

University at Buffalo
GIFTED MATH PROGRAM

Course II Curriculum

Textbooks: Comprehensive School Mathematics Program, *Elements of Mathematics*, Book 0, Chapters 10 and 11; and *GMP Elements of Mathematics, Book 2 Logic and Sets*; *GMP Elements of Mathematics, Book 0, Chapter 12A: An Introduction to Geometry and Trigonometry*

Unit 1: ALGEBRA IN OPERATIONAL SYSTEMS

- **GROUPS:** Review of one-fold operational systems, Examples of non-commutative groups, Cancellation property and uniqueness of inverses, Solving equations in groups, Notational conventions of inverses, Opposite operation in a group
- **RINGS:** Review of two-fold operational systems and distributivity, Definition of a ring, Notation for rings, Ring properties, Iterated sums and products
- **FIELDS:** Zero divisors, Definition of a field, Solving equations in fields, Fractional notation, Field formulas
- **RELATIONS:** Definition and graphs, Set operations with relations, Converse of a relation, Properties of relations, Equivalence relations
- **MAPPINGS AND EQUATIONS OVER FIELDS:** Mappings, Mappings as relations, Converse of a function, Composition of functions, Invertible mappings, The mappings (+a) and (-a), Additive and multiplicative inverse mappings, Power mappings
- **RELATIONAL SYSTEMS:** Definition and examples, Linearly ordered sets
- **ORDERED GROUPS, RINGS, AND FIELDS**

Unit 2: ALGEBRA OF REAL FUNCTIONS

- **THE REAL NUMBERS:** Extending the Ordered Field of Rational Numbers; Approaching the Real Numbers via the Decimals; Notation for Real Numbers; Finding the Rational Number with a Given Periodic Nest; Historical Note about π
- **REAL FUNCTIONS:** Some Uses of the Real Numbers in Physical Situations; Coordinatizing the Plane; Real Functions; Functions Whose Graphs are Lines; The Ring of Real Functions with Domain \mathbb{R} ; Some Functions Whose Graphs are not Lines
- **REAL POLYNOMIAL FUNCTIONS:** Systems of First Degree Equations and Inequalities; Solution of Quadratic Equations and Inequalities; Solutions of Quadratic Equations by Factorization; Completing the Square; The Quadratic Formula
- **POWER FUNCTIONS:** Integral Exponents; Integral Power Functions, The Converse of a Real Function; Root Functions; Rational Power Functions; Composition of Certain Real Functions
- **OTHER REAL FUNCTIONS:** The Absolute Value Function; The Greatest Integer Function; Growth and Decay Functions; Rational Functions

Unit 3: LOGIC AND SETS

- **SETS:** Introduction; Set theory; Primitive notations; Elementary properties of sets; Operations with Sets; Counterexamples and Examples; Sets, Classes, and Russell's Paradox
- **LOGIC:** Introduction and Review, The Real Numbers, Equivalence and Cardinality, Formal Ideas about Cardinality, Finite and Infinite Cardinal Numbers, Cardinality of the Continuum
- **PROOFS:** Introduction, Proofs from Demonstrations, Proofs Involving \emptyset , Proving Sets Equal, The Deduction Theorem Revisited

Unit 4: PROBLEM SOLVING

- **PROBLEM SOLVING HEURISTICS:** Game Strategies, Writing Complete Solutions to Problems

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(Continued)

Unit 5: MATH PROJECT

- **STUDENT RESEARCH:** Topics or Influential People Related to Mathematics or Science, Submission of Research Paper, Class Presentation of Topic Researched

Unit 6: GEOMETRY

- **SPACE:** Planes, Lines, and Points; Measurement of Distances; Measurement of Angles
- **CONSTRUCTIONS WITH STRAIGHT EDGE AND COMPASS:** Congruent Segment, Congruent Angle, Perpendicular Bisector, Angle Bisector
- **GEOMETRIC RELATIONSHIPS:** Complementary and Supplementary Angles, Angle Pair Relationships Given Two Intersecting Lines or Two Parallel Lines Cut by a Transversal.
- **TRANSFORMATIONAL GEOMETRY:** Rotation, Reflection, Translation, Dilation; Properties Preserved and Not Preserved Under a Transformation
- **TRIGONOMETRIC FUNCTIONS:** Sine, Cosine, and Tangent of Angles in a Right Triangle; Pythagorean Theorem; Equivalence Classes of Similar Right Triangles
- **COORDINATE GEOMETRY:** Relations and Functions; Graphing Linear, Quadratic, Absolute Value, Exponential Functions, and Linear Inequalities; Solving Systems of Linear Equations and Inequalities

Unit 7: DATA AND CHANCE

- **ORGANIZATION AND DISPLAY OF DATA:** Histogram, Cumulative Frequency Histogram, Box and Whisker Plot, Scatter Plot, Line of Best Fit for Scatter Plot
- **ANALYSIS OF DATA:** Frequency Distribution Table, Histogram, Evaluate Reports and Graphs, Percentile Rank, Quartiles, Independent and Dependent Variables
- **COMBINATORICS:** Permutations, Combinations, Fundamental Counting Principle