Geometry is a complete college preparatory course of plane and solid geometry. It is recommended that there be a strand of algebra review woven throughout the course to help students maintain their understanding of algebra and the use of their algebraic skills. The exploration of various proof methods is recommended. Such methods are two and three column proofs, flowcharts, and paragraph formats. Constructions for the sake of visualization is encouraged which may include construction tools, paper folding, and the Geometry Sketchpad investigations.

I. LANGUAGE OF GEOMETRY

1. Undefined terms: points, lines, and planes
2. Defined terms: angle, bisector, midpoint, etc.

II. LOGICAL REASONING

1. Conditional and bi-conditional statements
2. Written justification for logical arguments
3. Patterning and mathematical modeling
4. Inductive and deductive reasoning
5. Indirect proofs
6. Convereses and proof by counterexample
7. Proof by contradiction
8. Truth tables

III. LINES AND SEGMENTS

1. Properties associated with transversal lines
2. Properties of parallel and perpendicular lines
3. Properties associated with perpendicular bisectors

IV. GRAPHS

1. Graphs and equations of linear functions
2. Equations of both parallel and perpendicular lines
3. Equations of both vertical and horizontal lines
4. Plane regions formed by linear equations
5. Graphs and equations of quadratic functions

V. PLANE FIGURES

1. Concept development of area and perimeter and their units of measure
2. Properties and their proofs for quadrilaterals to include parallelograms, rectangles, squares, rhombuses, trapezoids and kites

(Continued on page 81)
3. Properties and their proofs for triangles to include scalene, isosceles, equilateral, right triangles
4. Triangle inequality property
5. Properties and their proofs for polygons to include regular and irregular polygons
6. Properties associated with medians and altitudes
7. Relationships between the base and height in triangles and quadrilaterals
8. Concept development for perimeter formulas for all polygonal regions
9. Concept development for area formulas for all polygonal regions
10. Area of polygons using figure dissection and sub-problems

VI. ANGLES
1. Properties and relationships of all angles
2. Conjectures for angle relationships formed by parallel lines
3. Converse for angle relationships formed by parallel lines
4. Conjecture for vertical angles
5. Conjectures for the exterior angles of triangles
6. Conjectures for the measure of the angles of a triangle
7. Conjectures for the isosceles triangle theorem
8. Formula development to find the sum of the angles of a polygon
9. Formula development to find the angle measurement in regular polygons
10. Formula development to find the sum of the exterior angles of a polygon

VII. SIMILARITY
1. Conjecture development for an intuitive understanding of similarity
2. Scale drawings as an application of similarity
3. Conjectures for the basic ratio of similarity for plane figures
4. AA similarity theorem
5. Application problems using the similarity properties
6. Mid-segment theorem
7. Formula development of ratios for perimeter, area and volume using similar figures or solids
8. Application problems using ratios for length, area, and volume

VII. CONGRUENCY
1. Concept development of congruence
2. Concept development for corresponding parts of two congruent figures
3. Fundamental congruence postulates for triangles: SSS, SAS, ASA, AAS

(Continued on page 82)
4. Fundamental congruence postulates for right triangles: HL, LL, HA, LA
5. Proofs using congruent triangles

IX. CIRCLES
1. Basic properties of a circle to include investigations of $\pi$
2. Conjectures and proofs of the properties of the circle
3. Area and circumference of circles
4. Concept development of the diameter-chord relationships in circles
5. Relationships between the area and central angles in circles
6. Area of sectors and sector segments
7. Angle and arc length relationships in circles
8. Concept development and proofs for the theorems of angles, chords, secants, and tangent segments
9. Concept development of the equation of the circle using its locus of points

X. PYTHAGOREAN THEOREM
1. Concept development of the Pythagorean Theorem and its converse
2. Pythagorean Theorem application to find the lengths of segments
3. Pythagorean Theorem application to find the midpoints of segments
4. Pythagorean Theorem application to find the distance between a point and a line
5. Pythagorean Theorem application to find the length of a segment
6. Concept development and use of the properties of special right triangles
7. Radical expressions and simplification review

XI. TRIGONOMETRY
1. Exploration of the sine, cosine, and tangent values using a calculator
2. Concept development for the sine, cosine and tangent ratio for right triangles
3. Concept development of the relationship between the tangent and slope ratios
4. Application problems using trigonometric ratios
5. Concept development of the relationships between the sides of special right triangles
6. Concept development and use of the Law of Sines as proportionality

XII. SOLID FIGURES
1. Isometric and orthogonal drawings of three-dimensional figures
2. Mats to build isometric figures
3. Surface area of polyhedrons and spheres

(Continued on page 83)
4. Construction of various polyhedrons and concept development of volume
5. Concept development of the formulas for the volume of prisms, cylinders, pyramids, cones and spheres
6. Concept development of the formulas for the surface area of prisms, cylinders, pyramids, cones and spheres
7. Application problems

XIII. TRANSFORMATIONAL GEOMETRY
1. Coordinate geometry
2. Explorations of line symmetry and reflections
3. Explorations of translations, rotations and dilations
4. Exploration of tessellations

XIV. GEOMETRIC PROBABILITY
1. Concept development of geometric probabilities
2. Applications of geometric probability

XV. CONSTRUCTIONS
1. Proof of geometric theorems using the construction tools
This is an Advanced Algebra course designed for students who have satisfactorily completed both the college-preparatory Algebra I and Geometry courses. Topics to be covered are listed below.

I. LINEAR FUNCTIONS
   1. Properties of linear functions
   2. Graphs of linear functions to include the vertical and horizontal shifts, and stretch factors
   3. Slope-intercept form
   4. Point-slope form
   5. Applications of the linear function
   6. Solving linear equations

II. EXPONENTIAL FUNCTIONS
   1. Properties of exponential functions
   2. Graphs of the exponential function to include the vertical and horizontal shifts, and stretch factors
   3. Effects of negative and rational exponents to the exponential function
   4. The properties of the number \( e \)
   5. Applications of the exponential function to growth and decay

III. LOGARITHMIC FUNCTIONS
   1. Properties of inverse functions
   2. Connections between the exponential and logarithmic functions
   3. Properties and graphs of logarithmic functions to include the vertical and horizontal shifts, and stretch factors
   4. Solving logarithmic equations
   5. Application of the logarithmic functions

IV. QUADRATIC FUNCTIONS
   1. Properties of quadratic functions
   2. Graphs of quadratic functions to include the vertical and horizontal shifts, and stretch factors
   3. Properties of quadratic functions in standard and intercept form
   4. Completing of the square process
   5. Proof and use of the quadratic formula
   6. Factoring the quadratics in their enhanced form
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V. SYSTEM OF EQUATIONS
1. Solving systems of equations using the graphing method and algebraic method
2. Solving linear systems using matrices
3. Properties and graphs of inequalities
4. Solving equations using absolute value
5. Solving systems of inequalities
6. Linear programming

VI. RADICAL FUNCTIONS
1. Properties of the square root function
2. Graphs of the square root function to include vertical and horizontal shifts, and stretch factors
3. Properties of radical functions
4. Graphs of radical functions to include vertical and horizontal shifts, and stretch factors
5. Solving radical equation
6. Properties of complex numbers

VII. POLYNOMIAL FUNCTIONS
1. Properties of polynomials
2. Multiplying and dividing polynomials
3. Graphs of polynomials to include vertical and horizontal shifts, and stretch factors
4. Finding zeros of polynomial functions
5. Solving cubic equations

VIII. RATIONAL FUNCTIONS
1. Inverse variation
2. Properties of rational functions
3. Graphs of rational functions to include vertical and horizontal shifts, and stretch factors
4. Solving rational equations

IX. SERIES AND SEQUENCES
1. Properties of arithmetic sequences
2. Properties of geometric sequences
3. Recursion formulas
4. Sums of arithmetic and geometric series
5. Infinite geometric series

(Continued on page 86)
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X. CONIC SECTIONS

1. Distance and midpoint formulas
2. Slopes of parallel and perpendicular lines
3. Properties of the parabola, circle, ellipse and hyperbola
4. Graphs of the parabola, circle, ellipse and hyperbola
5. Identification of second degree equations

XI. TRIANGLE TRIGONOMETRY

1. Right triangle trigonometry
2. Sine, cosine, and tangent ratios
3. Angles of rotation
4. Area of a triangle
5. Law of sines
6. Law of cosines

XII. TRIGONOMETRIC FUNCTIONS

1. Unit circle properties of the sine and cosine
2. Radian measure
3. Amplitude, period, and phase shifts
4. Tangent function
5. Graphs of the sine, cosine and tangent functions to include the vertical and horizontal shifts, and stretch factors
This course shows students how statistics is used to picture and describe the world. With this knowledge, students will be able to make informed decisions about their world as contributing members of society. This course should be offered as an elective upper division course. Topics to be covered are listed below.

I. INTRODUCTION TO STATISTICAL MEASURES
   1. Methods of data classification
   2. Design experiments

II. DESCRIPTIVE STATISTICS
   1. Frequency distributions and their graphs
   2. Measures of central tendency
   3. Measures of variation
   4. Measures of position

III. PROBABILITY
   1. Basic concepts of probability
   2. Conditional probability and the multiplication rule
   3. Addition rule
   4. Counting principles

IV. DISCRETE PROBABILITY DISTRIBUTIONS
   1. Probability distributions
   2. Binomial distributions
   3. Discrete probability distributions to include Poisson distributions

V. NORMAL PROBABILITY DISTRIBUTIONS
   1. Normal distributions
   2. Standard normal distribution
   3. Central limit theorem
   4. Normal approximations to binomial distributions

VI. CONFIDENCE INTERVALS
   1. Confidence intervals for the mean for large samples
   2. Confidence intervals for the mean for small samples
   3. Confidence intervals for population proportions
   4. Confidence intervals for variance and standard deviation
VII. HYPOTHESIS TESTING WITH ONE SAMPLE
1. Definition of hypothesis testing
2. Hypothesis testing for the mean for $n \geq 30$
3. Hypothesis testing for the mean for $n < 30$
4. Hypothesis testing for proportions
5. Hypothesis testing for the variance and standard deviation

VIII. HYPOTHESIS TESTING WITH TWO SAMPLES
1. Testing the difference between two means – large independent samples
2. Testing the difference between two means – small independent samples
3. Testing the difference between two means – dependent samples
4. Testing the difference between two proportions

IX. CORRELATION AND REGRESSION
1. Definition of correlation
2. Definition of linear regression
3. Measures of regression and prediction intervals
4. Multiple regression

X. CHI-SQUARE TESTS AND THE F-DISTRIBUTION
1. ‘Goodness of Fit’ concept
2. Independence
3. Comparing two variances
4. Analysis of variance

XI. NONPARAMETRIC TESTS
1. Sign test
2. Wilcoxon tests
3. Kruskal-Wallis test
4. Rank correlation
This course combines algebraic, geometric, and trigonometric ideas and techniques that are needed to prepare students for calculus. It introduces students to the concept of limit. This course is frequently taught in conjunction with an in-depth study of trigonometry or with linear algebra or statistics if the trigonometric concepts were taught completely in the Algebra II course. The topics to be addressed are listed below.

I. FUNCTION ANALYSIS
   1. Properties of relations and functions
   2. Properties and graphs of piecewise functions
   3. Continuity
   4. Functional properties of parallel and perpendicular lines
   5. Properties of odd and even functions
   6. Properties of increasing and decreasing functions
   7. Properties of domain, range, maxima, minima, and end-behavior
   8. Properties of limits to include at a point and at infinity

II. FUNCTIONS, EQUATIONS AND INEQUALITIES
   1. Equation solving techniques to include systems of equations
   2. Properties of composite functions to include the domain and range
   3. Properties of inverse functions to include the domain and range
   4. Approximate solutions to equations
   5. Inequality equation solving techniques
   6. Graphs of inequalities to include the vertical and horizontal shifts, and stretch factors
   7. Absolute value equation solving techniques
   8. Graphs of absolute value equations to include the vertical and horizontal shifts, and stretch factors
   9. Linear programming

III. INTEGERS AND POLYNOMIALS
   1. Factors of polynomial
   2. Zeros of a polynomial
   3. Quotient/ remainder theorem
   4. Division of polynomials
   5. Synthetic division
   6. Remainder and factor theorems
   7. Quadratic equations and inequalities
IV. RATIONAL NUMBERS AND FUNCTIONS
   1. Rational numbers and expressions
   2. Irrational numbers
   3. Reciprocals of the power function
   4. Properties of rational functions
   5. End behavior of rational functions
   6. Graphs of rational functions
   7. Solving rational equations

V. EXPONENTIAL AND LOGARITHMIC FUNCTIONS
   1. Properties and use of rational exponents
   2. Properties and graphs of exponential functions
   3. Properties and graphs of logarithmic functions
   4. Solving the exponential and logarithmic equations
   5. The number e
   6. Properties and graphs of natural logarithmic functions
   7. Applications

VI. TRIGONOMETRIC FUNCTIONS
   1. Properties of the circular functions
   2. Radian measure
   3. Trigonometric functions of special angles
   4. Right triangle trigonometry
   5. Law of sines
   6. Law of cosines
   7. Ambiguous case
   8. Parent graphs of sin (x), cos (x), tan (x) and their reciprocals
   9. Properties of trigonometric graphs to include the vertical shift, horizontal shift and stretch factor components
   10. Properties of inverse trigonometric functions
   11. Properties of inverse trigonometric graphs to include the vertical shift, horizontal shift and stretch factor components
VII. TRIGONOMETRIC IDENTITIES AND EQUATIONS
1. Trigonometric identities
2. Proofs of identities
3. Sum/ difference formulas
4. Double-angle formulas
5. Half-angle formulas
6. Solving trigonometric equations
7. Solving trigonometric inequalities
8. Applications

VIII. VECTORS AND PARAMETRIC EQUATIONS
1. Geometric and algebraic vectors
2. Vectors in three-dimensional space
3. Perpendicular vectors
4. Dot product and the angle between vectors
5. Applications using vectors to include directional problems
6. Properties and graphs of parametric equations
7. Applications of parametric equations to model motion

IX. POLAR COORDINATES AND COMPLEX NUMBERS
1. Properties of complex numbers
2. Distinguish the characteristics and uses of vectors in representations of velocity and force
3. Polar coordinates
4. Conversions between the polar and rectangular systems
5. Polar equations and their graphs
6. Product and quotients of complex numbers in polar form
7. Powers of complex numbers
8. Roots of complex numbers

X. CONICS
1. Properties of the parabola, hyperbola, and ellipse
2. Graphs of the conics and their degenerates: the line and circle
3. Transformations of the conics
4. Solving quadratic systems to include inequality properties

(Continued on page 92)
XI. RECURRENCE AND MATHEMATICAL INDUCTION

1. Recurrence and explicit formulas
2. Arithmetic and geometric series
3. Principle of mathematical induction

XII. AREA UNDER THE CURVE: INTEGRATION

1. Area of rectangles
2. Summation and sigma notation
3. Graphical interpretation
4. Area of rectangles using the left and right endpoints
5. Application of distance as area
6. Definite integral of polynomial functions

XIII. RATES OF CHANGE: DERIVATIVE

1. Rates of change
2. Secants and tangents to the curve
3. Graphical interpretation of the derivative
4. Derivative at a point
5. Derivative of a function
6. Applications: velocity, acceleration, and critical points on a polynomial
The calculus course taught in high school should be rigorous and taught at the same depth as an entry-level college or university calculus course. It is recommended that the syllabi presented by the College Board for Calculus AB and Calculus BC be considered when designing a Calculus class for high school students. Presented here is the topic outline for the Advanced Placement Calculus curriculum.

ADVANCED PLACEMENT CALCULUS AB

FUNCTIONS, GRAPHS, AND LIMITS

Analysis of Graphs
1. Using both geometric and analytic information, predict and explain the observed local and global behavior of functions

Limits of functions
1. Intuitive understanding of the limiting process
2. Calculate limits using algebra
3. Estimating limits from graphs and tables of data

Asymptotic and unbounded behavior of functions
1. Understand asymptotes in terms of graphical behavior
2. Describe asymptotic behavior in terms of limits involving infinity
3. Compare relative magnitudes of functions and their rates of change

Continuity as a property of functions
1. Intuitive understanding of continuity
2. Continuity in terms of limits
3. Geometric understanding graphs of continuous functions to include, Intermediate and Extreme Value Theorems

DERIVATIVES

Concept of the derivative
1. Derivatives presented graphically, numerically, and analytically
2. Derivatives interpreted as an instantaneous rate of change
3. Derivatives defined as the limit of the difference quotient
4. Relationship between differential ability and continuity

Derivative at a point
1. Slope of a curve at a point
2. Tangent line to a curve at a point of local linear approximation

(Continued on page 94)
3. Instantaneous rate of change as the limit of average rate of change
4. Approximate rate of change from graph and tables of values

**Derivative as a function**
1. Corresponding characteristics of graphs of $f$ and $f'$
2. Relationship between the increasing and decreasing behavior of $f$ and $f'$
3. The Mean Value Theorem
4. Equations involving derivatives

**Second derivatives**
1. Corresponding characteristics of $f$, $f'$, and $f''$
2. Relationship between the concavity of the $f$ and $f''$
3. Points of inflection

**Applications of derivatives**
1. Analysis of curves
2. Optimization
3. Modeling rates of change to include related rates
4. Use of implicit differentiation to find the derivative of an inverse function
5. Interpretation of the derivative as a rate of change to include velocity, speed, and acceleration

**Computation of derivatives**
1. Derivatives of basic functions to include; power, exponential, logarithmic, trigonometric and inverse trigonometric functions
2. Derivatives of sums, products, and quotients
3. Chain rule and implicit differentiation

**INTEGRALS**

**Interpretations and properties of definite integrals**
1. Computation of Reiman sums to include left, right, and midpoint evaluation points
2. Definite integral as a limit of Reiman sums over equal subdivisions
3. Definite integral of the rate of change of a quantity over an interval interpreted as the change of the quantity over the interval
4. Basic properties of definite integrals

**Applications of integrals**
1. Applications to model physical, biological, and economic situations
2. Area of a region

(Continued on page 95)
3. Volume of a solid with known cross sections
4. Average value of a function
5. Distance traveled by a particle along a line

**Fundamental Theorem of Calculus**
1. Use of the Fundamental Theorem to evaluate definite integrals
2. Use of the Fundamental Theorem to represent a particular antiderivative, including the analytical and graphical analysis of the function

**Techniques of antidifferentiation**
1. Antiderivatives following directly from derivatives of basic functions
2. Antiderivatives by substitution of variables

**Applications of antidifferentiation**
1. Specific antiderivatives using initial condition, including applications to motion along a line
2. Solve separable differential equations using them in modeling

**Numerical approximations to definite integrals**
1. Reiman and trapezoidal sums

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**ADVANCED PLACEMENT CALCULUS BC**

The topics for the BC course include the topics listed below as well as all of the above-mentioned topics from the AB curricular topics outline.

**FUNCTIONS, GRAPHS, AND LIMITS**

**Parametric, Polar, and Vector functions**
1. Analysis of planar curves to include those given in parametric, polar and vector form

**DERIVATIVES**

**Applications of derivatives**
1. Analysis of planar curves given in parametric, polar, and vector form to include velocity and acceleration vectors
2. Geometric interpretation of differential equations via slope fields
3. Numerical solutions of differential equations using Euler’s method
4. L’Hospital’s Rule to include determining limits and convergence of improper integrals and series

**Computation of derivatives**
1. Derivatives of parametric, polar and vector functions

(Continued on page 96)
INTEGRALS

Applications of integrals
1. Area of a region bounded by polar curves
2. Length of a curve

Fundamental Theorem of Calculus

Techniques of antidifferentiation
1. Antiderivatives by substitution of variables, by parts, and simple partial fraction
2. Improper integrals

Applications of antidifferentiation
1. Solve logistic differential equations

Numerical approximations to definite integrals

POLYNOMIAL APPROXIMATION AND SERIES

Concept of series
1. Partial sums and convergence

Series of Constants
1. Decimal expansions
2. Geometric series
3. Harmonic series
4. Alternating series with error bound
5. Terms of series as areas of rectangles to include p-series
6. Test ratio test for convergence and divergence

Taylor Series
1. Taylor polynomial approximation
2. Maclaurin series
3. Formal manipulation of Taylor series
4. Functions defined by power series
5. Radius and interval of convergence of power series
6. Language error bound for Taylor polynomials

(Continued on page 97)
Some electives at the high school level might include the following based on staff availability and student interest.

- Discrete / Finite Math
- Consumer Math
- Accounting
- Mechanical Drawing