

**SALPOINTE CATHOLIC HIGH SCHOOL
MATHEMATICS CURRICULUM
GRADES 9 – 12**

**CATHOLIC SCHOOLS IN THE
DIOCESE OF TUCSON**

**APRIL 2003
(revised in 2005, 2008 and 2009)**

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Introduction

The committee that prepared this curriculum was composed primarily of math teachers from Catholic Schools in the Diocese of Tucson. We organized our work around the traditional math courses that are offered in high schools, from Algebra I through AP Calculus and Statistics. Our goal was to decide what we felt constituted essential material in each course and to present that material in the form of a guide for teachers to follow. We also considered optional material, and included topics that we would recommend if time permits, or if an individual teacher believes they are essential.

As background for our work, we considered the Principles and Standards for School Mathematics published by the National Council of Teachers of Mathematics. We paid special attention to the Communications standard, wanting our students to be able to effectively use mathematics to communicate with others, both verbally and in writing. We used the 2002 curriculum of the Diocese of Phoenix for inspiration and format. We checked our curriculum drafts against the Arizona State Mathematics Standards to identify any missing elements.

The resulting curriculum is our declaration of what we as math teachers believe must be taught in each different math course. We hope it will be a guide to teachers in the years to come as they design their courses.

Finally, we present this curriculum to you in the spirit of Sir Isaac Barrow. On the occasion of his installation as the first Lucasian Professor of Mathematics at Cambridge University on March 14, 1664, he offered the following invitation to his students. May it also be an invitation to our students.

“If it be then your Pleasure, ye Lovers of Study, come always; be not restrained through any Fear, nor retarded by too much Modesty, what you may do by your Right, you shall make me do willingly, nay gladly and joyfully. Ask your Questions, make your Enquiries, bid and command; you shall neither find me averse nor refractory to your Commands, but officious and obedient. If you meet with any Obstacles or Difficulties, or are retarded with any Doubts while you are walking in the cumbersome Road of this Study of Mathematics, I beg you to impart them, and I shall endeavour to remove every Hindrance out of your Way to the best of my Knowledge and Ability.”

Mathematics Vision Statement

The Catholic schools in the Diocese of Tucson are distinct because they educate the mind, body, and the soul. We believe every student is holy because they are made in the image and likeness of God and must be encouraged to grow spiritually and academically as they progress in their faith life journey.

Learning mathematics improves the mind, is essential to succeed in life, and its mastery requires the development of important skills. It is important that our mathematics curriculum help students accomplish the goals of the National Council of Teachers of Mathematics, and take into account the Arizona State Standards. Students will:

- Learn to value mathematics.

- Learn to reason mathematically.

- Become mathematical problem solvers.

- Become confident of their mathematical abilities.

Mathematics is a discipline that encourages skills of critical thinking and problem solving. Such skills require strategies that include multi-step problems that deal with real life situations, the analysis of solutions, and utilization of technology. The diverse needs of all students are addressed through innovative and developmentally appropriate methodologies to help them reach their greatest potential.

The ultimate goal is the formation of the whole person; individuals, who grow in their faith, and who, by developing a strong understanding of mathematics, enrich their own lives and are able to contribute to their community.

PRE-ALGEBRA (revised 2005)

NUMBER AND OPERATION

Students will:

1. Work flexibly with fractions, decimals and percents to solve problems.
2. Compare and order fractions, decimals and percents efficiently.
3. Understand and use ratios and proportions.
4. Use exponents and scientific notation, especially when working with large numbers.
5. Use factors, multiples, prime factorization and relatively prime numbers to solve problems.
6. Understand the meaning of arithmetic operations with fractions and decimals.
7. Compute with integers, fractions and decimals and select appropriate methods for computation from among mental arithmetic, estimation, calculators or pencil and paper.
8. Apply computations with integers, fractions and decimals to problem situations.
9. Use the associative, commutative and distributive properties to simplify computations with integers, fractions and decimals.
10. Understand the inverse relationship between addition and subtraction, between multiplication and division, and between squaring and square roots and apply this understanding to solve problems.
11. Use number sense and mental arithmetic skills to judge the reasonableness of answers.
12. Simplify expressions using order of operations.

ALGEBRA

Students will:

1. Represent and analyze a variety of patterns with tables, graphs, words and symbolic rules, with emphasis on linear patterns and how they differ from non-linear patterns.
2. Identify functions from among patterns and relations.
3. Identify linear functions from tables, graphs and equations.
4. Develop an initial understanding of using variables.
5. Simplify algebraic expressions.
6. Use symbolic algebra to model situations and solve problems, especially with linear relationships.
7. Recognize and solve linear equations.
8. Use graphs to analyze the nature of changes in linear relationships.

GEOMETRY AND MEASUREMENT

Students will:

1. Use geometric models to represent and explain numerical and algebraic relationships.
2. Use formulas for area, surface area, volume and perimeter, and use appropriate tools and units of measurement for geometric figures, including angles.

DATA ANALYSIS AND PROBABILITY

Students will:

1. Formulate questions, design studies and collect data.

2. Make and use graphical representations of data, such as box plots, stem-and-leaf plots and scatterplots. Approximate the line-of-best-fit when appropriate.
3. Make conjectures about conclusions that can be drawn from the data.
4. Find and use appropriately measures of central tendency (mean, median, mode).
5. Compute simple probabilities of events, and use tree diagrams to determine the probability of compound events.

PROBLEM SOLVING

Students will:

1. Develop a variety of strategies for solving problems.
2. Translate problem situations into a mathematical expression or equation.
3. Reflect on problems they solve as a means to developing mathematical understanding.
4. Solve problems using real-world data to connect classroom mathematics to the larger world.

REASONING AND PROOF

Students will:

1. Develop reasoning skills by making and investigating conjectures.
2. Explain their work and justify their conclusions through logical arguments.

COMMUNICATION

Students will:

1. Communicate their mathematical thinking coherently and clearly to peers and teachers through written and spoken word.
2. Use correct mathematical vocabulary and language to express ideas precisely.
3. Work in a team, communicating with others to solve problems and develop knowledge.

CONNECTIONS AND REPRESENTATION

Students will:

1. Solve problems using more than one approach.
2. Understand problems from graphical, numerical and algebraic perspectives, and make good choices about which perspective to use to solve problems.
3. Model physical, social and mathematical phenomena with mathematical representations (graphs, tables, equations).
4. Identify graphs representing real-world situations.
5. Sketch a graph modeling real-world situations.

Correlation to the Pre-Algebra book by Charles, Davison et al.

Chapter 1: Sections 1.1 – 1.10

Chapter 2: Sections 2.1 – 2.10

Chapter 3: Sections 3.1 – 3.8

Chapter 4: Sections 4.1 – 4.9

Chapter 5: Sections 5.1 – 5.9

(continued)

Chapter 6: Sections 6.1- 6.2 and 6.4 – 6.10 (Section 6.3 optional)
Chapter 7: Sections 7.1 – 7.5 (Section 7.7 optional)
Chapter 8: Sections 8.1 – 8.7
Chapter 9: Sections 9.1 – 9.4, 9.6 (As much as time permits.)
Chapter 10: Sections 10.1 – 10.3 (Other sections optional as time permits.)
Chapter 11: Sections 11.1 – 11.4
Chapter 12: Section 12.1 – 12.4

ALGEBRA I (revised 2005)

NUMBER AND OPERATION

1. Classify real numbers as members of one or more subsets: natural, whole, integers, rational, or irrational numbers.
2. Simplify numerical expressions using order of operations, like terms, distributive property, opposites, absolute value, and scientific notation
3. Identify and apply the commutative, associative and distributive properties.
4. Define and use grade level appropriate mathematical terminology
5. Determine equivalent fractions, decimals and percents.
6. Solve word problems using grade-level appropriate operations and numbers
7. Determine equivalent decimal (standard) notation and scientific notation.

ALGEBRAIC REPRESENTATIONS

1. Use variables to represent unknown quantities.
2. Simplify algebraic expressions using the order of operations, like terms, and distributive property
3. Translate between verbal expressions and sentences and algebraic expressions and sentences.
4. Solve real world problems using multi-step linear equations.
5. Solve and graph multi-step and compound inequalities.
6. Solve and graph absolute value equations and inequalities.
7. Solve linear, inverse variation, and proportion equations using the appropriate operations
8. Solve literal equations for a specific variable.
9. Solve a system of linear equations by graphing (graphing calculator), substitution and elimination.
10. Represent and solve real-world problems with two variables using a system of linear equations.
11. Recognize and use formulas to calculate interest, percent of increase and decrease, sales tax, discount, and distance.
12. Solve systems of inequalities (linear only), with and without a graphing calculator.
13. Simplify numerical and algebraic expressions using the laws of exponents.
14. Factor, add, subtract, multiply, and divide (by monomials only) polynomials.
15. Add, subtract, multiply, and divide rational expressions
16. Simplify radical expressions
17. Solve quadratic equations by factoring, square roots, and the quadratic formula.
18. Solve rational and radical equations (intro only – not mastery)
19. Apply the concept of radicals to the Pythagorean theorem and distance formula.

PATTERNS, FUNCTIONS, AND RELATIONSHIPS

1. Use method of finite differences to identify patterns.
2. Represent linear patterns with graphs using the coordinate plane and equations.
3. Use a graphing calculator to graph relations given data or equations (linear, quadratic, exponential, inverse and direct variation relationships).
4. Identify the domain and range of a function.
5. Determine if relationships are functions given a graph, table, or set of ordered pairs.

6. Identify, determine, and represent slope as a rate of change.
7. Identify and write equations for parallel and perpendicular lines.
8. Recognize, graph, and analyze linear, exponential, quadratic, inverse and direct variation relationships between two variables.
9. Express the relationship between two quantitative variables in words, graphs, organized data tables, and algebraic expressions and equations.
10. Recognize and predict patterns of change between two variables
11. Draw inferences from represented relationships by estimation from tables and graphs, and by exact reasoning using functions

DATA ANALYSIS AND PROBABILITY

1. Calculate experimental probability.
2. Identify and apply measures of central tendency.
3. Organize collections of data into frequency charts, stem-and leaf plots, scatterplots, and construct histograms, line graphs, circle graphs, and box-and-whiskers plots.
4. Understand positive, negative, and no correlation of scatterplots.
5. Draw a line of best fit (without calculator) and use a graphing calculator to identify a line of best fit.
6. Gather real-world data representing a linear relationship (independent variable is time) and analyze it using appropriate methods

PROBLEM SOLVING

Students will:

1. Develop a variety of strategies for solving problems.
2. Translate problem situations into a mathematical expression or equation.
3. Reflect on problems they solve as a means to developing mathematical understanding.
4. Solve problems using real-world data to connect classroom mathematics to the larger world.

REASONING AND PROOF

Students will:

1. Develop reasoning skills by making and investigating conjectures.
2. Explain their work and justify their conclusions through logical arguments.

COMMUNICATION

Students will:

1. Communicate their mathematical thinking coherently and clearly to peers and teachers through written and spoken word.
2. Use correct mathematical vocabulary and language to express ideas precisely.
3. Work in a team, communicating with others to solve problems and develop knowledge.

CONNECTIONS AND REPRESENTATION

Students will:

1. Solve problems using more than one approach.
2. Understand problems from graphical, numerical and algebraic perspectives, and make good choices about which perspective to use to solve problems.

3. Model physical, social and mathematical phenomena with mathematical representations (graphs, tables, equations).

Correlation to the Holt Algebra book

Chapter 1: Sections 1.1 – 1.6

Chapter 2: Sections 2.1 – 2.7

Chapter 3: Sections 3.1 – 3.6

Chapter 4: Sections 4.1 – 4.6

Chapter 5: Sections 5.1 – 5.6

Chapter 6: Sections 6.1- 6.5

Chapter 7: Sections 7.1 – 7.6

Chapter 8: Sections 8.1 – 8.7

Chapter 9: Sections 9.1 – 9.3, 9.5 – 9.8

Chapter 10: Sections 10.1 – 10.5

Chapter 11: Sections 11.1, 11.2 (rational expressions only)

Chapter 12: Section 12.1, 12.3, 12.4

If time allows: 11.2 Rational functions, 12.2 square root function & radical equations

Chapter 14: (intro to translations related to quadratic functions only)

INTERMEDIATE ALGEBRA

INTRODUCTION TO ALGEBRA

Students will:

1. Explore fundamental real number properties.
2. Understand the number line associated with the real number system.
3. Perform the mathematical operations of addition, subtraction, multiplication, and division of real numbers.
4. Understand exponential notation and definitions of exponents.

SOLVING EQUATIONS

Students will:

1. Solve elementary equations.
2. Solve applications involving percentages.
3. Solve inequalities and illustrate solutions on a number line.
4. Solve application problems using inequalities.

LINEAR EQUATIONS

Students will:

1. Recognize linear equations and graphs.
2. Transform linear equations from slope/intercept form to standard form.
3. Identify the slope and intercept of a linear equation.
4. Write the equation of the line given slope and coordinates of a point.
5. Sketch the graph of a linear equation.

GRAPHS

Students will:

1. Illustrate data on a rectangular Cartesian coordinate system.
2. Plot points and identify quadrants.
3. Interpret fundamental graphs.
4. Identify the slope of a line.

PROPERTIES OF EXPONENTS

Students will:

1. Add, subtract, multiply, and divide like terms.
2. Determine the degree of an algebraic expression.
3. Simplify algebraic expressions using properties of exponents.
4. Use scientific notation to represent extremely large/small numbers.

POLYNOMIALS

Students will:

1. Perform addition, subtraction, and multiplication of polynomials.
2. Perform division of polynomials using long division and synthetic division if applicable.
3. Factor general trinomials of the type $x^2 + bx + c$ and $ax^2 + bx + c$ into products of linear factors.

4. Recognize special case polynomials and factor accordingly.
5. Factor sums/difference of cubes.
6. Solve polynomial equations by factoring.
7. Solve application problems involving polynomial equations.

RATIONAL EXPRESSIONS

Students will:

1. Identify a rational expression.
2. Multiply/divide a rational expression and simplify the result.
3. Find common denominators for rational expressions.
4. Add/subtract rational expressions.
5. Solve rational equations and verify the solutions.

ALGEBRA II

SOLUTIONS OF EQUATIONS AND INEQUALITIES

Students will:

1. Extend elementary skills of solving equations and inequalities.
2. Solve linear equations and inequalities.
3. Solve systems of equations in two variables algebraically and graphically.
4. Solve systems of equations in three variables by algebraic methods and matrices.
5. Solve quadratic equations by factoring, completing the square, and using the quadratic formula.
6. Graph quadratic equations and recognize the relationships between the x -intercepts and solutions.
7. Solve equations containing radicals.
8. Solve polynomial equations.
9. Use equations and inequalities in the solution of word problems.
10. Apply the solutions of equations and inequalities to scientific and business problems.
11. Derive a polynomial equation from the known solutions.
12. Use a graphing utility where appropriate.

FUNCTIONS

Students will:

1. Define relation and function.
2. Determine if a function is one-to-one and has an inverse.
3. Determine the domain and range of a relation.
4. Determine maximum and minimum points of a graph and interpret results in problem situations.
5. Recognize linear and quadratic functions from both equations and graphs.
6. Evaluate functions.
7. Graph linear and quadratic functions.
8. Use transformations to graph functions.
9. Find the inverse and composition of functions.
10. Use functions in practical applications.
11. Combine functions using arithmetic operations.

POLYNOMIALS AND RATIONAL FUNCTIONS

Students will:

1. Recognize and simplify polynomial expressions.
2. Add, subtract, multiply, and divide polynomials.
3. Solve polynomial equations using both long and synthetic division.
4. Use the remainder and factor theorems to solve polynomial equations.
5. Completely factor polynomial expressions.
6. Factor and solve polynomial equations.
7. Simplify complex rational expressions.
8. Add, subtract, multiply, and divide rational expressions.
9. Solve rational equations.
10. Graph polynomial and rational functions and identify horizontal and vertical asymptotes.

ROOTS, RADICALS, AND EXPONENTS

Students will:

1. Simplify expressions containing radicals and exponents.
2. Convert from radical form to exponential form and vice versa.
3. Use the properties of exponents and logarithms to solve logarithmic and exponential equations.
4. Simplify and graph logarithmic and exponential functions.
5. Identify the different types of logarithms.
6. Convert logarithms from one base to another.
7. Use logarithmic and exponential models to solve real-world problems.

MATRICES

Students will:

1. Perform operations on matrices.
2. Solve equations using matrices.
3. Manipulate matrices on a graphing calculator.
4. Find the inverse of a matrix and use it to solve systems of equations.

COMPLEX NUMBER SYSTEM

Students will:

1. Understand the definition of a complex number.
2. Perform the basic operations with complex numbers.
3. Solve equations that have complex number solutions.

PROBABILITY AND STATISTICS

Students will:

1. Use measures of central tendency (mean, median, mode) to analyze data.
2. Determine probability of events, using binomial and normal distributions.
3. Calculate and use measures of dispersion, such as range, mean deviation, variance, and standard deviation.
4. Solve real-world problems by using combinations and permutations with the graphing calculator.
5. Represent and analyze relationships using written and verbal explanations, tables, equations, graphs, and matrices and describe the connections among those representations.

GEOMETRY

GEOMETRY AS A LOGICAL MATHEMATICAL SYSTEM

Students will:

1. Understand and use geometric symbols and terms when reading and writing mathematical statements.
2. Introduce and use definitions, postulates, and theorems to justify statements associated with deductive reasoning.
3. Recognize mathematical patterns in order to interpret and solve real-world problems.

GEOMETRY AS A MEANS OF LOGICAL REASONING

Students will:

4. Introduce the techniques of writing a proof.
5. Distinguish between hypothesis and conclusion of a conditional statement.
6. Understand and gives examples of inductive and deductive reasoning.
7. Understand, recognize, and write the converse and inverse of a conditional statement.

BASIC GEOMETRIC CONCEPTS

Students will:

1. Be familiar with basic concepts such as point, line, line segment, rays, and planes.
2. Be familiar with parts of angles, types of angles, and angle relationships.
3. Measure angles with a protractor.
4. Be able to solve problems involving angles and angle relationships.

TRIANGLES

Students will:

5. Classify types of triangles such as isosceles, obtuse, etc.
6. Define and use altitudes, medians, and angle bisectors to solve problems.
7. Know and use triangle inequality, mid-segment, sum and exterior angle conjectures.

CONGRUENCY

Students will:

8. Understand the congruency of segments, angles, triangles, and other polygons.
9. Identify the methods of showing triangles congruent.
10. Identify the corresponding parts of congruent triangles.
11. Apply and solve real-world problems involving congruency.

PARALLEL AND PERPENDICULAR LINES

Students will:

12. Identify the angles related to parallel lines and recognize their relationship
13. Apply methods of showing lines parallel/perpendicular.
14. Define and use the properties of perpendicular lines.
15. Use methods to solve applications problems.

POLYGONS

Students will:

1. Identify types of polygons.
2. Understand and use specific terminology related to polygons such as regular, concave, diagonal, etc.
3. Know and understand the types and properties of quadrilaterals, especially parallelograms.
4. Find the sums of exterior and interior angles of polygons.
5. Find the interior and exterior angle of a regular polygon.

SIMILARITY

Students will:

6. Define ratio and proportion.
7. Use the definition of similarity to show figures are similar.
8. Solve proportions of similar polygons.
9. Use the proportional relationships of altitudes, medians, perimeters, and areas of similar triangles.
10. Solve equations and word problems involving proportions and ratios.

RIGHT TRIANGLES

Students will:

1. Understand and use the Pythagorean Theorem and its converse.
2. Apply similarity to right triangles.
3. Know the relationships between the sides of special right triangles.
4. Learn the basic trigonometric ratios.

AREA AND VOLUME

Students will:

1. Use the formulas for areas of triangles, rectangles, parallelograms, rhombi, trapezoids, regular polygons, circles and regions of circles.
2. Discuss the relationships of perimeters and areas related to regular polygons.
3. Use formulas to find volume and surface area of prisms, cones, etc.
4. Apply the geometric concept of area and volume to real world problems.
5. Draw a three dimensional figure.

CIRCLES AND SPHERES

Students will:

1. Know and use the terminology of circles and spheres such as diameter, chord, inscribed angle, sectors, etc.
2. Use the properties of circles and spheres to solve problems.
3. Know the ratio of circumference to diameter is equal to π .
4. Recognize and measure the angles formed by intersecting chords, secants, and tangents.
5. Calculate arc lengths and areas of sectors and segments of circles.

CONSTRUCTIONS

Students will construct:

1. A segment congruent to a given segment.
2. An angle congruent to a given angle.
3. Midpoint of a segment.
4. Angle bisectors, altitudes, and medians of a triangle.
5. An equilateral triangle.
6. Perpendicular lines to a line from a point on the line and from a point not on the line.
7. Perpendicular bisector of a segment.
8. Divide a line segment into congruent segments.
9. Parallel lines.
10. Optional: Circumscribe a circle about a triangle.
11. Optional: Inscribe a circle in a triangle.
12. Optional: The geometric mean between two given segments
13. Optional: Points of congruency.

OPTIONAL TOPICS:

COORDINATE GEOMETRY

Students will:

1. Graph points in a coordinate plane.
2. Use the midpoint formula.
3. Derive the distance formula by applying the Pythagorean Theorem.
4. Find the slope of a line.
5. Find the slopes of parallel and perpendicular lines.
6. Show lines are parallel and perpendicular by their slopes.

TRANSFORMATIONAL GEOMETRY

Students will:

1. Understand the terms reflection, rotation, translation, dilation, and apply the terms to figures.

LOCUS

Students will:

1. Understand the concept of locus of points.
2. Use constructions to solve locus problems.

Honors Geometry includes an enrichment of additional material and an acceleration of materials, and adds extensive work on proofs.

PRECALCULUS/TRIGONOMETRY (revised 2005)

FUNCTIONS AND THEIR GRAPHS

Students will:

1. Recognize whether relations are functions whether given by algebraic, graphical or numerical representations; use function notation; and evaluate functions.
2. Find the domains and ranges of functions graphically and algebraically.
3. Determine graphically the intervals on which functions are increasing or decreasing.
4. Determine relative maximum and minimum values of functions.
5. Identify even and odd functions
6. Recognize graphs of common functions.
7. Use shifts, stretches, shrinks, and reflections to sketch graphs of functions.
8. Find combinations and compositions of functions algebraically and numerically.
9. Determine whether a function is one-to-one (invertible) graphically.
10. Use functions to model and solve real-world problems graphically, algebraically and numerically.
11. Correctly use the language of functions to describe (orally and in writing) characteristics of functions and graphs.
12. Evaluate difference quotients and recognize them as slopes.
13. Evaluate piecewise-defined functions.
14. Use a graphing calculator to explore characteristics of functions.

POLYNOMIAL AND RATIONAL FUNCTIONS

Students will:

1. Sketch and analyze graphs of quadratic and other polynomial functions with and without a graphing calculator
2. Determine the number of zeros of polynomial functions and find them, including with a graphing calculator.
3. Perform operations with complex numbers.
4. Factor polynomials completely using appropriate techniques.
5. Use mathematical language accurately to discuss the relationship between factors, zeros, solutions to polynomial equations and x -intercepts.
6. Determine the domain, find asymptotes, and sketch graphs of rational functions.
7. Use polynomial and rational functions to model and solve applications problems.
8. Use a graphing calculator to fit linear and quadratic models (regression) to sets of data.

EXPONENTIAL AND LOGARATHMIC FUNCTIONS

Students will:

1. Recognize, evaluate, and graph exponential and logarithmic functions.
2. Rewrite logarithmic functions with different bases.
3. Use properties of logarithms to evaluate, rewrite, expand, or condense logarithmic expressions.
4. Solve exponential and logarithmic equations with a graphing calculator and algebraically.
5. Use exponential growth models, exponential decay models, logistic models, and logarithmic models to solve real-life problems.

6. Use the mathematical language of exponential and logarithmic functions to discuss applications problems such as population growth or decay.
7. Use the graphing calculator to fit exponential and logarithmic models (regression) to sets of data.

SYSTEMS OF EQUATIONS AND MATRICES

Students will:

1. Solve systems of equations by substitution, by elimination, by Gaussian elimination and graphically.
2. Use systems of equations to model and solve applications problems.
3. Write matrices, identify their order, and perform row operations.
4. Add, subtract, and multiply matrices.
5. Use augmented matrices to solve systems of linear equations, by hand and with the graphing calculator.
6. Use inverse matrices to solve systems of linear equations.
7. Optional: Find the determinants of square matrices to solve systems of linear equations.

SEQUENCES AND SERIES

Students will:

1. Distinguish arithmetic and geometric sequences.
2. Find the n th term of arithmetic and geometric sequences.
3. Find the first n terms of arithmetic and geometric sequences.
4. Find the sum of arithmetic, geometric, and infinite geometric series.
5. Use sequence, factorial, and summation notation to write the terms and sums of sequences
6. Optional: Use the binomial theorem and Pascal's triangle to calculate binomial coefficients and write binomial expansions.
7. Optional: Use mathematical induction to prove statements involving a positive integer, n .

PROBABILITY AND COUNTING

Students will:

1. Use permutations and combinations to solve counting problems.
2. Find probabilities of events, including independent events and complements of events.

STUDY OF CONIC SECTIONS

Students will:

1. Use coordinate geometry to derive the slope, distance, and midpoint formulas
2. Recognize parabolas, circles, ellipses, and hyperbolas through definitions, examples, equations, and graphs.
3. Graph conic sections.
4. Write the equation of conic sections given certain conditions.
5. Solve systems of quadratic equations algebraically and graphically.

TRIGONOMETRY

Students will:

1. Describe an angle and convert between degree and radian measures.
2. Compute arc length.
3. Use a unit circle to evaluate the six trigonometric functions of special angles.
4. Evaluate the trigonometric functions of special angles with right triangles.
5. Sketch graphs of trigonometric functions, including transformations.
6. Describe the trigonometric functions correctly using the vocabulary of even/odd, amplitude, period, and phase shift.
7. Evaluate inverse trigonometric functions.
8. Use the graphing calculator to do sine regression.
9. Use fundamental trigonometric identities to evaluate trigonometric functions and simplify expressions.
10. Verify trigonometric identities algebraically.
11. Solve trigonometric equations graphically and algebraically.
12. Rewrite and evaluate trigonometric functions using a variety of identities including some or all of the following: sum and difference formulas, multiple-angle formulas, half-angle formulas, and product-sum formulas.
13. Use the Law of Sines and the Law of Cosines to solve oblique triangles.
14. Optional: Find areas of triangles using Heron's formula.
15. Optional: Re-write complex numbers in trigonometric form (DeMoivre's Theorem) and find powers/roots of complex numbers.

HONORS ENRICHMENT OPTIONS:

INTRODUCTION TO CALCULUS

Students will:

1. Estimate limits and use properties and operations of limits.
2. Find limits by direct substitution and by using the dividing out and rationalizing techniques.
3. Approximate limits graphically and numerically.
4. Evaluate one-sided limits.
5. Evaluate limits of functions at infinity.
6. Evaluate the limit of a difference quotient and identify this as the slope of a graph at a point.
7. Use the vocabulary of derivatives to describe slopes.
8. Use rectangles to approximate areas under curves.
9. Use the vocabulary of the definite integral to describe areas under curves in simple cases.

VECTORS

Students will:

1. Represent vectors in the plane.
2. Add, subtract and use scalar multiplication.
3. Find unit vectors.
4. Find the dot product and use properties of dot products.
5. Apply vectors to real-world problems such as velocity/direction, force, and work.

STATISTICS (revised 2008)

EXPLORING DATA

Students will:

1. Interpret graphical displays of distributions of univariate data.
2. Summarize distributions of univariate data using measures of center, spread and position.
3. Compare distributions of univariate data using dotplots, back-to-back stem plots and parallel boxplots.
4. Explore bivariate data, including the use of scatterplots, correlation, linear regression, residuals and transformations.

PLANNING A STUDY

Students will:

1. Select appropriate methods of data collection (census, sample survey, experimental or observational study).
2. Know how to plan and conduct surveys, including topics such as identifying bias in surveys and forms of random sampling.
3. Identify and apply treatments, control groups, experimental units, and random assignment.
4. Understand how to plan and conduct experiments, including completely randomized and random block designs.
5. Apply the results of observational studies, experimental studies, and surveys to more general situations appropriately.

PROBABILITY

Students will:

1. Understand probability as relative frequency.
2. Recognize and work with discrete random variables and their probability distributions, including the binomial distribution.
3. Compute the mean and standard deviation of a random variable.
4. Understand the concept of an independent random variable and compute means and standard deviation for their sums and differences.
5. Use the normal distribution as a model, understand its properties and use tables.
6. Understand and use sampling distributions of a sample proportion and sample mean.
7. Know the Central Limit Theorem.

STATISTICAL INFERENCE

Students will:

1. Use and interpret confidence intervals for a proportion, a mean and the difference between two proportions or means.
2. Use tests of significance and understand their logic, including for proportions, and means differences between two proportions or means.

ADVANCED PLACEMENT STATISTICS

Note: This outline was summarized from the topic outline for AP Statistics published by the College Board. See the AP Statistics Course Description for full details.

EXPLORING DATA

Students will:

1. Interpret graphical displays of distributions of univariate data.
2. Summarize distributions of univariate data using measures of center, spread and position.
3. Compare distributions of univariate data using dotplots, back-to-back stem plots and parallel boxplots.
4. Explore bivariate data, including the use of scatterplots, correlation, linear regression, residuals and transformations.
5. Explore categorical data with frequency tables

PLANNING A STUDY

Students will:

1. Select appropriate methods of data collection (census, sample survey, experimental or observational study).
2. Know how to plan and conduct surveys, including topics such as identifying bias in surveys and forms of random sampling.
3. Identify and apply treatments, control groups, experimental units, and random assignment.
4. Understand how to plan and conduct experiments, including completely randomized and random block designs.
5. Apply the results of observational studies, experimental studies, and surveys to more general situations appropriately.

PROBABILITY

Students will:

1. Understand probability as relative frequency.
2. Recognize and work with discrete random variables and their probability distributions, including the binomial distribution.
3. Compute the mean and standard deviation of a random variable.
4. Understand the concept of an independent random variable and compute means and standard deviation for their sums and differences.
5. Use the normal distribution as a model, understand its properties and use tables.
6. Understand and use sampling distributions of a sample proportion and sample mean.
7. Know the Central Limit Theorem.

STATISTICAL INFERENCE

Students will:

1. Use and interpret confidence intervals for a proportion, a mean and the difference between two proportions or means.
2. Use tests of significance and understand their logic, including for proportions, means differences between two proportions or means, and chi-square for goodness of fit.
3. Use t -distributions in both single and two sample cases.

ADVANCED PLACEMENT CALCULUS AB AND BC

Note: This outline was summarized from the topic outline for AP Calculus published by the College Board. See the AP Calculus Course Description for full details.

Topics marked with an asterisk (*) are covered in the BC course. All other topics below are covered in the AB course. The BC exam also covers all AB topics.

FUNCTIONS, GRAPHS AND LIMITS

Students will:

1. Analyze graphs of functions, including with the aid of a graphing calculator.
2. Master an intuitive understanding of the limit process.
3. Calculate one- and two-sided limits algebraically.
4. Estimate limits from graphs or tables of data.
5. Recognize and predict asymptotes of graphs, and discuss them in terms of limits involving infinity.
6. Compare relative magnitudes of functions and their rates of growth, contrasting exponential, polynomial and logarithmic growth, for example.
7. Understand continuity intuitively (from a graphical and numeric perspective) and in terms of limits.
8. * Analyze planar curves given in parametric, polar and vector form.

DERIVATIVES

Students will:

1. Understand the concept of the derivative graphically, numerically and analytically.
2. Interpret the derivative as an instantaneous rate of change.
3. Calculate the derivative as the limit of a difference quotient.
4. Understand the derivative at a point as the slope of the curve at a point, using graphical and numerical approximations, and analytically.
5. Find the equation of the tangent line to a curve at a point.
6. Recognize the graphical relationships between f , f' , and f'' , and the implications for increasing/decreasing behavior and concavity of f .
7. Compute derivatives using basic differentiation rules, the chain rule and implicit differentiation.
8. *Compute derivatives of parametric, polar, and vector functions.
9. Know the Mean Value Theorem.
10. Translate verbal/written situations into equations involving derivatives.
11. Analyze curves using derivatives.
12. *Analyze planar curves given in parametric, polar and vector form.
13. Apply mathematical modeling and the derivative to optimization problems, related rates problems, and problems involving velocity and acceleration.
14. Know the technique of implicit differentiation, and use it to find the derivative of an inverse function.
15. *Recognize the relationships among differential equations, slope fields and solution curves.
16. *Find numerical solutions of differential equations using Euler's method.
17. *Use L'Hopital's Rule to help determine limits and convergence of improper integrals and series.

INTEGRALS

Students will:

1. Compute Riemann sums and the definite integral as a limit of Riemann sums.
2. Use Riemann and trapezoidal sums to approximate definite integrals of functions given algebraically, graphically and numerically.
3. Interpret the definite integral of the rate of change of a quantity over an interval as the change of the quantity.
4. Use basic properties of definite integrals, such as additivity.
5. Use the Fundamental Theorem of Calculus to evaluate definite integrals, and to represent and analyze functions defined as anti-derivatives.
6. Use basic integration rules, i.e., those that follow from the derivatives of basic functions.
7. Perform integration by the method of substitution.
8. *Use the techniques of integration by parts and by simple partial fractions.
9. *Compute improper integrals as limits of definite integrals.
10. Find particular anti-derivatives using initial conditions, including applications.
11. Solve separable differential equations and use them in modeling.
12. *Solve logistic differential equations and use them in modeling.
13. Use integration to find areas of regions bounded by curves and volumes of solids.
14. Solve applications problems involving integration.
15. *Apply integration to a variety of physical, biological or economic situations, including but not limited to finding the area of a region (including one bounded by polar curves), the volume of a solid, the average value of a function, the distance traveled by a particle along a line and the length of a curve (including one given in parametric form).

***POLYNOMIAL APPROXIMATIONS AND SERIES**

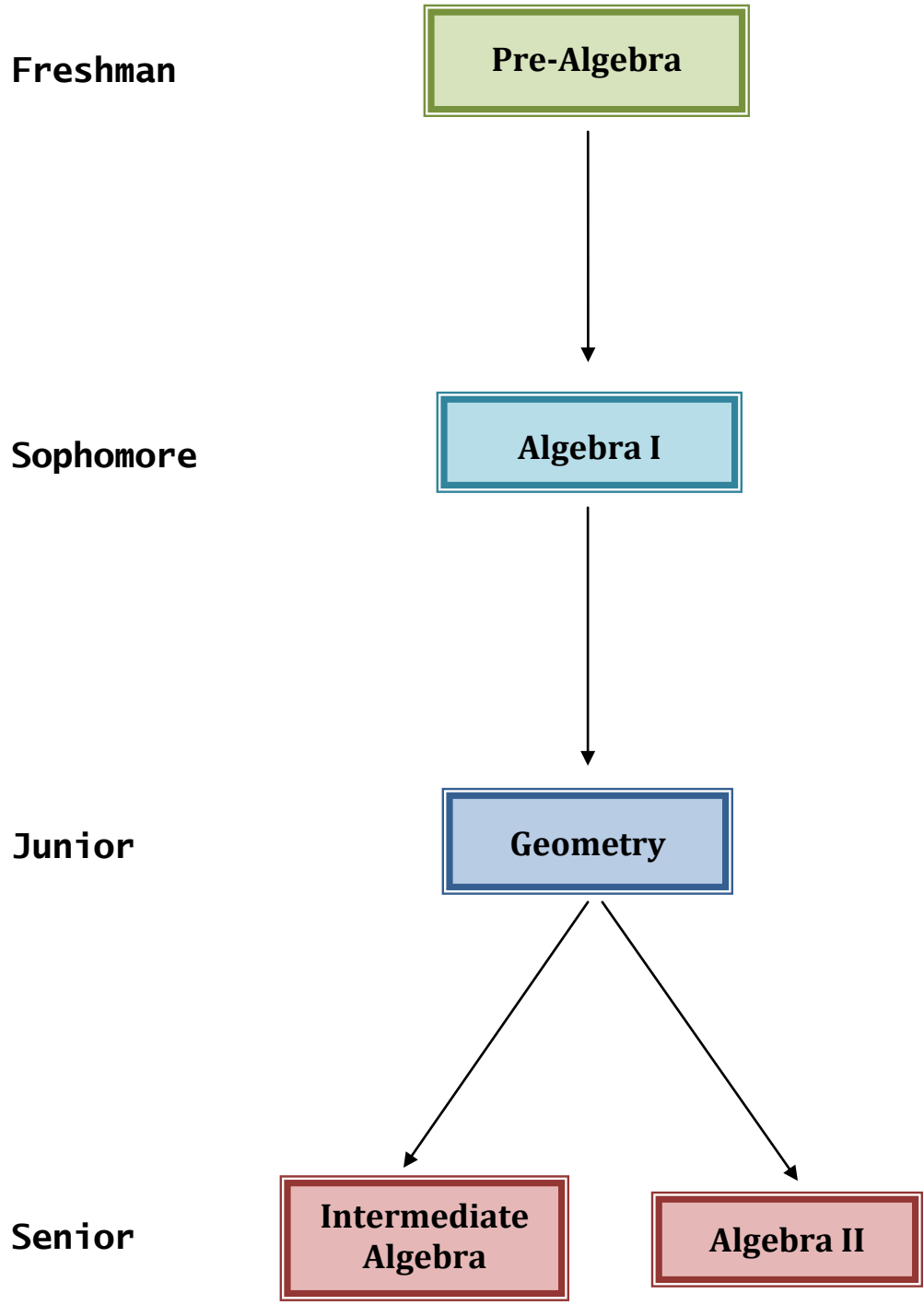
Students will:

1. Understand the concept of a series, and divergence or convergence of series.
2. Be adept at exploring and analyzing series of constants, including geometric series, the harmonic series and alternating series.
3. Use appropriate means to determine convergence or divergence of series, including the integral test, the ratio test and comparison.
4. Compute Taylor polynomials and explore convergence to functions graphically.
5. Compute Taylor and Maclaurin series from the definitions.
6. Memorize Maclaurin series for the functions e^x , $\sin x$, $\cos x$, $1/(1-x)$.
7. Use known Taylor series and appropriate techniques (substitution, differentiation, and antidifferentiation) to form new series.
8. Explore and analyze power series, including the radius and interval of convergence.
9. Use the Lagrange error bound for Taylor polynomials.

OPTIONAL TOPICS

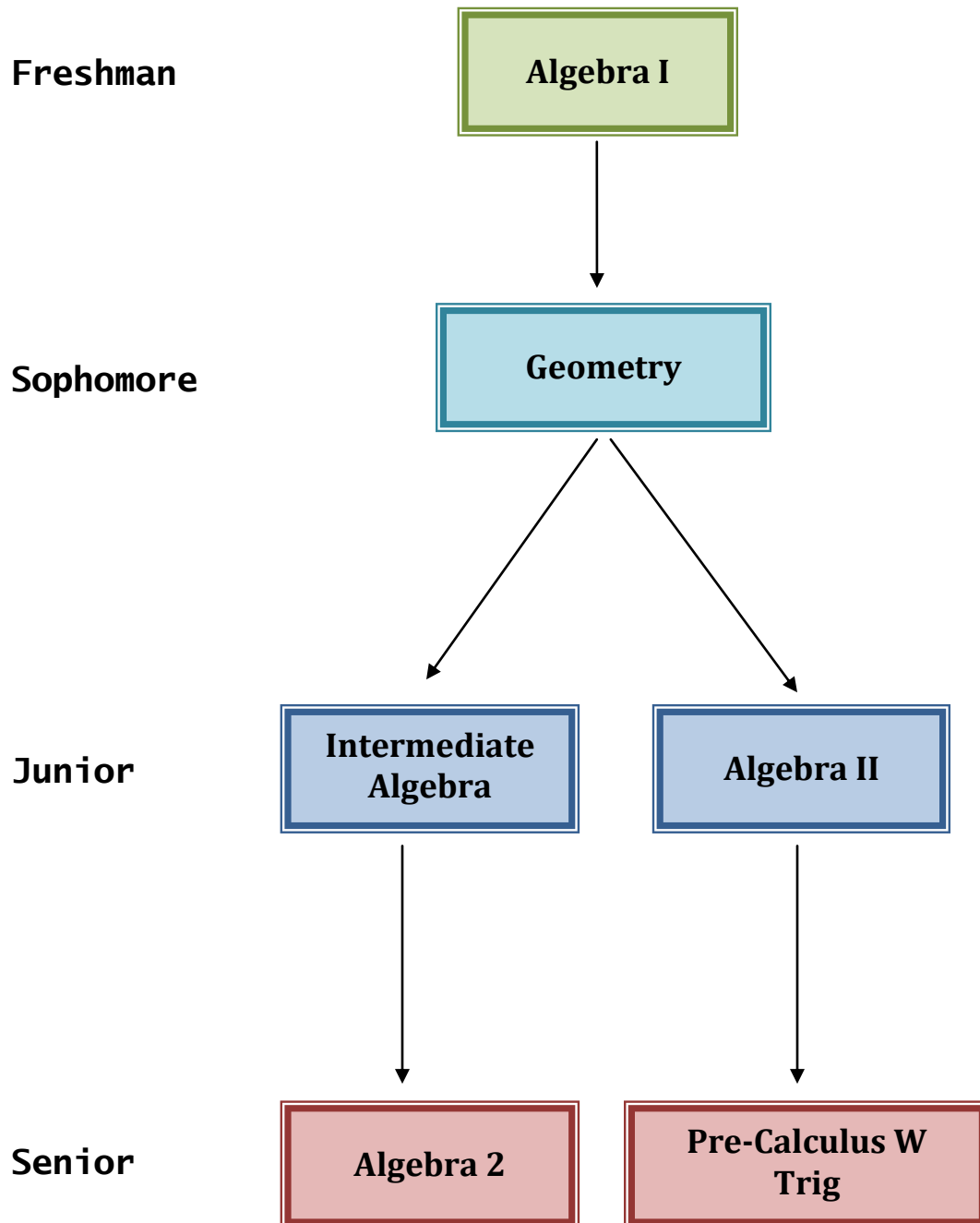
There are many optional topics in Calculus that teachers may decide wish to include based on their own experiences and on the interests of their particular students. Teachers may decide to include a variety of longer applications projects. They may decide that Newton's method is important for their students. They may decide that students should learn additional techniques of integration such as trigonometric substitution or integration by tables.

Pre-Algebra Track

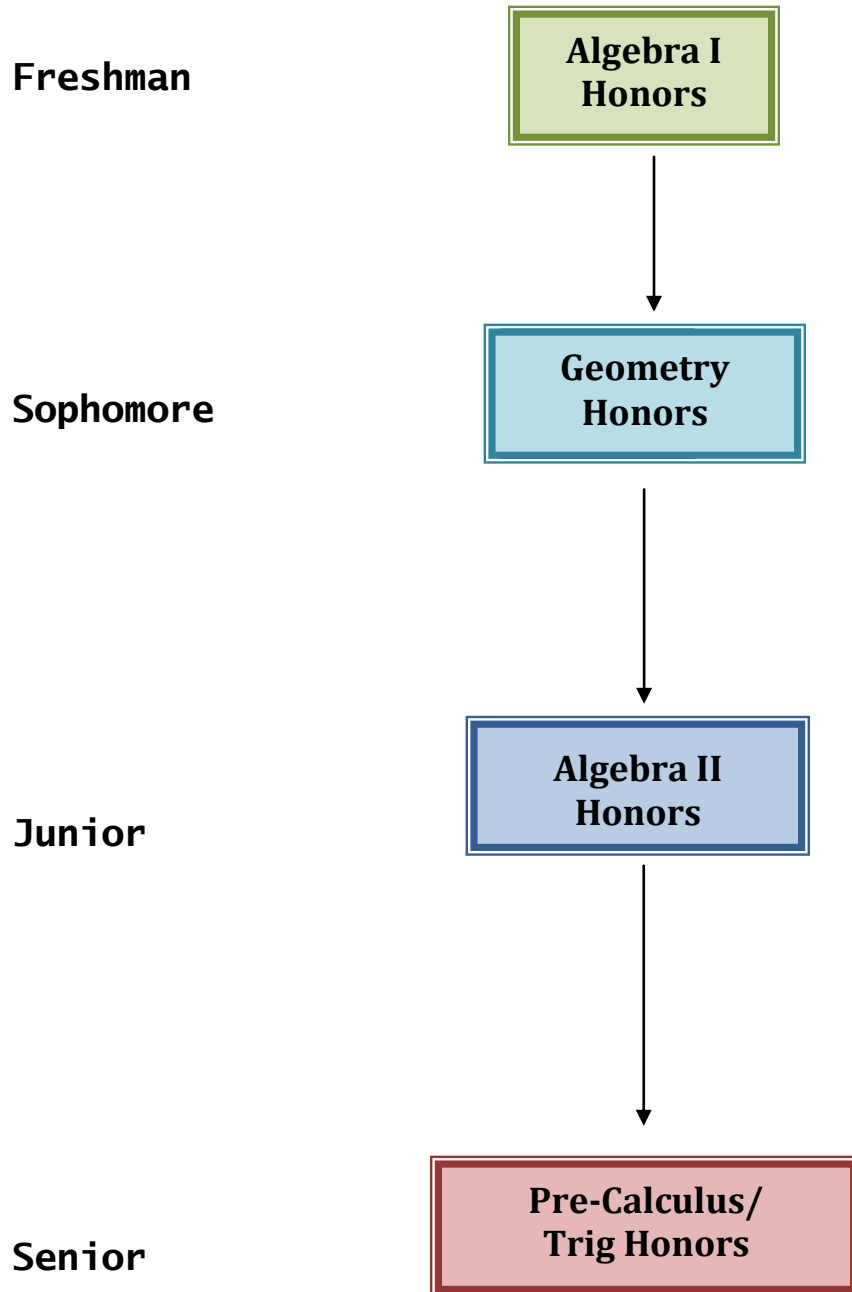


This track does not satisfy the University of Arizona's fourth year of math requirement.

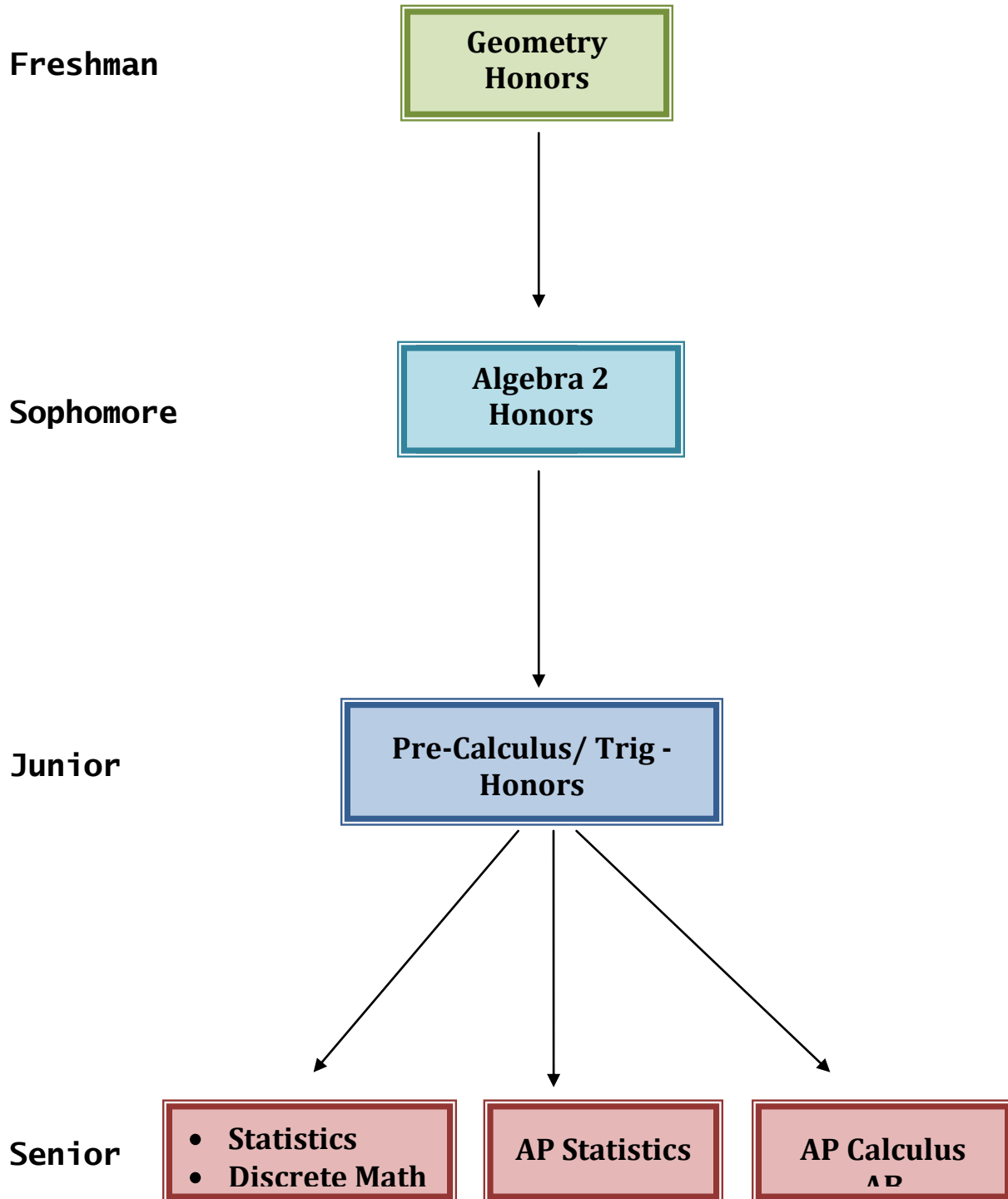
Traditional Track



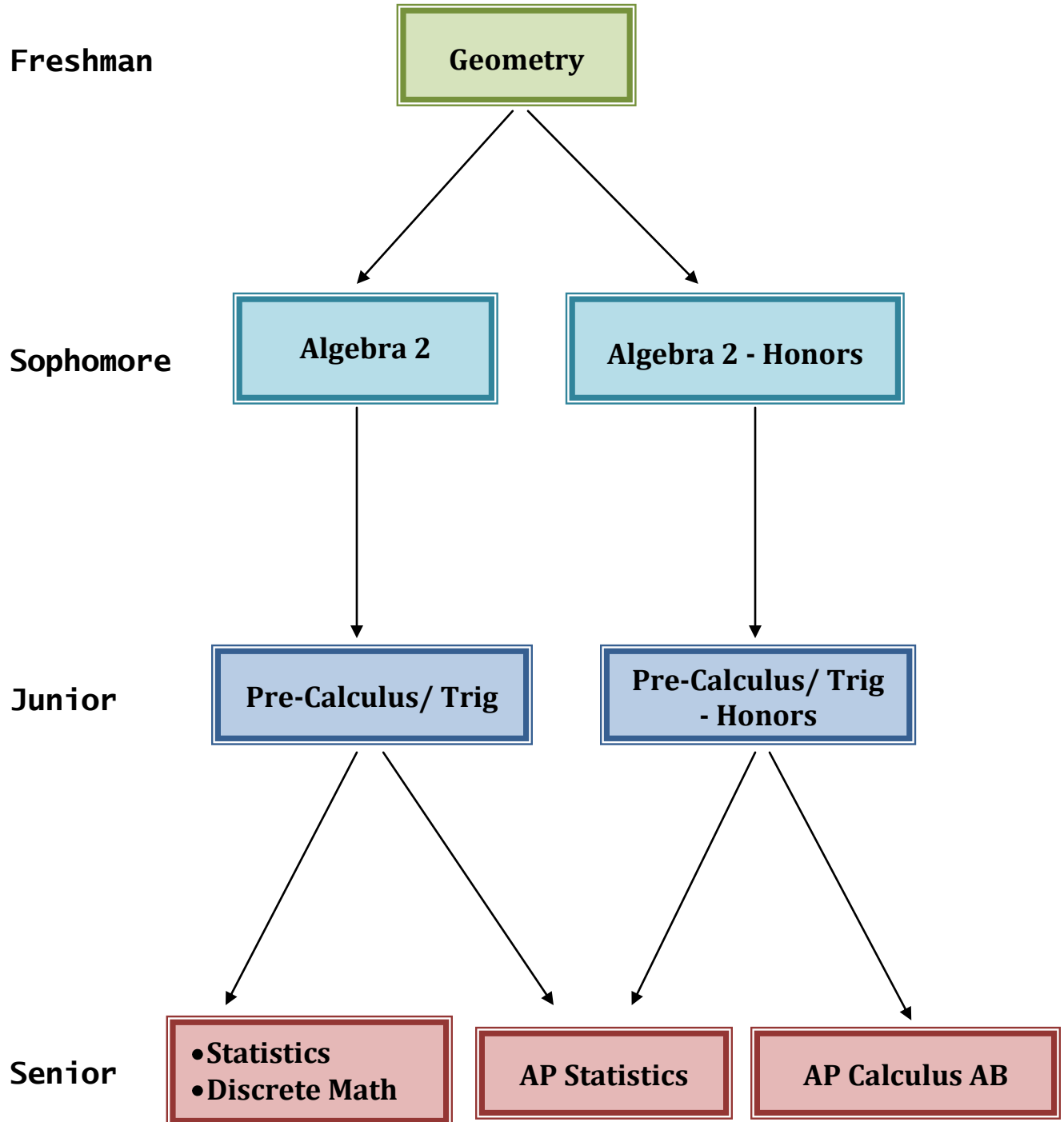
Honors Track I



Honors Track 2



Advanced Track



Accelerated Track

Freshman

Geometry-H with
Algebra 1-H

Sophomore

Algebra 2-H/ with
Geometry-H

Junior

Pre-Calculus/ Trig -
Honors

Senior

•Statistics
•Discrete

AP Statistics

AP Calculus AB

Exceptional Track

Freshman

Algebra 2
Honors



Sophomore

Pre-Calculus/
Trig
Honors



Junior

AP Calculus AB



Senior

AP Calculus BC