University at Buffalo
Gifted Math Program
Graduate School of Education

Course III Curriculum

Textbooks: *Transformational Geometry by Richard Brown; eMathInstruction, Common Core Geometry, https://emathinstruction.com/common-core-geometry/*

Transformational And Analytic Geometry

- THE GEOMETRY OF TRANSFORMATIONS: maps and mappings; one-to-one mappings; transformations; mappings in algebra; functions; isometries; problems solved by reflections; properties of isometries; rotations; translations and glide reflections; symmetry; the fundamental theorems of isometries
- THE ALGEBRA OF TRANSFORMATIONS: the composite (product) of mappings; the algebra of translations; the algebra of half-turns; the algebra of rotations; groups; transformation groups; symmetry groups
- ANALYTIC GEOMETRY: Equations of Lines and Circles; Proofs with Analytic Geometry; Distance between a Point and a Line

Conic Sections

- CIRCLES: construction given center and radius; equations of circles in coordinate plane
- ELLIPSES: construction given foci-pins and string; concentric circles construction; paper folding construction; equations of ellipses in coordinate plane; eccentricity; area; applications of ellipses
- PARABOLAS: construction given focus and directrix; sliding ruler method; concentric circles construction; paper folding construction; equations of parabolas in coordinate plane; application of parabolas
- HYPERBOLAS: construction of hyperbolas based on foci; concentric circles construction; eccentricity; equation of hyperbolas in coordinate place; asymptotes; application of hyperbolas
- OPTIMIZATION: pre-calculus solutions (using ellipses) to burning tent and swimming pool problems

Geometry with Emath Instruction

- ESSENTIAL GEOMETRIC TOOLS AND CONCEPTS: points, distance, and segments; lines, rays, and angles; types of angles; complements and supplements; circles and arcs; constructing a triangle; geometry terminology; properties of lines
- TRANSFORMATIONS, RIGID MOTIONS AND CONGRUENCE: transformations; rotations; reflections; isosceles triangles; translations; congruence and rigid motion; basic rigid motion proofs; congruence reasoning with triangles; symmetries
- EUCLIEAN TRIANGLE PROOF: givens; axioms of equality; triangle congruence theorems; proofs with partitioning; parallel properties

- CONSTRUCTIONS: angles and parallel lines; perpendicular lines; circumscribed circles; bisecting and angle; inscribed circle of a triangle; inscribing regular polygons
- TOOLS OF COORDINATE GEOMETRY: slope and parallelism; slope and perpendicularity; equations of lines; point-slope form of a line; horizontal and vertical lines; pythagorean theorem; distance formula; midpoint formula; rotations in the coordinate plane; reflections in the coordinate plane; translations in the coordinate place
- QUADRILATERALS: trapezoids and parallelograms; properties of parallelograms; midpoints of a triangle; rectangles; rhombus; squares
- DILATIONS AND SIMILARITY: dilations; dilations in the coordinate plane; dilations and angles; similarity and its criteria; reasoning with similarity; side splitter theorem; partitioning a line segment; medians of a triangle; right triangles and similarity; proving the Pythagorean theorem
- RIGHT TRIANGLE TRIGONOMETRY: similar right triangles; trigonometric ratios; trigonometry and the calculator; solving for missing sides of a right triangle; trigonometric applications
- CIRCLE GEOMETRY: terminology; inscribed angles; intersecting chords; tangents to a circle; tangents, secants, and angles; tangent and secant proofs; equations of circles; standard form; constructing tangents; equations of tangent lines
- MEASUREMENT AND MODELING: perimeter; circumference; area of polygons; area of circle; sectors of circles; radian measure; solids and cross sections; volume of prisms and cylinders; volume of pyramids and cones; spheres; volume of truncated cone

Computational Geometry

- LINEAR ALGEBRA TOPICS: matrix, determinant, linear transformation, linear combinations
- ALGORITHMS: convex hull, orientation, affine combinations, convex combinations
- CAPSTONE PROJECT