Mathematics & Computer Science

The department's mission is to develop in each student a love of mathematics and computer science, confidence in his/her abilities and a sense of responsibility for his/her academic achievement. The mathematics and computer science curriculums combine the best of the rich cultural tradition of both disciplines with applications to modern problems. While preparing students for the most rigorous college programs, the curriculum also exposes them to the history and beauty of both disciplines. The wide range of course offerings enable students to complete four years of mathematics at the Upper School. Ability grouping allows students to be successful as well as challenged. The pace of the course and the depth of study of various topics differ between courses offered at multiple levels.

Honors-level courses: It is not automatic for students doing well in a non-Honors course, even with a grade of A, to be recommended for an Honors course the subsequent year.

Graduation Requirement: Students must complete three years of mathematics at the Upper School. A minimum grade of C- is required to advance to the next sequential course. Any student earning below a C- in a sequential course must either repeat the course the following year or enroll in an approved summer school program and earn a minimum grade of C- in the course of study. Students may not take the same course twice at different levels, such as Geometry and Geometry Honors.

Acceleration Policy: Students who wish to accelerate through the mathematics sequence by completing an approved summer school program may do so only with the recommendation of their current teacher and the prior approval of the department chairperson. Students will receive credit in courses taken for the purpose of acceleration only if the department chairperson has approved the specific course in advance.

Calculator Requirement: A TI-84 or TI-nspire CAS calculator is required for all courses. However, many assessments have calculator and non-calculator sections.

MATHEMATICS

GEOMETRY *(Prerequisite:* *Algebra I)*

This course provides the core of the general concepts and theorems of Geometry. While formal two-column and coordinate proofs are introduced, emphasis is placed on the development of logical and evidence-based thinking.

The traditional concepts concerning lines, angles, planes, polygons, congruence, and similarity are connected to real-world applications and careers. The course also covers topics such as areas, surface areas and volumes of solids. Practice in applying concepts is strengthened by spiral review and occasional references to SAT-formatted questions. The goal of the course is to build a solid understanding of the fundamentals of Geometry.

Full Year 5 Credits

Next Sequential Course: *Honors Algebra II or College Prep Algebra II*

HONORS GEOMETRY (Prerequisites: *A- in Algebra I and department recommendation)*

This course begins with an introduction to the terms and fundamental concepts in the field of Euclidean Geometry. Using these building blocks throughout the year, students derive powerful theorems and develop an understanding of geometric concepts. They learn to compose formal proofs for the first time. Composing formal proofs promotes an understanding of the rigor required when working in a deductive system. Students apply Algebra 1 skills to solve challenging problems in a geometric context. Topics studied include parallel and perpendicular lines; triangles, quadrilaterals, and other polygons; congruent and similar figures; circles; area, surface area and volume; and trigonometry.

Full Year 5 Credits

Next Sequential Course: *Honors Algebra II or College Prep Algebra II*

CP ALGEBRA II *(Prerequisite:* Geometry)

This course begins with a review of Algebra I topics, including linear equations, functions, and inequalities. Students solve systems of equations using graphing, substitution, and linear combinations. Focus then turns to the study of quadratic equations and the various methods of solving them, as well as an in-depth study of quadratic functions and their graphs. Students learn about properties of rational exponents and radicals, rational expressions, and solving algebraic equations that use these various expressions. Students then explore the properties of logarithms and apply them to solving exponential and logarithmic equations. Finally, students are introduced to right triangle trigonometry, radian measure, and trigonometric functions.

Full Year 5 Credits

Next Sequential Course: *Pre-Calculus, Honors Pre-Calculus, and AP Statistics*

HONORS ALGEBRA II *(Prerequisites:* A- *in both Algebra I & Geometry Honors and department recommendation)*

This course includes the study of linear equations, linear data models, and linear relations. Students explore techniques of factoring, graphing parabolas, solutions of quadratic equations, and the algebraic properties of powers, roots, and exponents. Other topics of study include synthetic division, the zeros of higher degree polynomials, rational functions, exponentials, and logarithms. Fundamental counting principles, probability, conic sections, and trigonometry are introduced. Emphasis is placed on learning how to graph equations by finding x and y intercepts and by understanding how coefficients and other constants transform parent functions into the given function.

Full Year 5 Credits

Next Sequential Course: *Pre-Calculus, Honors Pre-Calculus, and AP Statistics*

PRECALCULUS ***(Prerequisite:*** *Algebra II)*

This course focuses on the interconnectedness between a function, its graph, and its relationship to relevant everyday topics. The course begins with an in-depth study of trigonometric functions and their inverses, including verifying identities, solving general triangles, and solving trigonometric equations. In the second semester, topics include the study of analytic geometry, parametric equations, vectors, and polar coordinates.

Full Year 5 Credits

Next Sequential Course: *Calculus, Advanced Placement courses Calculus AB, AP Statistics. Please view AP Placement Policy for more details.*

HONORS PRECALCULUS ***(Prerequisites:*** *A- in Algebra II Honors and department recommendation)*

In this course, students complete a summer assignment review of Algebra 2 Honors topics in preparation for the various topics in math analysis that are required for learning calculus. The course begins with an in-depth study of trigonometric functions and their inverses, including verifying identities, solving general triangles, and solving trigonometric equations. In the second semester, topics include the study of analytic geometry, parametric equations, vectors, and polar coordinates. Students also study the concept of a limit using mathematical sequences and series, before introducing the definition of the derivative.

Full Year 5 Credits

Next Sequential Course: *Calculus, Honor Calculus, AP Calculus AB, AP Statistics. Please view AP Placement Policy for more details.*

CALCULUS ***(Prerequisites:*** *B- in Precalculus and department recommendation)*

This course is intended for students who want to learn some of the practical applications of calculus while increasing their understanding of the underlying mathematical concepts. Topics include limits, differentiation, and integration. Functions studied during the year include polynomial, rational, trigonometric, exponential, and logarithmic. This course will provide students the opportunity to refine their algebra skills and to develop a deeper understanding of functions.

Full Year 5 Credits

Next Sequential Course: *AP Calculus AB, AP Statistics. Please view AP Placement Policy for more details.*

HONORS CALCULUS ***(Prerequisites:*** *A- in Precalculus Honors, and department recommendation)*

This course is intended for students who want to learn the practical applications of traditional calculus while understanding the mathematical concepts underlying the techniques they have acquired. Students study nearly all the topics covered in a one-semester, college-level calculus course in a non-AP setting. First semester topics include limits at a point, derivatives, differentiation techniques, and the application of derivatives. Second semester topics include antiderivative, definite and indefinite integrals, integration techniques, area bounded by curves, and the volume of rotating solids. Functions studied during the year include polynomials, rational functions, exponentials, logarithms, and trigonometric functions.

Full Year 5 Credits

Next Sequential Course: *AP Calculus AB, AP Calculus BC, and AP Statistics. Please view AP Placement Policy for more details.*

ADVANCED PLACEMENT CALCULUS AB ***(Prerequisites:*** *A- Honors Precalculus or B+ in Honors Calculus, and department recommendation)*

A formal study of limits and continuity provides the foundation for the study of differential and integral calculus. The major emphasis is on clear, intuitive understanding of the concepts. Students develop facilities with the elementary techniques of calculating derivatives and integrals of frequently encountered algebraic and transcendental functions. Applications include curve-sketching techniques; motion along a straight path; related rates; extreme value problems; and the computation of area and volume.

Full Year 5 Credits

Next Sequential Course: *AP Calculus BC, and AP Statistics. Please view AP Placement Policy for more details.*

ADVANCED PLACEMENT CALCULUS BC ***(Prerequisites:*** *AP Calculus AB minimum grade of 3 on the AP exam or Honors Calculus and department recommendation)*

This course covers all topics listed in the current Advanced Placement BC Calculus syllabus. In conjunction with Advanced Placement Calculus AB, it is equivalent to two semesters of first-year college calculus. Major topics include limits, integrals and their applications, techniques of integration, improper integrals, infinite series and convergence tests, Taylor and Maclaurin polynomials/series, parametric and polar functions, vector-valued functions, and linear differential equations. In addition, students will be introduced to a variety of proofs using William Dunham's Journey Through Genius.

Full Year 5 Credits

STATISTICS ***(Prerequisite:*** *Algebra II)*

Statistics is a field that has applications in many academic disciplines. This introductory course in statistics provides students with a strong statistical base that is applicable to many courses of study in college. Throughout the course, students will apply their knowledge through self-selected projects that highlight the concepts they have learned. Students will begin by focusing on the different methods of collecting data. After data is collected, students will study the advantages and disadvantages of the numerous ways to analyze and display their data. In addition, the majority of time will be spent interpreting student data in many meaningful ways using statistical language.
*Students may not take both Statistics and AP Statistics

Full Year 5 Credits

ADVANCED PLACEMENT STATISTICS ***(Prerequisites:*** *A- in Algebra II/Honors Algebra II or A- in Precalculus or B+ in Honors Precalculus or B in Calculus or B- in Honors Calculus or AP Calculus AB; and department recommendation)*

In this course, students are introduced to the processes of designing experiments and statistical studies, as well as the tools for appropriately displaying and describing one-variable and two-variable data. Students will learn how to use the rules and laws of probability, normal distributions, and other statistical models to evaluate and interpret probabilities. The second semester of the course focuses on a rigorous in-depth study of the field of statistical inference including the concepts of using sampling distributions, confidence intervals, and hypothesis testing in to analyze sample data.

Full Year 5 Credits

COMPUTER SCIENCE

INTRODUCTION TO COMPUTER PROGRAMMING

This course is an introduction to understanding and analyzing problems by writing and debugging computer programs. Using the Python programming language, students create programs of increasing complexity using multiple paradigms. The course begins with a focus on functional programming and culminates in the study of object-oriented programming, which is a paradigm of software design and development used in academia, industry, and the AP course. Programming projects range from solving mathematical challenges to drawing 2-D graphics using modeling algorithms. Prior computer programming experience is not required. HTML and JavaScript are not used in this course.

Half Year: 2.5 credits

ADVANCED COMPUTER PROGRAMMING *(**Prerequisite:** Intro to Computer Programming)*

This course introduces students to the Java programming language with a focus on object-oriented programming. Java is a popular industrial language that can be used to write general purpose applications. Students learn Java code organization, syntax, data typing, control structures and exception handling. Accepted practices and conventions for professional Java coding are taught and used in the course. Object-oriented topics include concepts such as recursion, inheritance, encapsulation, and polymorphism. Programming with data input/output and with GUI interfaces is also covered.

Half Year: 2.5 credits

AP COMPUTER SCIENCE ***(Prerequisites:*** *B+ in Algebra I and B+ in Intro to Computer Programming and department recommendation)*

This course's concepts fall into six main categories: program design, program implementation, program analysis, algorithms, classes, and objects. Students begin by learning Java language syntax with an emphasis on object-oriented design methods. This class explores the concepts of inheritance, encapsulation, and polymorphism by designing and writing Java programs of increasing complexity. Students develop solid programming skills and debugging strategies through lab assignments which prepare them to take the AP Computer Science Exam, and which are also useful for the future, beyond the scope of the course.

Full Year 5 Credits