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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)

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Core Skills

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<u>**Purpose**</u>

There are several purposes of core skills. The first is to identify for ourselves and students the most essential learnings in the course, and to give students as many opportunities as they need to master these essential learnings. The other goal is for students to be able to focus their attention amidst all of the different things that they learn in math class so that they know where to best put energy that will lead to the most success going forward. Another goal of core skills is to encourage a culture of revision and working until mastery.

<u>**Format**</u>
- 1-2 per quarter, per course
- Worth 2-3 times other skills in the gradebook
- Infinitely re-takable until student reaches mastery

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: Describing Stories Using Graphs
- Unit 3: Linear Functions
- Unit 4: Finding Solutions
- Unit 5: Exponential Functions
- Unit 6: Quadratic Functions
- Unit 7: Statistics

Resources, Texts, Approaches

Through collaborative learning, students will develop and extend their knowledge, skills and identity as mathematicians. 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.

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: Geometry Basics
- ● Unit 2: Transformations & Transformational Thinking
- ● Unit 3: Proofs & Logic
- ● Unit 4: Similarity & Congruence
- ● Unit 5: Trigonometry & Triangles
- ● Unit 6: Surface Area & Volume
- ● Unit 7: Circles & Quadrilaterals

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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 (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 from patterns?

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

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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. 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 relationship problems.

☑ 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 and 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 strengthens 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 Equations 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

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.
- ☑ Use statistics and probability as tools to model situations and make predictions.

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 strengthens students' conceptual understanding of problems and mathematical reasoning in solving problems?

Units of Study
- ● UNIT 0: Arithmetic and Geometric Sequences
- ● UNIT 1: Exponential Functions
- ● UNIT 2: Functions (Composition, Operations, Inverses, Graph Features)
- ● UNIT 3: Trigonometric Functions
- ● UNIT 4: Polynomials and Rational Expressions and Functions
- ● UNIT 5: Statistics and Intro to AB Calculus

Resources, Texts, Approaches
- ● SFUSD Algebra 2 + Precalculus Scope and Sequence
- ● www.illustrativemathematics.org
- ● Blitzer Precalculus Textbook 5th Edition

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.

Applied Math and Statistics

Key Learning Goals

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

- ☑ Be critical readers of data.
- ☑ 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.

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.