AMC8/MATHCOUNTS Fundamentals Course Syllabus

Algebra

Lesson 1: Algebraic Thinking

- Intro to variables and equations
- Simplifying expressions
- Solving linear equations
- Properties of algebra
- Function notation
- Special symbols and operations
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Lesson 2: Quadratics and the Quadratic Formula

- Intro to quadratics
- Solving quadratics
- Common Quadratics

Lesson 3: Solving Polynomials

- Solving polynomials (factoring)
- Polynomial formulas (difference of squares/cubes)
- Operations with polynomials
- Intro to Vieta's theorem

Lesson 4: Sequences and Series

- Arithmetic sequences
- Geometric sequences (finite and infinite)
- Exponent and Radical Properties
- Nested Roots
- Continued Fractions

Lesson 5: Applications of Algebra

- Proportion/rate/ratio (age, mixture/dilution, work rate, etc)
- Word problems related to percentages
- Distance = rate * time

Lesson 6: Common AMC8 Problems

- Logic
- Pattern finding
- Word problems and AMC 8 examples (review)

Geometry

Lesson 7: Basics of Geometry
- Euclidean Plane Geometry
- Definitions of Lines, Angles, Parallel, Perpendicular, Adjacent, Transfersvals
- Triangle Basics

Lesson 8: Similar Triangles and Angle Chasing
- Definitions
- Triangle Similarity using 3 given
- Solving for missing quantities using Similar Triangles
- Angle-Chasing Problems

Lesson 9: Special and Right Triangles
- Triangle classification
- 30-60-90 and Equilateral Triangles
- Pythagorean Theorem Proof
- Applications of Right Triangles

Lesson 10: Quadrilaterals and other polygons
- Interior Angle Sums
- Definitions of apothem, etc.
- Ptolemy/Brahmaputra Theorem
- Problems involving area & angles

Lesson 11: Circles
- Power of Point
- Chord/Secant/Radii/Diameter
- Properties of Circles
- Inscribed/Exscribed Circles

Lesson 12: 3D Geometry & Irregular Problems
- Euler's Polyhedra Formula
- Visualization Tips and Tricks
- Solving problems with irregular shapes
- Rectangular Prism Distances and Spheres/Cones

Number Theory/Combinatorics

Lesson 13: Counting Basics
- Permutations and combination
- Factorial Notation
- Complementary counting

- Set theory
- Casework
- Multinomials

Lesson 14: Arrangements and Counting Techqnieus
- Stars and bars
- Binomial theorem

Lesson 15: Inclusion and Exclusion

- Principle of inclusion and exclusion
- Venn Diagrams

Lesson 16: Probability and Events
- Independent and dependent events
- Calculating probability

Lesson 17: Prime Numbers and Factors
- Types of numbers
- Prime and composite
- GCF and LCM
- Prime factorization

Lesson 18: Modular Arithmetic and Divisibility
- Divisibility rules
- Remainders
- Module notation