CURRICULUM GUIDE

Precalculus

Providence Schools

Background

Providence Schools teachers and administrators worked collaboratively with consultants from the Charles A. Dana Center at the University of Texas at Austin to develop the mathematics and science curriculum frameworks. The curriculum frameworks encompass two critical questions:

- Content Standards that establish clearly defined expectations for all students, helping to answer the question, ***What do students have to learn?***
- Performance Standards that determine performance expectations for content standards, helping to answer the question, ***How well do the students have to learn it?***

The curriculum framework provides a work plan that directs the instruction delivered in every classroom in every school in the district. Instruction—the way the curriculum is presented to students—will focus on the needs of students.

Purpose and Use of Curriculum Guides

Curriculum Guides for the curriculum for each grade and subject outline the approximate number of days that each unit in the curriculum will be taught; describe the content to be learned; and list the essential questions that students should be able to answer by the end of the unit.

Parents should become familiar with the Curriculum Guides. You should know when your child is being taught different topics. You should also know the essential questions that your child should be able to answer by the end of each unit.

It is important that you understand that you do not have to be familiar with the content that your child is learning in order to help them with their studies. There are basic questions that you can ask to determine if your child understands the content.

Ask your child what she is learning in each subject

Does she understand the topic? Is the unit exciting or boring? What specifically does she like or dislike about the topic? Does she understand how the topic relates to the real world?

You know your child better than anyone. You will be able to tell if she or he is benefiting from the instruction and understanding the content of the material by the way they answer you. Speak to your child's teacher if you suspect there is a problem.

Ask your child about his assignments

What is the required work? Has he finished the work on time? Is he having difficulty? If he is having difficulty, why?

Encourage your child to talk to her teachers if she is having difficulty understanding a concept or completing an assignment. If your child continues to experience difficulty, speak to the teacher yourself so that the two of you can work together to support your child.

Even if you do not understand the content that your child is learning, the fact that you are showing interest in his or her school work and believe that it is important that he or she does well sends a powerful message.

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QUARTER 1	
Content students will be learning	**Essential questions students should be able to answer by end of unit**
Unit 1.1 - Real Number System, Part 1: Relations and Functions (9 days) • Use characteristics of functions to compare and contrast the similarities and differences between relations and functions.	» What are the similarities and differences between relations and functions? » What are the similarities and differences between surjective and injective functions? » Are composite functions equal if they are evaluated backwards? Justify your answer.
Unit 1.2 - Real Number System, Part 2: Solving Equations (6 days) • Use characteristics of linear and nonlinear functions to compare and contrast the similarities and differences of functions. • Solve real-world applications with appropriate functions.	» What is the relationship between the multiple representations of the functions? » What are the characteristics of the functions studied? » What are the properties of families of functions? » What is the relationship between the properties of logarithms and the properties of exponents? Why?
Unit 1.3 - Real Number System, Part 3: Transformations (6 days) • Use multiple representations (including graphical, tabular, verbal, and algebraic forms) of functions to identify their relationships in families of functions (linear, quadratic, cubic, rational, exponential, logarithmic, trigonometric, polynomial, etc.). • Use knowledge of characteristics of families of functions to solve applications of science and art (dilations) situations.	» What are the similarities and differences among functions? » What is the relationship among the transformations of functions? » Why are dilations needed in real-world situations? » Why is the understanding of even and odd functions important in the study of functions?
Unit 1.4 - Real Number System, Part 4: Complex Numbers (6 days) • Understand conceptually the meaning of complex roots in the context of polynomial functions. • Graphically represent complex numbers.	» Why are complex numbers necessary in mathematical notation? » What do complex number solutions represent in a polynomial? » How are the rectangular and polar coordinates similar and different? » What is the relationship between complex and real numbers?

QUARTERS 1 & 2

Content students will be learning	Essential questions students should be able to answer by end of unit
Unit 1.5 - Real Number System, Part 5: Theorems (6 days) • Understand that the complex number system is made up of real and imaginary numbers. • Use polynomial theorems (fundamental theorem, remainder theorem, rational root theorem, and intermediate value theorem) and factoring to identify the characteristics of polynomials. • Understand the characteristics of polynomials and the implications for their use in the real world.	» How do the different theorems help dissect polynomials? » Why is knowing the characteristics of polynomials important for mathematics students? » Knowing the characteristics of polynomials, what kinds of higher order equations can now be solved? » What are the similarities/differences among the roots of the different polynomial functions?
Unit 1.6 - Matrices (6 days) • Understand conceptually matrices and their uses as tools for solving various real-world applications.	» Why are matrices used to solve systems of equations? » How can matrices be used as tools to help transform geometric shapes? Justify your answer. » In what situations are matrices used in the real world?

Unit 2.1 - Probability, Part 1: Combinations, Permutations, and the Basic Counting Principle (6 days) • Understand the concept of probability (both permutations and combinations) and its use for solving various real-world applications.	» What are the similarities and differences between permutations and combinations? » Why are linear permutations not computed the same way as circular permutations? » What is the difference between probability and odds?
Unit 2.2 - Probability, Part 2: Binomial Theorem and Probability (6 days) • Understand the concept of probability (both permutations and combinations) and its use as a tool for solving various real-world applications.	» What is the difference between an independent and dependent event? » How do you know if an event is an inclusive event? » What are the similarities and differences between theoretical and experimental probability?
Unit 2.3 - Statistics (6 days)	» What measures of central tendencies are used in the distribution of data?

UNIT CONTINUES ON NEXT PAGE

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QUARTER 2 (CONTINUED)

Content students will be learning	Essential questions students should be able to answer by end of unit
UNIT 2.3 - STATISTICS (CONTINUED)	UNIT 2.3 - STATISTICS (CONTINUED)
• Understand the concept of statistics and its use in analyzing data in real-world situations.	» How can outliers affect data? » What is the difference between a raw score and a percentile score?
Unit 2.4 - Trigonometry, Part 1: Working with Circles (7 days)	
• Use the conceptual understanding of trigonometric characteristics of circles and angles. • Understand the conceptual difference between Euclidean and non-Euclidean geometric systems.	» What are the similarities and differences of radian and degree measurement? » Why do mathematicians need to understand the characteristics of a circle? » What are the similarities and differences of Euclidean and non-Euclidean geometry?
Unit 2.5 - Trigonometry, Part 2: Right Triangle and Unit Circle Trigonometry (5 days)	
• Use right triangle concepts to find trigonometric ratios. • Use unit circle concepts to solidify the conceptual understanding of the trigonometric ratios.	» What is the relationship between right triangles and trigonometry? » Why is trigonometry important in our study of mathematics? » What are the similarities and differences of right triangle trigonometry and unit circle trigonometry? » What are the relationships of the angles in the four quadrants?
Unit 2.6 - Trigonometry, Part 3: Applications of Trigonometry Functions (6 days)	
• Use trigonometric ratios to solve real-world problems.	» How are inverse trigonometric functions similar to other inverse functions? » What role do trigonometric ratios play in modern building techniques? » How did early explorers use trigonometric functions to guide them? » What are the similarities and differences of linear and angular velocity?
Unit 2.7 - Trigonometry, Part 4: Law of Sines and Cosines (7 days)	
• Use the law of sines and law of cosines to solve real-world problems.	» Why do we need to have formulas for law of sines and law of cosines?
UNIT CONTINUES ON NEXT PAGE	UNIT CONTINUES ON NEXT PAGE

QUARTERS 2 & 3

Content students will be learning	Essential questions students should be able to answer by end of unit
UNIT 2.7 - TRIGONOMETRY, PART 4: LAW OF SINES AND COSINES (CONTINUED)	UNIT 2.7 - TRIGONOMETRY, PART 4: LAW OF SINES AND COSINES (CONTINUED)
	» How are the areas of triangle formulas connected? » What is the relationship between the Pythagorean theorem and the law of cosines? » Why does law of sines allow you to find all the missing parts of a triangle? Justify using a proof.
QUARTER 3	QUARTER 3
Unit 3.1 - Trigonometry, Part 5: Graphing Trigonometric Functions (12 days) • Use the conceptual understanding of how to graph trigonometric functions and transform them.	» How are trigonometric transformations related to transformations of other functions? » How are slope and amplitude similar? Different? » What concept is constant with all inverse functions?
Unit 3.2 - Trigonometry, Part 6: Trigonometric Identities (9 days) • Understand the conceptual ideas of trigonometric identities.	» What is the relationship between the Pythagorean theorem and the Pythagorean identities in trigonometry? » How are the radians connected to our work with circles? » Why is the study of trigonometric identities important? » What careers are directly affected by trigonometry?
Unit 3.3 - Trigonometry, Part 7: Solving Trigonometric Equations (5 days) • Understand the concept of trigonometric equations and inequalities and their uses as tools for solving various real-world applications.	» What strategies do you have to use to solve trigonometric equations and inequalities? » How are the strategies used to solve trigonometric equations the same as and different from other linear and nonlinear functions? » What is the difference between a trigonometric identity and a trigonometric equation that is not an identity? » Why do many trigonometric equations have more than one solution?
Unit 3.4 - Vectors (8 days) • Understand the concept of vectors and their uses as tools for solving various real-world applications.	» What is the relationship between the linear form of an equation and the normal linear form of an equation?
UNIT CONTINUES ON NEXT PAGE	UNIT CONTINUES ON NEXT PAGE

QUARTERS 3 & 4

Content students will be learning	Essential questions students should be able to answer by end of unit
UNIT 3.4 - VECTORS (CONTINUED)	UNIT 3.4 - VECTORS (CONTINUED)
	» Why are vectors important in the study of science? » How are the operations similar and different for geometric and algebraic manipulations of vectors? » What are the similarities and differences between the distance formula and the distance formula with trigonometric functions?
Unit 3.5 - Polar Coordinates (8 days) • Understand conceptually the difference between rectangular and polar graphs. • Graphically represent complex numbers using both polar and rectangular graphs.	» What is the relationship between rectangular and polar graphs? » Why is the quadrant important when converting a point from rectangular to polar coordinates? » What is a complex number in polar coordinate form?
QUARTER 4	QUARTER 4
Unit 4.1 - Conics, Part 1: Circles (4 days) • Understand conceptually the characteristics and use of standard and general forms of the equation of the circle. • Uses analytic geometry to prove mathematical concepts.	» Why is completing the square an important method to know before beginning a study of conic sections? » What slice of a cone is used to form a circle? » How is analytic geometry used in everyday situations? » What are the characteristics of an equation that verify it is a circle?
Unit 4.2 - Conics, Part 2: Ellipses (4 days) • Understand conceptually the characteristics and use of standard and general forms of the equation of the ellipse.	» What are the similarities and differences between a circle and an ellipse? » What real-world situations use ellipses? » What are the similarities and differences in the major and minor axes? What do the axes tell you? » What slice of a cone forms an ellipse?
Unit 4.3 - Conics, Part 3: Hyperbolas (5 days) • Understand conceptually the characteristics and use of standard and general forms of the equation of the hyperbola.	» What are the similarities and differences between a hyperbola and other conic sections?
UNIT CONTINUES ON NEXT PAGE	UNIT CONTINUES ON NEXT PAGE

QUARTER 4 (CONTINUED)

Content students will be learning	Essential questions students should be able to answer by end of unit
UNIT 4.3 - CONICS, PART 3: HYPERBOLAS (CONTINUED)	**UNIT 4.3 - CONICS, PART 3: HYPERBOLAS (CONTINUED)**
• Use multiple representations to show the characteristics of hyperbolas.	» What is the difference between the vertex and the foci in a hyperbola? » What are the similarities and differences in the major and minor axes in the ellipse and the transverse and conjugate axes in the hyperbola? » What slice of a cone forms a hyperbola?
Unit 4.4 - Conics, Part 4: Parabolas and Systems (9 days) • Understand conceptually the characteristics and use of standard and general forms of the equation of the parabola. • Understand algebraically and geometrically the solutions of systems of equations and inequalities of conic sections.	» What are the similarities and differences between a parabola and other conic sections? » What is the difference between the vertex and the foci in a hyperbola and in a parabola? » What slice of a cone forms a parabola? » Why are the eccentricities of the four conic sections different? » Where are parabolas used in the real world?
Unit 4.5 - Limits, Part 1: Introduction to Limits (9 days) • Use patterns to generate partial sums and make connections to other functions and the real world. • Use patterns to generate infinite geometric sequences and series and make connections to other functions and the real world. • Understand the concept of limits as they apply to convergent or divergent series.	» What are the similarities and differences between sequences and series? » Why are limits important in the study of calculus? » How are arithmetic and geometric sequences connected to linear and exponential functions? » What is the significance of divergent and convergent series?
Unit 4.6 - Limits, Part 2: Derivatives (8 days) • Use the conceptual idea of limits and derivatives of a function to solve real-world applications.	» What does a limit represent? » What is the difference between a derivative and an anti-derivative? » What causes an undefined portion of a curve? » How are the derivative rules related to power, scalar multiplication, and sum and difference rules of real numbers?
Unit 4.7 - Limits, Part 3: Integrals (6 days) • Use the conceptual idea of limits and the integral of a function to solve real-world applications.	» What does an integral represent? » What is the relationship between integrals and anti-derivatives?