



# 2022-2023

## COURSE CATALOG

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# MATH

# GENERAL INFORMATION

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The primary goal of the Mathematics Department is to provide a curriculum that meets the academic needs of each student at Springside Chestnut Hill Academy. The Mathematics Department strives to develop opportunities for students to engage in active inquiry at every course level and to encourage students to achieve their highest mathematical potential.

All students are required to take four years of mathematics and some elect to take one or more additional elective math courses. The typical four-year sequence of mathematics begins with Geometry and extends through Algebra II, Pre-Calculus, Calculus, or Statistics. Courses in 9th and 10th grade are sectioned into Honors and College Prep while in 11th and 12th grade the classes are sectioned into Pre-AP, Honors, and College Prep, allowing for each student to be challenged at an appropriate level. The full range of AP mathematics and statistics courses are also offered and taught to the specific AP curriculum. Juniors are required to take the AP Exam or an AP-based final exam at year's end. Seniors may opt out of the AP exam. Students are required to have a graphing calculator. Students are encouraged to communicate with their math teacher, advisor, college counselor, and parents as they determine the appropriate sequence of courses for their high school program.

## CONCEPTS OF ALGEBRA AND GEOMETRY

Full-year course; 1 credit

Prerequisite: Departmental recommendation

This course serves two purposes: 1) to strengthen and support students' algebraic understanding and reasoning skills, and 2) to introduce and support students' learning of geometry. By the end of the course, students will have reviewed, practiced, and developed their Algebra 1 skills to be fully prepared to take Algebra 2. They will have also developed their ability to reason by building definitions, writing logic statements, physically drawing geometric constructions, and writing proofs. Students arrive at the SCH Upper School from a wide variety of backgrounds, training, and experiences. Thus, this course has been designed to specifically accommodate a wide range of needs by use of blended instruction. It is a class that meets face to face and receives much direct instruction. There are also aspects of the class that use online resources to meet students where they are and allow students to work at their own pace on the areas they need the most help with and receive live help from the teacher right when they need it.

## GEOMETRY

Full-year course; 1 credit

Prerequisite: Departmental recommendation

This yearlong study of geometry will include such fundamental concepts as points, lines, planes, angles, polygons, and perpendicular and parallel lines. The properties of triangles and triangle inequalities will be studied in depth. Right triangles, congruent and similar polygons, properties of quadrilaterals, coordinate geometry, right triangle trigonometry, and calculating areas and volumes of various 2D and 3D figures will also be studied extensively. Students use inductive reasoning to explore and discover geometric ideas via computer software and hands-on experiences. Students will use deductive reasoning, including informal and formal proofs, to solve various kinds of problems. As students move through the curriculum, they see concepts and problems that are related to questions on the SAT.

## HONORS GEOMETRY

Full-year course; 1 credit

Prerequisite: Departmental approval

The main topics in this geometry course are points, lines, planes, angles, polygons, perpendicular and parallel lines, and the fundamental axioms of geometry. In addition, topics include right triangles, congruent and similar polygons, properties of quadrilaterals, coordinate geometry, special right triangles, circles, triangle trigonometry, and properties of three-dimensional figures. Students use geometric ideas to solve problems, find relationships in complex drawings, and construct formal proofs. The ultimate goal is for students to think deductively. To be successful in the course, students must gain a mastery of the facts, see the connections among concepts, and synthesize interrelated ideas to present cogent arguments for their solutions to problems. As students move through the curriculum, they see concepts and problems that are related to questions on the SAT.

## ALGEBRA 2

Full-year course; 1 credit

Prerequisite: Successful completion of Concepts of Algebra & Geometry OR Geometry.

This course begins with a review and extension of topics presented in Algebra 1. Topics include linear, quadratic, and other polynomial functions, with an overview of solving systems of equations. Students will investigate the complex number system. The study of Rational, Radical, and Exponential functions will be included as time permits. The numerical, graphing, and other features of the graphing calculator are used to explore and extend the skills and concepts covered. As students move through the curriculum, they see concepts and problems that are related to questions on the SAT.

## HONORS ALGEBRA 2

Full-year course; 1 credit

Prerequisite: A or better in Geometry, Departmental approval

This course covers linear, quadratic, polynomial, rational, exponential, and logarithmic functions. In addition, students study complex numbers, radicals, and systems of equations and matrices. To be successful, students must be able to analyze functions numerically, symbolically, and graphically. The numeric and graphing features of the graphing calculator are used to explore and extend the skills and concepts covered. As students move through the curriculum, they see concepts and problems that are related to questions on the SAT. Students are required to have a graphing calculator.

## HONORS ACCELERATED ALGEBRA 2 / TRIGONOMETRY

Full-year course; 1 credit

Prerequisite: A or better in Honors Geometry, Departmental approval

This course covers the same curriculum as the Algebra 2/Trig Honors above; however, students will be expected to analyze concepts at a more abstract level and move through the material at a faster pace and includes the study of trigonometric functions and their graphs. Students will analyze functions numerically, symbolically, and graphically. As students move through the curriculum, they see concepts and problems that are related to questions on the SAT. The numeric, graphing, and programming features of the graphing calculator are used to explore and extend the skills and concepts covered.

## PRECALCULUS/ TRIGONOMETRY

Full-year course; 1 credit

Prerequisites: Algebra 2 and Geometry

Precalculus is an introduction to the language and concepts of Calculus. Student understanding of functional analysis will be extended within the study of polynomial, rational, exponential, logarithmic, and trigonometric functions. Students will be looking at these functions from a numeric, algebraic, and graphic standpoint. As students move through the curriculum, they see concepts and problems that are related to questions on the SAT.

## HONORS PRECALCULUS/TRIGONOMETRY

Full-year course; 1 credit

Prerequisite: B or better in Honors Algebra 2/Trig, Departmental approval

Honors Precalculus/Trigonometry is a thorough preparation for Honors Calculus. In this course, functional analysis will be stressed. Topics include polynomial, exponential, logarithmic, trigonometric functions, and conic sections. The year concludes with a unit of study on Limits and Continuity. Students are required to have a graphing calculator. As students move

through the curriculum, they see concepts and problems that are related to questions on the SAT. The numeric, graphing, and other features of the graphing calculator are used to explore and extend the skills and concepts covered.

## HONORS PRE-BC CALCULUS

Full-year course; 1 credit

Prerequisite: B or better in Honors Accelerated Algebra II/Trigonometry, Departmental approval

Pre-BC Calculus is a yearlong class in functions and limits that develops the theoretical underpinnings of calculus. The first semester expands upon what is learned in Accelerated Honors Algebra II/ Trigonometry with the study of Analytic Trigonometry, Conic Sections, and mathematical relationships defined with vectors, parametric curves, and polar equations. The second semester rigorously develops formal notions of limits of sequences and functions, as well as the theory of continuous functions (functional analysis). Differential calculus for single-valued functions of real variables rounds out the second semester.

## DIFFERENTIAL CALCULUS

Full-year course; 1 credit

Prerequisite: Precalculus

Summer work required

Differential Calculus begins with a review of linear, absolute value, non-linear, rational, and piecewise defined functions. Calculus topics include limits, derivatives, and applications of the derivative. A variety of real-life applications taken from fields such as business, life sciences, economics, and physics are used throughout this course. As students move through the curriculum, they see concepts and problems that are related to questions on the SAT.

## HONORS CALCULUS

Full-year course; 1 credit

Prerequisite: B or better in Honors Precalculus/Trigonometry, Departmental approval

In Honors Calculus, the theory of elementary functions and real-world applications of mathematics will be studied. Differential calculus and an introduction to integral calculus plus the applications of each will be explored. The course focuses on polynomial, rational, power, exponential, and logarithmic functions. Students are required to have a graphing calculator. (TI-84 Plus is recommended.)

## AP CALCULUS (AB)

Full-year course; 1 credit

Prerequisites: B or better in Honors Precalculus/Trigonometry, Departmental approval

Summer work required

AP Calculus AB includes both the theory of elementary functions and real-world applications. Differential and integral calculus plus their applications will be studied in preparation for the Calculus AB exam. In addition to polynomial, rational, power, exponential, and logarithmic functions, this course also includes work with trigonometric functions. Juniors are required to take the AB level of the AP Exam or an AP-based final exam at year's end. Seniors may opt out of the AP exam. Students are required to have a graphing calculator.

#### AP CALCULUS (BC)

Full-year course; 1 credit

Prerequisites: B or better in Honors Pre-BC Calculus, Departmental approval

BC Calculus picks up where Pre-BC Calculus left off. It is a yearlong class that rigorously develops differential and integral calculus for all piecewise-smooth functions of a single real variable, including Cauchy limits, the derivative and its applications, and the Riemann integral and its applications. In addition, several topics in real analysis, including the completeness of the real line, are introduced as time allows. Participation in this class requires an excellent mastery of algebraic and transcendental functions and a formal notion of limits, continuity, and derivatives of algebraic functions. Students without the correct prerequisites will require extensive independent summer work and the special permission of the department. Juniors are required to take the BC level of the AP Exam or an AP-based final exam at year's end. Seniors may opt out of the AP exam. Students are required to have a graphing calculator. (TI-84 Plus is recommended.)

#### HONORS MULTIVARIABLE CALCULUS

Grades 11, 12; elective; full-year course; 1 credit

Prerequisites: Successful completion of AP Calculus AB/BC or concurrent enrollment in AP Calculus BC, successful completion of a full-year physics course, and departmental approval. Multivariable Calculus is a full-year course in differential and integral calculus for vector-valued functions of several real variables. Topics include three-dimensional vector fields, partial and directional derivatives and their applications, and multiple integrals. Line and surface integrals (including Green's and Stoke's Theorems) are introduced. Students are required to have a graphing calculator.

#### STATISTICS

Elective; full-year course; 1 credit

Prerequisites: Algebra 2

In this course, students will master the art and science of making decisions with data. Topics to be explored are descriptive statistics, inferential statistics, and probability. How do statisticians establish truth? They produce data through

observation and experiments. Students will generate, collect and examine data. Individual measurements vary, even in seemingly identical conditions. Descriptive statistics provides graphical and numerical tools for modeling variation in data. Descriptive statistics includes visual representation of data and describing the data with summary statistics, such as mean, median, standard deviation, and interquartile range. Students will also gain practice critically assessing statistics in context. Inferential statistics includes drawing conclusions based on data collected from various sources. Probability answers the critical question "What are the chances?"

#### HONORS STATISTICS

Elective; full-year course; 1 credit

Prerequisites: B+ or better in Algebra II. Students should be highly motivated and curious about the world of statistics. Summer work required

Understanding and interpreting data are critical skills for 21st century learners. The Honors Statistics course will provide students with the requisite skills to navigate the sea of data in an organized and scholarly manner. Using an investigative approach to learning, the course will introduce and then develop a method of analyzing data with an emphasis on descriptive and inferential topics. Key concepts such as significance, generalization, and causation will be studied. Students will use technology tools to work with data sets drawn from various disciplines and also gather data using accepted and appropriate data collection methods.

#### AP STATISTICS

Elective; full-year course; 1 credit

Prerequisites: Minimum 550 on PSAT Math and PSAT Evidence-Based Reading & Writing, departmental approval

Summer work required

AP Statistics introduces students to the major concepts and tools for collecting, analyzing, and drawing conclusions from data. Students are exposed to four broad conceptual themes: 1) exploring data: describing patterns and departures from patterns; 2) sampling and experimentation: planning and conducting a study; 3) anticipating patterns: exploring random phenomena using probability and simulation; and 4) statistical inference: estimating population parameters and testing hypotheses. Students interested in AP Statistics should possess a strong work ethic, as substantial new vocabulary and calculator procedures will be introduced; the ability to work collaboratively as well as independently; and a desire to master the AP curriculum to succeed on the AP examination in May. Juniors are required to take the AP Exam or an AP-based final exam at year's end. Seniors may opt out of the AP exam. Students are required to have a graphing calculator. (TI-84 Plus is recommended.)