills
- Strengthen/Learn math skills
- Practice problem solving with multi-step questions

The second and third parts are entwined together when preparing.

## Levels of Competition

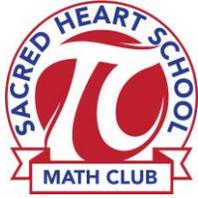
- Elementary (3<sup>rd</sup> – 6<sup>th</sup> grades)
  - o Mathleague
  - o SHS Math Competition
- Middle School (6<sup>th</sup> – 8<sup>th</sup> grades)
  - o Mathcounts
  - o Mathleague
  - o iLearn Math Contest

## Automaticity

What does automaticity mean? In a phrase: second nature. The goal of the base skills is automaticity, in other words the knowledge can be recalled almost instantly, like muscle memory. The less brain power needed for certain math skills, the more can be focused on the actual question. Most of these skills also count as mental math, therefore Number Sense scores can greatly increase, as will Sprint, Target, and Team. This lays the FOUNDATION for success.

## What should be automatic for all (mental math):

- Times tables up to and including 12's
- Division tables up to and including 12's
- Squares ( $5^2 = 5*5 = 25$ ) up to  $25^2$
- Times and division tables up to 15's
- Cubes ( $5^3 = 5*5*5 = 125$ ) up to  $12^3$
- Basic 2-digit and 3-digit addition and subtraction
- Listing smallest ten prime numbers (2, 3, 5, 7, 11, 13, 17, 19, 23, 29)



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## What should be automatic for Middle School and for those Elementary students looking to qualify for states in Mathleague:

- Basic Pythagorean triples and special cases
- Factorials ( $5! = 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 = 120$ ) up to  $8!$
- Perfect Square Roots up to and including  $\sqrt{625} = 25$
- Greatest Common Factor and Least Common Multiple of common numbers (mainly 1- and 2-digit numbers)
- Simplify fractions
- Simple percents of numbers (20% of 40, 50% of 80, etc.)
- Fraction/Decimal/Percent Conversions for commonly used numbers:  
 $\frac{1}{2}, \frac{1}{3}, \frac{2}{3}, \frac{1}{4}, \frac{3}{4}, \frac{1}{5}, \frac{2}{5}, \frac{3}{5}, \frac{4}{5}, \frac{1}{6}, \frac{5}{6}, \frac{1}{8}, \frac{3}{8}, \frac{5}{8}, \frac{7}{8}, \frac{1}{9}, \frac{2}{9}, \frac{4}{9}, \frac{5}{9}, \frac{7}{9}, \frac{8}{9}, \frac{1}{10}, \frac{1}{12}, \frac{1}{20}, \frac{1}{25}, \frac{1}{50}, \frac{1}{100}$

## How to train for skills:

- Once the facts are learned, use flash cards and time yourself.
- Try to continually beat your time. Try it every day.
- Practice some of the SHS Number Sense rounds (10 minutes). The questions are easier than those of Mathleague, so it is a good stepping stone.
- For more information, look later in the packet for *The Approach*

## How to train for Problem Solving:

In a word: PRACTICE! Try a few questions from the SHS Sprint (40 minutes) and Target (6 min each question pair) rounds, check the answers, figure out what went wrong if incorrect.

## Other Math Skills to Strengthen/Learn

Most of the skills seen underneath work for both Elementary and Middle School Level skills, though the list is focused more for Elementary Level.

- Square Roots (“undoing” squares, since  $5^2 = 25$ ,  $\sqrt{25} = 5$ )
- Roman Numerals
- Greatest Common Factors
- Least Common Multiples
- Fraction Operations
- Decimal Operations
- Integer Operations
- Percentage of a Number (ex: 15% of 450)
- New operation definitions (ex: if  $a \nabla b = 2a - 3b$ , find  $15 \nabla 8$  or find  $12 \nabla (5 \nabla 4)$ )
- Ratios and Rates
- Proportions
- Difference of Squares
- Perfect Squares (binomials)



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- Probability
- Counting (how many primes between 30 and 100, how many ways can 12 runners finish in 1<sup>st</sup>, 2<sup>nd</sup>, and 3<sup>rd</sup> place, etc.)
- Pythagorean Theorem
- Geometry (2D/3D, slopes)
- Logic

## How do you decide which skills to work on?

Easy! Practice the competition rounds! There are many topics and subtopics in the list. They are also normally presented in a different way than most textbooks will present them. Therefore, try the competition rounds in this way:

## The Approach:

1. Take a Number Sense Round, Sprint Round, or Target Round in the normal time frame.
  - For Number Sense Rounds, work up to the 80 questions if you are not answering 40+ correct yet. Start with only the first 30 or 40 instead of the entire round.
  - For Sprint Rounds, work up to the 30 questions if you are not answering 15+ correct yet. Start with only the first 10 or 15 questions instead of the entire round.
  - For Middle School Sprint Rounds: try using the Mathcounts Handbook (see Resources page) which has 10 questions per page. Time yourself for 15 minutes (maybe 20 minutes).
2. When done, score your round with a simple circle (correct) or X (incorrect).
3. Spend another 15 minutes or so solve the problems which you got wrong or didn't answer during the test. Check the accuracy of your answers.
4. At this point, you should have 4 categories of problems:
  - Completely correct- don't worry about these questions at all.
  - Correct, but it took a long time- if it is an early question taking 2-3 minutes, then it is a time-sink. Find out *why* it is a time-sink. Is there an easier/faster way of solving the problem?
  - Incorrect (or blank) but solved it after the normal round was done- these are probably larger time-sinks. Find out *why* it was originally incorrect (or blank).
  - Incorrect and could not solve it afterwards- Look up the solution (not just the answer). Write the solution and figure out where the lapse was. Was it a fluke? Was it incomplete knowledge? Was it not knowing how to start the question? If there were multiple questions in similar categories that were incorrect, focus on those categories (such as similar triangles or factoring).
5. File away every question you got wrong (last category) in folder(s).
6. TAKE A BREAK, recharge your brain: read a book, play a game, go swimming, etc.
7. At the end of the week, review all the questions that were incorrect. Spend some time reviewing the topics and try sample questions.
8. Repeat, including trying some of the same questions again.

## Why take this approach?



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You can practice shooting eight hours a day, but if your technique is wrong, then all you become is very good at shooting the wrong way. Get the fundamentals down and the level of everything ***you do will rise.***" - Michael Jordan

First, this approach instills good and effective studying habits. It maximizes the effect of your work. For many students, 45 minutes-1 hour of this approach can be more effective than 2-3 hours of just practice problems.

This process allows you to focus on your weak points and make them your strong points. It helps you to self-reflect on your own work and see where you normally succeed and where you normally fail.

***"When you first start off trying to solve a problem, the first solutions you come up with are very complex, and most people stop there. But if you keep going, and live with the problem and peel more layer of the onion off, you can often times arrive at some very elegant and simple solutions."***

**- Steve Jobs, 2006**

Secondly, it allows you to revisit questions and find a more elegant solution. Math is not just about finding the right answer. That is a small part. Peel the onion layers off and find the most elegant (and quickest) solution!



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## Resources:

### Automaticity:

- Mr. Dalzell's blog will have **5 minute challenges** posted periodically during the summer. Answer as many as possible in 5 minutes and follow the approach outlined above to complete the 5 minute challenge. These should (eventually) be mental math where only the answer is written. If you are not up to that point yet, keep working!
- Google search the topic and "worksheet pdf." There are many free worksheets to be found online. Try a 5 minute challenge with that worksheet.

### Other skills/problem solving:

- Elementary
  - o SHS Math Competitions are on Mr. Dalzell's blog. These reflect some of the easier questions in the Mathleague competitions, and it is a good starting point but by no means the end!
  - o Request more Mathleague-style questions from Mr. Dalzell or go to [mathleague.org](http://mathleague.org) and request their sample Elementary Rounds for free.
  - o [Khanacademy.org](http://Khanacademy.org) to learn/relearn more skills and practice basic questions with the skills.
  - o Note: Once a good foundation in skills is learned, switch most of the focus to problem solving (Sprint and Target)
- Middle School
  - o Go to [mathleague.org](http://mathleague.org) and request their sample Middle School Rounds for free.
  - o Mathcounts Minis- to learn how to solve styles of problems
    - <https://www.mathcounts.org/resources/video-library/mathcounts-minis>
  - o Mathcounts Trainer- problems which scale from School level through Chapter, State, and National. If your answer to a question is incorrect, take a screen shot and revisit later.
    - [http://www.artofproblemsolving.com/mathcounts\\_trainer](http://www.artofproblemsolving.com/mathcounts_trainer)
  - o Mathcounts Handbook- includes answers (not solutions). Try 15 or 20 minutes for 10 questions and follow the approach outlined earlier in this document.
    - <https://www.mathcounts.org/resources/school-handbook>
  - o [Khanacademy.org](http://Khanacademy.org) to learn/relearn more skills and practice basic questions with the skills.
  - o NOTE: Mathcounts does hit a good amount of PreAlgebra and Algebra. They are approachable to 6<sup>th</sup> graders with some time and practice.