GATEWAY HIGH SCHOOL
measuring success one student at a time

# Math Department Curriculum Guide

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## Math at Gateway

***At Gateway, we believe that...***

- All students can learn math at deep levels.
- Powerful math learning has three parts: content skills, math practices/problem-solving skills and noncognitive (Process of Learning) skills.
- It is important to emphasize complex modeling and problem solving skills, which we know are expected in college and in life.
- Students are more likely to retain skills if they can name their goals and can see themselves grow in these skills over time. We recognize that some of these skills may take more than one year to develop.
- It is important to give students agency in making meaning of new content - they need the opportunity to figure out and own new ideas for themselves.
- Our decisions we make are influenced by current research on best practices and student data/assessed student needs.

**What are the power standards emphasized in all grades?**

We use the Standards for Mathematical Practice as defined by the Common Core to guide our thinking:

- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.
- Model with mathematics.
- Use appropriate tools strategically.
- Attend to precision.
- Look for and make use of structure.

**What other values or desired outcomes guide curriculum planning?**

- Balance between collaborative time and space for individual growth/output
- Value and analyze mistakes as part of the learning process
- Opportunities for students to struggle with new ideas
- Value risk-taking and sharing ideas
- Develop a positive math identity
- Opportunities for students to share and argue their reasoning

**What are the key practices across all grades?**

- Performance Tasks
- Visual representations (e.g. area model)
- Technology aids (e.g. Desmos)
- Do Nows & Objective-Oriented Instruction
- Standards-Based Grading
- Lab Days (e.g. Exploratory, Open-Ended Tasks)

# Algebra 1

## Key Learning Goals

*By the end of the school year, all Algebra 1 students should be able to ...*

- ☑ Write algebraic expressions based on key features of patterns
- ☑ Read, create, and analyze graphs to understand mathematical relationships
- ☑ Make and justify connections between different representations of functions
- ☑ Distinguish between different types of mathematical relationships (linear, quadratic, exponential)
- ☑ Increase their computational fluency - use this to find solutions and key features of functions
- ☑ Manipulate exponential and quadratic expressions
- ☑ Talk to the text to analyze mathematical situations
- ☑ Attack novel situations using a variety of problem-solving strategies

## Essential Question

How do you use Algebra to express patterns that you see in the world? What are strategies to make sense of situations you see?

## Units of Study

- Unit 1: Describing Mathematical Patterns
- Unit 2: Building Math Representations
- Unit 3: Linear Functions & Descriptions of Functions
- Unit 4: Finding Solutions
- Unit 5: Systems of Equations
- Unit 6: Quadratic Equations & Functions

## Resources, Texts, Approaches

Through collaborative learning, students will develop and extend their knowledge, skills and identity as mathematicians and build their capacities as independent learners. Teachers create innovative and personalized curriculum using a variety of Common Core Aligned resources based on the work of Marilyn Burns, Jo Boaler, the SFUSD and the National Council of Teachers of Mathematics (NCTM). Students use technology, such as Desmos, to support their understanding. Students will develop conceptual understanding and procedural fluency through number talks, hands-on activities, small and whole group math tasks, and individual practice.

## Geometry

**Key Learning Goals**

*By the end of the school year, all Geometry students should be able to …*

- ☑ Use the language of Geometry to describe and classify objects in the world
- ☑ Use transformational language to describe movement of shapes in the plane
- ☑ Prove new information based on a known set of rules
- ☑ Use Algebra to describe Geometric relationships and solve for unknown quantities
- ☑ Apply proportional reasoning in a wide variety of scenarios (Similarity, Trigonometry, Circles)
- ☑ Analyze what it means to measure area, surface area, and volume and distinguish whether area, surface area or volume is the required measurement for a given situation
- ☑ Talk to the text to analyze mathematical situations
- ☑ Attack novel situations using a variety of problem-solving strategies

**Essential Questions**

How do we communicate about shapes using the languages of Geometry and Algebra?
Where does Geometric thinking help us better understand our world?

**Units of Study**

- Unit 1: Circles and Constructions
- Unit 2: Transformations
- Unit 3: Proofs & Congruence
- Unit 4: Similarity
- Unit 5: Trigonometry
- Unit 6: Surface Area & Volume
- Unit 7: Coordinate Geometry
- Unit 8: Circles & Quadrilaterals

**Resources, Texts, Approaches**

Through collaborative learning, students will develop and extend their knowledge, skills, and identity as mathematicians and build their capacities as independent learners. Teachers create innovative and personalized curriculum using the Open Up Resources Geometry curriculum. Students use technology such as Desmos and Geogebra to support their understanding. Students will develop conceptual understanding and procedural fluency through number talks, hands-on activities, small and whole group math tasks, and individual practice.

## Algebra 2

**Key Learning Goals**

*By the end of the school year, all Algebra 2 students should be able to …*

- ☑ Categorize, defend, and model situations as linear, quadratic, exponential or trigonometric
- ☑ Read, create, and analyze graphs to understand mathematical relationships
- ☑ Make and justify connections between different representations of functions
- ☑ Manipulate expressions/equations to highlight information about a function
- ☑ Use inverse operations to find inputs and solve equations
- ☑ Use transformations to model situations
- ☑ Talk to the text to analyze mathematical situations
- ☑ Attack novel situations using a variety of problem-solving strategies

**Essential Questions**

How can math help us model different phenomena and patterns in our world and in our minds?
How do different representations of math help us interpret and make predictions from patterns?

**Units of Study**

- Unit 0: Intro to Visual Patterns and Sequences
- Unit 1: Exponential Functions
- Unit 2: Exponential Properties
- Unit 3: Quadratics
- Unit 4: Functions
- Unit 5: Building Functions
- Unit 6: Polynomial Functions
- Unit 7: Trig Functions

**Resources, Texts, Approaches**

Through collaborative learning, students will develop and extend their knowledge, skills and identity as mathematicians and build their capacities as independent learners. Teachers create innovative and personalized curriculum using the SFUSD Algebra 2 Curriculum. Additional curriculum is drawn using a variety of Common Core Aligned resources based on the work of Marilyn Burns, Jo Boaler, Open Up Resources, and the National Council of Teachers of Mathematics (NCTM). Students use technology such as Desmos to support their understanding. Students will develop conceptual understanding and procedural fluency through number talks, hands-on activities, small and whole group math tasks, and individual practice.

## Algebra 2 Honors

**Key Learning Goals**

*By the end of the school year, all Algebra 2 students should be able to …*

- ☑ Categorize, defend, and model situations as linear, quadratic, exponential or trigonometric
- ☑ Read, create, and analyze graphs to understand mathematical relationships
- ☑ Make and justify connections between different representations of functions
- ☑ Manipulate expressions/equations to highlight information about a function
- ☑ Use inverse operations to find inputs (roots and logarithms emphasized)
- ☑ Use transformations to model situations
- ☑ Talk to the text to analyze mathematical situations
- ☑ Attack novel situations using a variety of problem-solving strategies

**Essential Questions**

How can math help us model different phenomena and patterns in our world and in our minds? How do different representations of math help us interpret and make predictions? How do we integrate the trigonometric, geometric, and algebraic skills needed to prepare students for the study of calculus and other fields that use higher level math skills? How do we strengthens students' conceptual understanding of problems and mathematical reasoning in solving problems?

**Units of Study**

- Unit 1: Intro to Mathematical Modeling
- Unit 2: Representations in Real Life
- Unit 3: Quadratic Functions and Modeling
- Unit 4: Exponential Functions and Modeling
- Unit 5: Function Transformations
- Unit 6: Trigonometric Functions & The Unit Circle

**Resources, Texts, Approaches**

Through collaborative learning, students will develop and extend their knowledge, skills and identity as mathematicians and build their capacities as independent learners. Teachers create innovative and personalized curriculum using a variety of Common Core Aligned resources based on the work of Marilyn Burns, Jo Boaler, the SFUSD and the National Council of Teachers of Mathematics (NCTM). Students use technology such as Desmos and Geogebra to support their understanding. Students will develop conceptual understanding and procedural fluency through number talks, hands-on activities, small and whole group math tasks, and individual practice.

## Precalculus

**Key Learning Goals**

*By the end of the school year, all Precalculus students should be able to …*

- ☑ Demonstrate understanding of the six trig functions, basic identities radian/degree relationships & graphs.
- ☑ Solve linear and angular velocity problems.
- ☑ Synthesize the skills needed to use inverse trig functions.
- ☑ Synthesize the skills needed to solve trig equations.
- ☑ Utilize the law of sines, cosines, SOHCAHTOA, & other formulas used to solve triangle relationships
- ☑ Analyze higher power polynomials and rational expressions, including asymptotes.
- ☑ Demonstrate understanding of polar coordinates and relationship to traditional (x,y) coordinates.
- ☑ Use vector skills to in motion based problem solving situations (planes, boats, etc.).
- ☑ Solve systems of three variables using a variety of methods, including Row Echelon Form & Cramer's Rule.
- ☑ Demonstrate understanding of algebraic and geometric sequences.

**Essential Questions**

How do we integrate the trigonometric, geometric, and algebraic skills needed to prepare students for the study of calculus and other fields that use higher level math skills?

How do we strengthen students' conceptual understanding of problems and mathematical reasoning in solving problems?

**Units of Study**

Unit 1: Trigonometric Functions
Unit 2: Analytic Trigonometry, including inverses, solving equations, and identities
Unit 3: Applications of Trigonometry, including Law of Sines and Cosines
Unit 4: Polynomial and Rational Functions
Unit 5: Exponential and Logarithmic Functions
Unit 6: Sequences

**Resources, Texts, Approaches**

*PreCalculus Enhanced with Graphing Utilities,* by Sullivan and Sullivan
Publisher: Pearson/Prentice Hall, fourth edition
ISBN: 0-13-192496-6

## Precalculus Honors

**Key Learning Goals**

*By the end of the school year, all Precalculus Honors students should be able to …*

- ☑ Categorize, defend, and model situations as linear, quadratic, exponential or trigonometric.
- ☑ Read, create, and analyze graphs to understand mathematical relationships.
- ☑ Make and justify connections between different representations of functions.
- ☑ Manipulate expressions/equations to highlight information about a function.
- ☑ Use transformations to model situations.
- ☑ Talk to the text to analyze mathematical situations.
- ☑ Attack novel situations using a variety of problem-solving strategies.
- ☑ Demonstrate key features of polynomials and be able to graph them based on their features.
- ☑ Demonstrate understanding of rational functions, including finding asymptotes.
- ☑ Demonstrate understanding of the six trig functions, radian/degree relationships & graphs.
- ☑ Synthesize the skills needed to use inverse trig functions.
- ☑ Synthesize the skills needed to solve trig equations.
- ☑ Utilize the law of sines, cosines, & other formulas used to solve triangle relationship problems.
- ☑ Use the coordinate plane to extend trigonometry to model periodic phenomena.
- ☑ Demonstrate understanding of polar coordinates and relationship to traditional (x, y) coordinates.
- ☑ Prove trigonometric identities.
- ☑ Use vector skills to in motion based problem solving situations (planes, boats, etc.).
- ☑ Demonstrate understanding of limits and their relationship with domain of functions.

**Essential Questions**

How do we integrate the trigonometric, geometric, and algebraic skills needed to prepare students for the study of calculus and other fields that use higher level math skills?

How do we strengthen students' conceptual understanding of problems and mathematical reasoning in solving problems?

**Units of Study**

- Unit 1: Trigonometric Functions
- Unit 2: Analytic Trigonometry, including inverses, solving equations, and identities
- Unit 3: Applications of Trigonometry, including Law of Sines and Cosines
- Unit 4: Polynomial and Rational Functions
- Unit 5: Polar Coordinates and Vectors
- Unit 6: Solving 3 Variable Systems in Multiple Ways
- Unit 7: Sequences

**Resources, Texts, Approaches**

*PreCalculus Enhanced with Graphing Utilities,* by Sullivan and Sullivan
Publisher: Pearson/Prentice Hall, fourth edition
ISBN: 0-13-192496-6

## AP Calculus

**Key Learning Goals**

*By the end of the school year, all AP Calculus students should be skilled with …*

- Calculating limits using algebra, graphs, and tables, including one sided limits.
- Describing asymptotic behavior in terms of limits involving infinity.
- Understanding continuity in terms of limits.
- Finding a derivative presented graphically, numerically and analytically, or as the limit of a difference quotient.
- Finding a tangent line to a curve at a point.
- Understanding the relationship between the increasing and decreasing behavior of f and the sign of f' .
- Utilizing relationships between f and f' to determine relative extrema.
- Understanding the relationship between the concavity of f and the sign of f'.
- Optimization, both absolute (global) and relative (local) extrema.
- Modeling rates of change, including related rates problems.
- Use of implicit differentiation to find the derivative of an inverse functions.
- Interpretation of the derivative as a rate of change in varied applied contexts, including velocity, speed and acceleration.
- Interpreting differential equations via slope fields and the relationship between slope fields and solution curves for differential equation.
- Using basic properties of definite integrals and using the Fundamental Theorem of Calculus.
- Evaluating antiderivatives by substitution of variables .
- Finding specific antiderivatives using initial conditions, including applications to motion along a line and total distance traveled.
- Solving separable differential equations.
- Calculating the area of a region and the volume of solids.

**Essential Questions**

How will students develop confidence and tenacity when approaching lengthy and intricate math problems involving the concepts and skills of AP Calculus?

How can students break down a problem into its component parts, analyze each part, and then reassemble the whole using the components of all previous math studies integrated into the applications of AP Calculus?

**Units of Study**

Unit 1: Limits and Continuity
Unit 2: Derivatives
Unit 3: Applications of Derivatives
Unit 4: Definite Integrals
Unit 5: Differential Equations and Mathematical Modeling
Unit 6: Applications of Definite Integrals

**Resources, Texts, Approaches**

*Calculus: Graphical, Numerical, Algebraic*, by Finney, Demana, Waits, and Kennedy
*AP Calculus Problem Book* (online PDF resource), by Chuck Garner, Ph. D.

## Introduction to Statistics and Applied Math

**Key Learning Goals**

*By the end of the school year, all Statistics and Applied Math students should be able to …*

- ☑ Be critical readers of data (be skeptical of numbers you hear and read)
- ☑ Speak and write intelligently and critically about data.
- ☑ Use data to model and make predictions.
- ☑ Think statistically and use statistical methods to analyze data.
- ☑ Produce business-quality math work, including presentations to community members

**Essential Questions**

How does a story turn into a single number?
How do we communicate about quantitative data?
How do mathematicians and statisticians see the world differently?

**Units of Study**

- Unit 1: The Single Number
- Unit 2: Mathematical Modeling
- Unit 3: Descriptive Statistics
- Unit 4: Inferential Statistics
- Unit 5: Intro to Financial Literacy

**Resources, Texts, Approaches**

In this course, we are drawing from a variety of resources, many from local community colleges (City College, Skyline College, San Mateo College) teaching a Pre-Statistics course. Teachers of this course also create many of their own materials based on work from leading researchers (Jo Boaler, Rachel Lotan, Elizabeth Cohen). We are also working on partnering with the Carnegie Mellon Open Learning Initiative through the Statway Program.

# Computer Science

**Key Learning Goals**
*By the end of the school year, all Computer Science students should be able to …*

- ☑ Create code in visual (Snap) and scripted (Python) computer languages.
- ☑ Write basic programs to complete a variety of functions.
- ☑ Know how to construct data structures that are used in professional computer science applications.
- ☑ Understand the variety of applications that computer programs can be used for.
- ☑ Consider the societal impacts of the growth of computer use in the information age.

**Essential Questions**
- How do computers work?
- What types of languages do computers use, and what are the similarities and differences?
- What is the Internet? How is it built? How does it function?
- How will computing and automation change the structure of our economy?
- How is cyber-security impacting the ever increasing number of Internet users?
- How are programs developed to help people, organizations, or society to solve problems?
- How can computing and the use of computational tools foster creative expression?

**Units of Study**
- Computer Language Basics
- Loops and Conditions
- Variables and Custom Functions
- Lists and List Modification
- Cloning
- Python Scripted Language
- Global/Personal Issues in the Information Age

**Resources, Texts, Approaches**
*Curriculum: Introduction to Computer Science,* Microsoft TEALS Foundation (2017)
*Technology*: Gateway Tech Center
*Additional Instructors*: Adult volunteers through the TEALS program (local industry professionals from Google, Microsoft, etc).

This course is a year-long exploratory study of the basics of computer programming languages. Every student works on their own iMac computer in the Tech Center to complete in-class computer labs that reinforce principles presented in lecture. Students work independently or paired with instructor support. Students also have “computer culture” days, where they explore the state-of-the-art in computer science, types of careers in computing, and connections between current global issues and computer science.