PreCalculus - High School Math
Curriculum Resources

Curriculum Overview

The Alabama Course of Study: Mathematics (2019) provides the framework for the K-12 study of Mathematics in Alabama's public schools. Content standards in this document are minimum and required, fundamental and specific, but not exhaustive. The standards set high expectations for student learning in all grades by requiring more attention to foundational reading, explicitly teaching comprehension skills for all text genres, and encouraging the development of advanced reading through increasing levels of complexity in literary and informational texts.

Here are definitions to help understand this curriculum guide:

- **Units of Study:** A series of lessons, experiences, and assessments aligned to standards that may last two to six weeks.
- **Priority Standards:** These are the standards students must know and be able to do to be prepared for the next grade level or course.
- **Supporting Standards:** These standards support, connect to, or enhance priority standards.
- **Knowledge:** What students should know related to the standard.
- **Skills:** What students should be able to do related to the standard.
- **Bloom's Taxonomy:** This hierarchy helps describe the complexity and requirements of a standard.
- **Quad:** This framework has four parts that help determine the rigor and relevance of a standard: Acquisition, Application, Assimilation, Adaptation.
- **ACT:** This refers to ACT standards alignment.
- **Key Understandings:** Essential ideas students need to understand about the standard.
- **Key Vocabulary:** Keywords that should be taught to ensure understanding of the standard.
- **Formative Assessment:** Frequent and ongoing checks for understanding teachers can use throughout the unit.
- **Summative Assessment:** How students will be assessed at the end of a unit to demonstrate their level of mastery of the standards.
- **Activities & Resources:** Specific examples, lessons, and/or resources that may be used to support implementation of the standard.
- **RTI:** Response to Intervention - additional supports/resources teachers can use for students who need them.
- **Extensions:** Additional activities and resources to extend the learning experience, especially for accelerated students.

PreCalculus - Curriculum At A Glance - Pacing Calendar				
Quarter	**# Weeks**	**Unit Name**	**Priority Standards**	**Supporting Standards**
	1	Launch Week	**Pre-Assessment**	
	2	UNIT 1: Series, Polynomials, and Binomial Theorem	**16, 17**	**15**
	3	UNIT 2: Radical and Rational Equations	**19a**	**18, 20, 21**
	2	UNIT 3: Key Features of Functions	**24**	**25a, 25b**
	3	UNIT 4: Graphing Functions	**30**	**26a**
	3	UNIT 5: Building Functions	**27, 28, 30**	
	2	UNIT 6: Inverse Functions	**28a, 28b, 28c, 28d**	
	3	UNIT 7: Trigonometry	**33, 34, 36, 37b, 37c**	**26b, 35, 37a**
	2	UNIT 8: Conics	**31a, 31b**	
	2	UNIT 9: Logarithm and Natural Logarithm	**1a, 1b**	**29**
	4	UNIT 10: Forms of Complex Numbers	**3, 4, 6, 32a, 32b**	**2, 5**
	2	UNIT 11: Limits	**7**	
	3	UNIT 12: Vectors	**8, 9, 12a, 12b, 12c, 13a, 13b**	
	4	UNIT 13: Applied Vectors	**10, 11, 14, 22**	**23**

UNIT 1: Series, Polynomials, and Binomial Theorem	DURATION: 2 weeks
CONTENT STANDARDS	
PRIORITY STANDARDS • 16. Derive and apply the Remainder Theorem: For a polynomial p(x) and a number a, the remainder on division by x – a is p(a), so p(a) = 0 if and only if (x – a) is a factor of p(x). • 17. Know and apply the Binomial Theorem for the expansion of (x + y) n in powers of x and y for a positive integer, n, where x and y are any numbers.	SUPPORTING STANDARDS • 15. Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems, extending to infinite geometric series.

KNOWLEDGE (students need to know):	SKILLS (students need to be able to do):	BLOOM'S TAXONOMY	QUAD	ACT
4.1: Identify polynomial polynomial functions and their degree		Understand	B	
4.1: Identify the real zeros of a polynomial function and their multiplicity		Understand	B	
4.3: Find the real zeros of a polynomial function		Understand	B	
4.3: Use the Remainder and Factor Theorem		Applying	B	
4.3: Use Descartes' Rule of Signs to determine the number of positive and the number of negative real zeros of a polynomial function		Applying	B	
12.3: Determine whether a sequence is arithmetic		Understand	B	
12.3: Find a formula for a geometric sequence		Understand	B	
12.3: Find the sum of a geometric sequence		Understand	B	

12.3: Determine whether a geometric series converges or diverges		Understand	B	
	12.5: Evaluate n taken j at a time	Evaluate	C	
12.5: Use the Binomial Theorem		Applying	B	

KEY COMPONENTSB

LEARNING TARGETS

- 4.1: Degree of the polynomial function $f:n$
- 4.1: Identify Polynomial functions and their degree
- 4.1: Identify the real zeros of a polynomial function and their multiplicity
- 4.3: Find the real zeros of a polynomial function
- 4.3: Use the Remainder and Factor Theorem
- 4.3: Use Descartes' Rule of Signs to determine the number of positive and the number of negative real zeros of a polynomial function
- 12.3: Determine whether a sequence is arithmetic
- 12.3: Find a formula for a geometric sequence
- 12.3: Determine whether a geometric series converges or diverges
- 12.5: Evaluate n taken j at a time
- 12.5: Use the Binomial Theorem

KEY VOCABULARY

- Polynomial Function
- Coefficient
- Leading coefficient
- Degree
- Terms
- Leading term
- Constant term
- Zero polynomial
- Standard form
- Power Function of degree n
- Real zero
- Real Zero of Multiplicity m
- Even multiplicity
- Odd multiplicity
- Turning Points
- End Behavior of a Graph
- Division algorithm for polynomials
- Dividend
- Divisor
- Quotient
- Remainder
- Remainder Theorem
- Factor Theorem
- Number of Real Zeros
- Descartes' Rule of Signs
- Geometric Sequence
- Common Ratio
- nth Term of a Geometric Sequence
- Sum of the First n Terms of a Geometric Sequence
- Infinite Geometric Series
- Convergence of an Infinite Geometric Series
- Finite Geometric Series
- n taken j at a time

ESSENTIAL QUESTION(S)

- What is the difference between finite and infinite geometric series?
- Infinite geometric series can always be solved, true or false? Explain.
- How are polynomials divided? Explain.
- If the remainder is 0, then the divisor is a facor of the polynomial. This describes _____.
- What tool does the Binomial Theorem use and who created it?

PRIOR KNOWLEDGE

- Polynomials
- Transformations
- Intercepts
- Evaluating functions
- Factoring polynomials
- Synthetic division
- Polynomial division
- Solving quadratic equations

	• **Compound interest**

FORMATIVE ASSESSMENT	SUMMATIVE ASSESSMENT

ACTIVITIES & RESOURCES	
RTI	**EXTENSION OPPORTUNITIES**

UNIT 2: Radical and Rational Equations	DURATION: 3 weeks
CONTENT STANDARDS	
PRIORITY STANDARDS ● 19. Add, subtract, multiply, and divide rational expressions. ○ a. Explain why rational expressions form a system analogous to the rational numbers, which is closed under addition, subtraction, multiplication, and division by a non-zero rational expression.	SUPPORTING STANDARDS ● 18. Rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated cases, a computer algebra system. ● 20. Explain each step in solving an equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a clear-cut solution. Construct a viable argument to justify a solution method. Include equations that may involve linear, quadratic, polynomial, exponential, logarithmic, absolute value, radical, rational, piecewise, and trigonometric functions, and their inverses. ● 21. Solve simple rational equations in one variable, and give examples showing how extraneous solutions may arise.

KNOWLEDGE (students need to know):	SKILLS (students need to be able to do):	BLOOM'S TAXONOMY	QUAD	ACT
Appendix Section A.3: Recognize monomials		Understand	B	
Appendix Section A.3: Recognize polynomials		Understand	B	
Appendix Section A.3: Know formulas for special products		Understand	B	
	Appendix Section A.3: Divide polynomials using long division	Applying	B	
	Appendix Section A.4: Divide Polynomials using synthetic division	Applying	B	

Appendix Section A.5: Reduce a rational expression to lowest term		Applying	B	
	Appendix Section A.5: Multiply and divide rational expressions	Applying	B	
	Appendix Section A.5: Add and subtract rational expressions	Applying	B	
Appendix Section A.5: Use least common multiple method		Applying	B	

KEY COMPONENTS

LEARNING TARGETS

- Appendix Section A.3: Recognize monomials
- Appendix Section A.3: Recognize polynomials
- Appendix Section A.3: Know formulas for special products
- Appendix Section A.3: Divide polynomials using long division
- Appendix Section A.4: Divide Polynomials using synthetic division
- Appendix Section A.5: Reduce a rational expression to lowest term
- Appendix Section A.5: Multiply and divide rational expressions
- Appendix Section A.5: Add and subtract rational expressions
- Appendix Section A.5: Use least common multiple method

KEY VOCABULARY

- Monomial
- Coefficient
- Degree
- Binomial
- Trinomial
- Polynomial
- Coefficients
- Leading coefficient
- Leading term
- Degree
- Terms
- Zero polynomial
- Standard form
- Special products
- Difference of Squares
- Squares of Binomials (Perfect Squares)
- Cubes of Binomials (Perfect Cubes)
- Difference of Two Cubes
- Sum of Two Cubes
- Divisors
- Dividend
- Quotient
- Remainder
- Factors
- Factoring
- Prime
- Factored completely
- Synthetic division
- Rational Expression
- Reduction property
- Least common Multiple Method

ESSENTIAL QUESTION(S)

- What power is a linear equation raised to? How are they solved?
- What is a rational equation made up of? How do you solve rational equations that use addition and subtraction?
- How are simplifying rational equations and solving quadratic equations similar?
- State the four methods for solving quadratic equations.
- What is the inverse of a radical? Are extraneous solutions always true?

PRIOR KNOWLEDGE

-

• **What is the difference between rational expression and rational equation?** • **How are rationa expressions simplified?** • **How are dividing and multiplying rational expressions similar and different?** • **What contributes to the complexity of complex rational expressions?** • **Complex roots are in Precalculus and what other subject? How does the other subject make it more complex?**	

FORMATIVE ASSESSMENT	SUMMATIVE ASSESSMENT

ACTIVITIES & RESOURCES	
RTI	**EXTENSION OPPORTUNITIES**

UNIT 3: Key Features of Functions	DURATION: 2 weeks
CONTENT STANDARDS	
PRIORITY STANDARDS ● 24. Compare and contrast families of functions and their representations algebraically, graphically, numerically, and verbally in terms of their key features. Families of functions include but are not limited to linear, quadratic, polynomial, exponential, logarithmic, absolute value, radical, rational, piecewise, trigonometric, and their inverses.	SUPPORTING STANDARDS ● 25. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. Extend from polynomial, exponential, logarithmic, and radical to rational and all trigonometric functions. ○ a. Find the difference quotient $\frac{f(x+\Delta x)-f(x)}{\Delta x}$ of a function and use it to evaluate the average rate of change at a point. ○ b. Explore how the average rate of change of a function over an interval (presented symbolically or as a table) can be used to approximate the instantaneous rate of change at a point as the interval decreases.

KNOWLEDGE (students need to know):	SKILLS (students need to be able to do):	BLOOM'S TAXONOMY	QUAD	ACT
	1.5: Calculate and interpret the slope of a line	Applying	B	
1.5: Find the equation of a vertical line		Understand	B	
1.5: Identify horizontal lines		Understand	B	
1.5: Use slope intercept form of a line		Applying	B	
1.5: Find an equation of a line given two points		Understand	B	
	1.5: Graph lines written in general(standard) form using intercepts	Applying	B	

2.1: Describe a Relation		**Understand**	**B**	
2.1: Determine whether a relation represents a function		**Understand**	**B**	
2.1: Use function notation and find the value of a function		**Applying**	**B**	
2.1: Find the difference quotient of a function		**Understand**	**B**	
2.2: Identify the Graph of a function		**Understand**	**B**	
2.2: Obtain information from or about the graph of a function		**Understand**	**B**	
2.3: FInd the rate of change of a function (pg. 93)		**Understand**	**B**	
	2.4: Graph the functions listed in the library of functions(Constant, Identity, Quadratic, Absolute Value, Cubic, Square Root, Cube Root, Reciprocal. Greatest integer)	**Applying**	**B**	
3.3: Identify the Vertex and Axis of Symmetry of a Parabola		**Understand**	**B**	
	3.3: Graph quadratic function using vertex, axis, intercepts	**Applying**	**B**	
	3.3: Graph quadratic function given its vertex and one other point	**Applying**	**B**	
	2.4: Analyze piecewise-defined functions	**Analyze**	**C**	

KEY COMPONENTS		
LEARNING TARGETS • **1.5: Calculate and interpret the slope of a line**	KEY VOCABULARY • **Slope**	

• 1.5: Find the equation of a vertical line • 1.5: Identify horizontal lines • 1.5: Use slope intercept form of a line • 1.5: Find an equation of a line given two points • 1.5: Graph lines written in general(standard) form using intercepts • 2.1: Describe a Relation • 2.1: Determine whether a relation represents a function • 2.1: Use function notation and find the value of a function • 2.1: Find the difference quotient of a function • 2.2: Identify the Graph of a function • 2.4: Graph the functions listed in the library of functions(Constant, Identity, Quadratic, Absolute Value, Cubic, Square Root, Cube Root, Reciprocal. Greatest integer) • 3.3: Identify the Vertex and Axis of Symmetry of a Parabola • 3.3: Graph quadratic function using vertex, axis, intercepts • 3.3: Graph quadratic function given its vertex and one other point • 2.4: Analyze piecewise-defined functions	• Slope formula • Vertical line • Undefined • Average rate of change • Slope intercept form • General/Standard Form • Relation • Domain • Range • Input • Output • Order pairs • Graphically • Mapping • Algebraically • Function • Value • Image • Function notation • Independent variable/argument • Dependent variable • Difference quotient • f is defined at x • f is not defined at x • Sum function • Difference function • Product function • Quotient function • Vertical line test • Constant function • Identity/Linear function • Quadratic/Square function • Parabolas • Intercepts • Cube/Cubic Function • Absolute Value Function • Square Root Function • Cube Root Function • Reciprocal Function • Greatest Integer Function • Piecewise Function	

ESSENTIAL QUESTION(S)	PRIOR KNOWLEDGE
• **Which functions are classified as piecewise? Compare and contrast.** • **How do even root functions compare to odd root functions? Describe domain, range, and end behavior.** • **How can key features develop the graph of a polynomial function?** • **Describe the role of vertical asymptopes, horizontal asymptopes, the y-intercept, and input-output table.** • **How are logarithmic and exponential functions connected? Explain.** • **How do sine, cosine, and tangent compare? Consider similarities, differences, and real world applications.**	• **Intervals** • **Solving inequalities** • **Evaluating algebraic expressions** • **Rationalizing numerators and denominators** • **Graphs of equations** • **Intercepts** • **Transformations** • **Completing the square** • **Quadratic eqautions**

FORMATIVE ASSESSMENT	SUMMATIVE ASSESSMENT

ACTIVITIES & RESOURCES	
RTI	EXTENSION OPPORTUNITIES

UNIT 4: Graphing Functions	DURATION: 3 weeks

CONTENT STANDARDS

PRIORITY STANDARDS	SUPPORTING STANDARDS
• 30. Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k \cdot f(x)$, $f(k \cdot x)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Extend the analysis to include all trigonometric, rational, and general piecewise-defined functions with and without technology.	• 26. Graph functions expressed symbolically and show key features of the graph, by hand and using technology. Use the equation of functions to identify key features in order to generate a graph. ○ a. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.

KNOWLEDGE (students need to know):	SKILLS (students need to be able to do):	BLOOM'S TAXONOMY	QUAD	ACT
2.3: Identify even and odd functions from a graph		Understand	B	
2.3: Identify even and odd functions from an equation		Understand	B	
2.3: Use a graph to determine where a function is increasing, decreasing, or constant		Applying	B	
2.3: Use a graph to locate local maxima and local minima		Applying	B	
2.3: Use a graphing utility to approximate local maxima and local minima and to determine where a function is increasing or decreasing		Applying	B	
	2.5: Graph functions using the vertical and horizontal shifts	Applying	B	
	2.5: Graph functions using compressions and stretches	Applying	B	

	2.5: Graph functions using reflections about the x-Axis or y-Axis	**Applying**	**B**	
	3.3: Graph a quadratic function using transformations	**Applying**	**B**	
	4.2: Analyze the graph of a polynomial function	**Analyze**	**C**	
4.5: FInd the domain of a rational function		**Understand**	**B**	
4.5: Find the vertical asymptotes of a rational function		**Understand**	**B**	
4.5: Find the horizontal or an oblique asymptotes of a rational function		**Understand**	**B**	
	4.6: Analyze the graph of a rational function	**Analyze**	**C**	

KEY COMPONENTS

LEARNING TARGETS

- **2.3: Identify even and odd functions from a graph**
- **2.3: Identify even and odd functions from an equation**
- **2.3: Use a graph to determine where a function is increasing, decreasing, or constant**
- **2.3: Use a graph to locate local maxima and local minima**
- **2.3: Use a graphing utility to approximate local maxima and local minima and to determine where a function is increasing or decreasing**
- **2.5: Graphing functions using the vertical and horizontal shifts**
- **2.5: Graph functions using compressions and stretches**
- **2.5: Graph functions using reflections about the x-Axis or y-Axis**
- **3.3: Graph a quadratic function using transformations**
- **4.2: Analyze the graph of a polynomial function**
- **4.5: FInd the domain of a rational function**
- **4.5: Find the vertical asymptotes of a rational function**
- **4.5: Find the horizontal or an oblique asymptotes of a rational function**
- **4.6: Analyze the graph of a rational function**

KEY VOCABULARY

- **Even function**
- **Odd function**
- **Increasing function**
- **Decreasing function**
- **Constant function**
- **Local maximum**
- **Local maximum value of f**
- **Local minimum**
- **Local minimum value of f**
- **Absolute maximum**
- **Absolute minimum**
- **Vertical shifts**
- **Horizontal shifts**
- **Vertical Compression**
- **Vertical Shifts**
- **Horizontal Compression**
- **Horizontal Stretch**
- **Reflection about the x-**

	Axis • Reflection about the y-axis • Quadratic function • Parabolas • Vertex • Axis of Symmetry • Intercepts • Rational function • Lowest terms • Horizontal asymptote • Vertical asymptote • Oblique (or Slant) asymptote • Multiplicity of an asymptote	
ESSENTIAL QUESTION(S) • When finding a functions domain, which values are excluded and why are they excluded? • How is a function tested and what will it be called if it passes the test? • Which even and odd functions are not classified by the exponent rule?	**PRIOR KNOWLEDGE** • Intervals • Intercepts • Slope of a line • Point-slope form • Symmetry • Transformations • Completing the square • Quadratic equations • Polynomials • Local maxima and minima • Rational expressions • Polynomial division	

FORMATIVE ASSESSMENT	SUMMATIVE ASSESSMENT

ACTIVITIES & RESOURCES

RTI	EXTENSION OPPORTUNITIES

UNIT 5: Building Functions	DURATION: 3 weeks
CONTENT STANDARDS	
PRIORITY STANDARDS ● 27. Compose functions. Extend to polynomial, trigonometric, radical, and rational functions. ● 28. Find inverse functions. ○ a. Given that a function has an inverse, write an expression for the inverse of the function. Example: Given $f(x) = 2x^3$ or $f(x) = (x + 1)/(x – 1)$ for $x \neq 1$ find $f^{-1}(x)$. ● 30. Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k \cdot f(x)$, $f(k \cdot x)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Extend the analysis to include all trigonometric, rational, and general piecewise-defined functions with and without technology.	SUPPORTING STANDARDS ●

KNOWLEDGE (students need to know):	SKILLS (students need to be able to do):	BLOOM'S TAXONOMY	QUAD	ACT
5.1: Form a composite function		Understand	B	
5.1: Find the domain of a composite function		Understand	B	
5.2: Determine whether a function is one-to-one		Understand	B	
5.2: Determine the inverse of a function defined by a mapping or a set of ordered pairs		Understand	B	
	5.2: Obtain the graph of the inverse function from the graph of a one-to-one function	Applying	B	
5.2: Find the inverse of a function defined by an equation		Understand	B	

KEY COMPONENTS		
LEARNING TARGETS ● 5.1: Form a composite function ● 5.1: Find the domain of a composite function ● 5.2: Determine whether a function is one-to-one ● 5.2: Determine the inverse of a function defined by a mapping or a set of ordered pairs ● 5.2: Obtain the graph of the inverse function from the graph of a one-to-one function ● 5.2: Find the inverse of a function defined by an equation	**KEY VOCABULARY** ● Composite function ● One-to-one ● Horizontal line test ● Inverse function of f	
ESSENTIAL QUESTION(S) ● The combination of functions is defined by which five operations? ● What is the process for composing functions and which algebraic process is it related to? ● What is it called when a composite function is expressed as the composition of two functions? ● How is the inverse function determined and what is its notation? ● How is a function tested and what will it be called if it passes the test?	**PRIOR KNOWLEDGE** ● Find the value of a function ● Domain of a function ● Functions ● Increasing/Decreasing functions ● Rational expressions ● Properties of rational functions	

FORMATIVE ASSESSMENT	SUMMATIVE ASSESSMENT

ACTIVITIES & RESOURCES	
RTI	**EXTENSION OPPORTUNITIES**

Curriculum Created in Partnership with the Proven Practices by PowerSchool Team
PowerSchool | 150 Parkshore Drive, Folsom, CA 95630 | powerschool.com

UNIT 6: Inverse Functions	DURATION: 2 weeks
CONTENT STANDARDS	
PRIORITY STANDARDS ● 28. Find inverse functions. ○ b. Verify by composition that one function is the inverse of another. ○ c. Read values of an inverse function from a graph or a table, given that the function has an inverse. ○ d. Produce an invertible function from a non-invertible function by restricting the domain.	SUPPORTING STANDARDS ●

KNOWLEDGE (students need to know):	SKILLS (students need to be able to do):	BLOOM'S TAXONOMY	QUAD	ACT
5.1: Find the domain of a composite function		Understand	B	
5.2: Determine whether a function is one-to-one		Understand	B	
5.2: Determine the inverse of a function defined by a mapping or a set of ordered pairs		Understand	B	
	5.2: Obtain the graph of the inverse function from the graph of a one-to-one function	Applying	B	
	5.2: Verify that a function defined by an equation is an inverse function	Applying	B	

KEY COMPONENTS		
LEARNING TARGETS ● 5.1: Form a composite function ● 5.1: Find the domain of a composite function	KEY VOCABULARY ● One-to-one ● Horizontal line test	

• **5.2: Determine whether a function is one-to-one** • **5.2: Determine the inverse of a function defined by a mapping or a set of ordered pairs** • **5.2: Obtain the graph of the inverse function from the graph of a one-to-one function** • **5.2: Verify that a function defined by an equation is an inverse function** • **5.2: Find the inverse of a function defined by an equation**	• **Inverse function of f**	
ESSENTIAL QUESTION(S) • **Which composition could be used to verify that two functions are inverses of each other?** • **If two functions are composed, what resultant is required?**	**PRIOR KNOWLEDGE** • **Find the value of a function** • **Domain of a function** • **Functions** • **Increasing/Decreasing functions** • **Rational expressions** • **Properties of rational functions**	

FORMATIVE ASSESSMENT	SUMMATIVE ASSESSMENT

ACTIVITIES & RESOURCES	
RTI	EXTENSION OPPORTUNITIES

UNIT 7: Trigonometry	DURATION: 3 weeks
CONTENT STANDARDS	
PRIORITY STANDARDS ● 33. Use special triangles to determine geometrically the values of sine, cosine, and tangent for π/3, π/4, and π/6, and use the unit circle to express the values of sine, cosine, and tangent for π − x, π + x, and 2π − x in terms of their values for x, where x is any real number. ● 34. Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions. ● 36. Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context. ● 37. Use trigonometric identities to solve problems. ○ b. Use the angle sum formulas for sine, cosine, and tangent to derive the double angle formulas. ○ c. Use the Pythagorean and double angle identities to prove other simple identities.	SUPPORTING STANDARDS ● 26b. b. Graph trigonometric functions and their inverses, showing period, midline, amplitude, and phase shift. ● 35. Demonstrate that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed. ● 37. Use trigonometric identities to solve problems. ○ a. Use the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ to derive the other forms of the identity. Example: $1 + \cot^2(\theta) = \csc^2(\theta)$

KNOWLEDGE (students need to know):	SKILLS (students need to be able to do):	BLOOM'S TAXONOMY	QUAD	ACT
6.1 Find the length of an arc of a circle		Understand	B	
	6.1 Convert from degrees to radian and from radians to degrees	Applying	B	
6.1 Find the area of a sector of a circle		Understand	B	
6.2 Find the exact values of the trigonometric functions on the unit circle		Understand	B	
6.2 Use a calculator to approximate the value of a trigonometric function		Applying	B	

6.3 Determine the domain and range of the trigonometric functions		**Understand**	**B**	
6.3 Determine the period of the trigonometric functions		**Understand**	**B**	
6.3 Determine the signs of the trignometric functions in a given quadrant		**Understand**	**B**	
6.3 Find the values of the trigonometric functions using fundamental identities		**Understand**	**B**	
6.3 Use even-odd properties to find the exact values of the trigonometric functions		**Applying**	**B**	
6.4 Determine the amplitude and period of sinusoidal functions		**Understand**	**B**	
	6.4 Graph variations of sinusoidal functions	**Applying**	**B**	
6.4 Find an equation for a sinusoidal graph		**Understand**	**B**	
	6.5 Graph variations of y = tan x, y = cot x, y = csc x, and y = sec x	**Applying**	**B**	
7.1 Define the inverse sine, cosine, and tangent function		**Understand**	**B**	
7.1 Find the value of an inverse sine, cosine, and tangent function		**Understand**	**B**	
	7.1 Solve equations involving inverse trigonometric functions	**Applying**	**B**	
7.2 Define the inverse secant, cosecant, and cotangent functions		**Understand**	**B**	
7.2 Find the value of inverse secant, cosecant, and cotangent functions		**Understand**	**B**	
7.2 Write a trigonometric expression as an algebraic expression		**Understand**	**B**	

	7.3 Solve equations involving a trigonometric function	**Applying**	**B**	
	7.3 Solve trigonometric equations in quadratic form, using a calculator, using fundamental identities, and using a graphing utility	**Applying**	**B**	
7.4 Use algebra to simplify trigonometric expressions		**Applying**	**B**	
7.4 Establish identities		**Understand**	**B**	
7.5 Use sum and difference formulas to find exact values and establish identities		**Applying**	**B**	
7.5 Use sum and difference formulas involving inverse trigonometric functions		**Applying**	**B**	
	7.5 Solve trigonometric equations linear in sine and cosine	**Applying**	**B**	
7.6 Use double-angle formulas to find exact values and establish identities		**Applying**	**B**	
7.6 Use half-angle formulas to find exact values		**Applying**	**B**	
7.7 Express products as sums and sums as products		**Understand**	**B**	

KEY COMPONENTS		
LEARNING TARGETS • **6.1 Find the length of an arc of a circle** • **6.1 Convert from degrees to radian and from radians to degrees** • **6.1 Find the area of a sector of a circle** • **6.2 Find the exact values of the trigonometric functions on the unit circle** • **6.2 Use a calculator to approximate the value of a trigonometric function**	KEY VOCABULARY • **Ray** • **Half-line** • **Vertex** • **Angle** • **Initial side** • **Terminal side** • **Positive**	

• 6.3 Determine the domain and range of the trigonometric functions • 6.3 Determine the period of the trigonometric functions • 6.3 Determine the signs of the trignometric functions in a given quadrant • 6.3 Find the values of the trigonometric functions using fundamental identities • 6.3 Use even-odd properties to find the exact values of the trigonometric functions • 6.4 Determine the amplitude and period of sinusoidal functions • 6.4 Graph variations of sinusoidal functions • 6.4 Find an equation for a sinusoidal graph • 6.5 Graph variations of y = tan x, y = cot x, y = csc x, and y = sec x • 7.1 Define the inverse sine, cosine, and tangent function • 7.1 Find the value of an inverse sine, cosine, and tangent function • 7.1 Solve equations involving inverse trigonometric functions • 7.2 Define the inverse secant, cosecant, and cotangent functions • 7.2 Find the value of inverse secant, cosecant, and cotangent functions • 7.2 Write a trigonometric expression as an algebraic expression • 7.3 Solve equations involving a trigonometric function • 7.3 Solve trigonometric equations in quadratic form, using a calculator, using fundamental identities, and using a graphing utility • 7.4 Use algebra to simplify trigonometric expressions • 7.4 Establish identities • 7.5 Use sum and difference formulas to find exact values and establish identities • 7.5 Use sum and difference formulas involving inverse trigonometric functions • 7.5 Solve trigonometric equations linear in sine and cosine • 7.6 Use double-angle formulas to find exact values and establish identities • 7.6 Use half-angle formulas to find exact values • 7.7 Express products as sums and sums as products	• Negative • Standard position • Quadrant angle • Right angle • Straight angle • Central angle • Arc length • Area of a sector • Linear speed • Angular speed • Wrapped • Trigonometric functions • Circular functions • Periodic • Period • Reciprocal identities • Quotient identities • Pythagorean identities • Fundamental identities • Cycle • Sinusoidal functions • Sinusoidal graphs • Amplitude • Reciprocal functions • Phase Shift • Inverse trigonometric functions • Trigonometric equations • Even and odd identities • Sum and difference formulas • Double-angle formulas • Half-angle formulas • Product to Sum formulas • Sum to Product formulas	
ESSENTIAL QUESTION(S) • How is graphing a phase shift trigonometric graph different from graphing a regular trigonometric graph? • What term describes the behavior of a sine and cosine function? What real world example is considered a sine function? • The graphs of cosecant and secant are created based off of what functions?	**PRIOR KNOWLEDGE** • Circumference and area of a circle • Uniform motion • Geometry essentials • Symmetry • Unit circle • Functions	

• **Which function is the most unique compared to the other trigonometric functions? Why?** • **Which formula can be used to verify identities for the sum and difference of sines and cosines?** • **What will the quotient of sin(α+β) and cos(α+β) equal to?** • **Power-reducing formulas are derived from which formulas?**	• **Identity** • **Even and odd functions** • **Transformations** • **Vertical asymptopes** • **Inverse functions** • **Linear equations** • **Quadratic equations** • **Distance formula**

FORMATIVE ASSESSMENT	SUMMATIVE ASSESSMENT

ACTIVITIES & RESOURCES	
RTI	EXTENSION OPPORTUNITIES

UNIT 8: Conics	DURATION: 2 weeks
CONTENT STANDARDS	
PRIORITY STANDARDS ● 31. Graph conic sections from second-degree equations, extending from circles and parabolas to ellipses and hyperbolas, using technology to discover patterns. ○ a. Graph conic sections given their standard form. ○ b. Identify the conic section that will be formed, given its equation in general form.	SUPPORTING STANDARDS ●

KNOWLEDGE (students need to know):	SKILLS (students need to be able to do):	BLOOM'S TAXONOMY	QUAD	ACT
1.6 Write the standard form of the equation of a circle		Understand	B	
	1.6 Graph a circle by hand and by using a graphing utility	Applying	B	
1.6 Work with the general form of the equation of a circle		Applying	B	
10.1 Know the names of the conics		Understand	B	
	10.2 Analyze parabolas at various locations on the coordinate plane	Analyze	C	
	10.2 Solve applied problems involving parabolas	Applying	B	
	10.3 Analyze ellipses at various locations on the coordinate plane	Analyze	C	
	10.3 Solve applied problems involving ellipses	Applying	B	

	10.4 Analyze hyperbolas at various locations on the coordinate plane	Analyze	C	
10.4 Find the asymptotes of a hyperbola		Understand	B	
	10.4 Solve applied problems involving hyperbolas	Applying	B	
10.5 Identify a conic and conics without rotating the axes		Understand	B	
10.5 Use a rotation of axes to transform equations		Applying	B	
	10.5 Analyze an equation using a rotation of axes	Analyze	C	
	10.6 Analyze and graph polar equations of conics	Analyze	C	
	10.6 Convert the polar equation of a conic to a rectangular equation	Applying	B	
	10.7 Graph parametric equations by hand and by using a graphing utility	Applying	B	
10.7 Find a rectangular equation for a plane curve defined parametrically and vice versa		Understand	B	

KEY COMPONENTS		
LEARNING TARGETS • 1.6 Write the standard form of the equation of a circle • 1.6 Graph a circle by hand and by using a graphing utility • 1.6 Work with the general form of the equation of a circle • 10.1 Know the names of the conics • 10.2 Analyze parabolas at various locations on the coordinate plane • 10.2 Solve applied problems involving parabolas • 10.3 Analyze ellipses at various locations on the coordinate plane • 10.3 Solve applied problems involving ellipses	KEY VOCABULARY • Circle • Radius • Center • Standard form of a circle • Unit circle • General form of the equation of a circle • Right circular cone • Axis	

• 10.4 Analyze hyperbolas at various locations on the coordinate plane • 10.4 Find the asymptotes of a hyperbola • 10.4 Solve applied problems involving hyperbolas • 10.5 Identify a conic and conics without rotating the axes • 10.5 Use a rotation of axes to transform equations • 10.5 Analyze an equation using a rotation of axes • 10.6 Analyze and graph polar equations of conics • 10.6 Convert the polar equation of a conic to a rectangular equation • 10.7 Graph parametric equations by hand and by using a graphing utility • 10.7 Find a rectangular equation for a plane curve defined parametrically and vice versa	• Vertex • Generators • Nappes • Conics • Conic sections • Circles • Ellipses • Hyperbolas • Parabolas • Degenerate conics • Focus • Directrix • Axis of symmetry • Latus rectum • Paraboloid revolution • Major axis • Minor axis • Transverse axis • Conjugate axis • Branches • Rotation of axes • Rotation formulas • Transformation angle • Eccentricity • Parameter • Parametric equations • Plane curve • Orientation • Rectangular equations • Curvilinear motion • Projectile motion • Brachistochrone • Tautochrone • Cycloid • Parametric equation of a cycloid	
ESSENTIAL QUESTION(S) • What is the standard form of a circle and what are the key features of the equation? • What is the 3 step process to convert the general form of a circle equation to the standard form of a circle equation? • What key features are needed to graph an ellipses and what	PRIOR KNOWLEDGE • Completing the square • Square root method • Distance formula • Intercepts • Symmetry	

feature is not needed to graph an ellipse but is included in the definition? ● What is a real world application that applies to ellipses? ● True or false, a hyperbola always contains branches and asymptotes and is always located at the origin. If false, give the correction. ● What is a real world application that applies to a hyperbola? ● What are the key features of a parabola and what function is it related to in algebra? ● True or false, conic sections can also consist of a point, a line, and a pair of intersecting lines that result from the intersection of a cone and a plane. If false, give the correction.	● Transformations ● Sum formulas for sine and cosine ● Half-anlge formulas for sine and cosine ● Double -angle formulas for sine and cosine ● Polar coordinates ● Amplitude and period of sinusoidal graphs

FORMATIVE ASSESSMENT	SUMMATIVE ASSESSMENT

ACTIVITIES & RESOURCES	
RTI	EXTENSION OPPORTUNITIES

UNIT 9: Logarithm and Natural Logarithm	DURATION: 2 weeks

CONTENT STANDARDS

PRIORITY STANDARDS	SUPPORTING STANDARDS
● 1. Define the constant e in a variety of contexts. Example: the total interest earned if a 100% annual rate is continuously compounded. ○ a. Explore the behavior of the function y=ex and its applications. ○ b. Explore the behavior of ln(x), the logarithmic function with base e, and its applications.	● 29. Use the inverse relationship between exponents and logarithms to solve problems involving logarithms and exponents. Extend from logarithms with base 2 and 10 to a base of e.

KNOWLEDGE (students need to know):	SKILLS (students need to be able to do):	BLOOM'S TAXONOMY	QUAD	ACT
	5.4 Evaluate logarithmic equations	Evaluate	C	
	5.4 Solve logarithmic equations	Applying	B	
5.5 Work with the properties of logarithms		Applying	B	
5.5 Write a logarithmic expression as a single logarithm		Understand	B	
	5.5 Evaluate logarithms whose base is neither 10 nor *e*	Evaluate	C	

KEY COMPONENTS

LEARNING TARGETS	KEY VOCABULARY	
● 5.4 Evaluate logarithmic equations ● 5.4 Solve logarithmic equations ● 5.5 Work with the properties of logarithms ● 5.5 Write a logarithmic expression as a single logarithm	● Logarithmic function with base *a* ● Natural logarithm function	

• 5.5 Evaluate logarithms whose base is neither 10 nor *e*	• Common logarithm function • Logarithmic equations • Properties of logarithms • Change-of-base formula	

ESSENTIAL QUESTION(S)	PRIOR KNOWLEDGE
• Using equations, show hoe logarithmic and exponential functions are inverses of each other. • What can you use to verify logarithmic properties? • Given a table for a logarithmic graph, how can the information be transformed into an exponential graph? • How are logarithm properties similar to natural logarithm properties?	• Solve linear inequalities • Polynomial and rational inequalities • Quadratic inequalities

FORMATIVE ASSESSMENT	SUMMATIVE ASSESSMENT

ACTIVITIES & RESOURCES	
RTI	EXTENSION OPPORTUNITIES

UNIT 10: Forms of Complex Numbers	DURATION: 4 weeks
CONTENT STANDARDS	

PRIORITY STANDARDS
• 3. Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number.
• 4. Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation.
• 6. Analyze possible zeros for a polynomial function over the complex numbers by applying the Fundamental Theorem of Algebra, using a graph of the function, or factoring with algebraic identities.
• 32. Solve application-based problems involving parametric and polar equations.
  ○ a. Graph parametric and polar equations.
  ○ b. Convert parametric and polar equations to rectangular form.
	SUPPORTING STANDARDS
	• 2. Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.
	• 5. Calculate the distance between numbers in the complex plane as the modulus of the difference, and the midpoint of a segment as the average of the numbers at its endpoints.

KNOWLEDGE (students need to know):	SKILLS (students need to be able to do):	BLOOM'S TAXONOMY	QUAD	ACT
	9.1 Transform equations between polar and rectangular forms	Applying	B	
	9.1 Plot points using polar coordinates	Applying	B	
9.2 Identify polar equations by converting to rectangular equations		Understand	B	
	9.2 Graph polar equations by converting to rectangular equations	Applying	B	
	9.2 Graph polar equations using a graphing utility	Applying	B	

	9.3 Plot points in the complex plane	**Applying**	**B**	
9.3 Find products and quotients of complex numbers		**Understand**	**B**	
9.3 Use De Moivre's Theorem		**Applying**	**B**	
9.3 Find complex roots				

KEY COMPONENTS

LEARNING TARGETS

- **9.1 Transform equations between polar and rectangular forms**
- **9.1 Plot points using polar coordinates**
- 9.2 Identify polar equations by converting to rectangular equations
- 9.2 Graph polar equations by converting to rectangular equations
- **9.2 Graph polar equations using a graphing utility**
- **9.3 Plot points in the complex plane**
- **9.3 Find products and quotients of complex numbers**
- **9.3 Use De Moivre's Theorem**
- **9.3 Find complex roots**

KEY VOCABULARY

- **Pole**
- **Polar axis**
- **Polar coordinates**
- **Rectangular coordinates**
- **Polar grids**
- **Polar equation**
- **Cardioids**
- **Limacons**
- **Rose**
- **Lemniscates**
- **Logarithmic spiral**
- **Complex numbers**
- **Complex plane**
- **Real axis**
- **Imaginary axis**
- **Modulus**
- **Conjugate**
- **Argument**
- **Rectangular form**
- **Polar form**
- **Euler's formula**
- **De Moivre's Theorem**

ESSENTIAL QUESTION(S)

- **In the complex standard form, a + b*i*, what does each part represent?**
- **When dividing complex numbers, what is used to remove *i* from**

PRIOR KNOWLEDGE

- **Definition of trigonometric functions**
- **Distance formula**
- **Inverse tangent function**

the denominator? • Which type of function can give us complex solutions and what formula is used to find the two solutions? • The complex plane is made up of which two axis' and which letters represent each? • What are the two forms of complex numbers and give an example of each? • Whose theorem allows us to find complex powers and roots in polar form?	• Completing the square • Angles; degree measure; radian measure • Symmetry • Circles • Even and odd properties of trigonometric functions • Difference formulas for sine and cosine • Values of the sine and cosine functions at certain angles • Laws of exponents

FORMATIVE ASSESSMENT	SUMMATIVE ASSESSMENT

ACTIVITIES & RESOURCES	
RTI	EXTENSION OPPORTUNITIES

UNIT 11: Limits	DURATION: 2 weeks
CONTENT STANDARDS	
PRIORITY STANDARDS ● 7. Determine numerically, algebraically, and graphically the limits of functions at specific values and at infinity. ○ a. Apply limits of functions at specific values and at infinity in problems involving convergence and divergence.	SUPPORTING STANDARDS ●

KNOWLEDGE (students need to know):	SKILLS (students need to be able to do):	BLOOM'S TAXONOMY	QUAD	ACT
14.1 Investigate a limit using a table and a graph		Understand	B	
14.2 Find the limit of a sum, a difference, and a product		Understand	B	
14.2 Find the limit of a polynomial		Understand	B	
14.2 Find the limit of a power or a root		Understand	B	
14.2 Find the limit of a quotient		Understand	B	
14.2 Find the limit of an average rate of change		Understand	B	
14.3 Find the one-sided limits of a function		Understand	B	
14.3 Determine whether a function is continuous at a number		Understand	B	

KEY COMPONENTS		
LEARNING TARGETS ● 14.1 Investigate a limit using a table and a graph ● 14.2 Find the limit of a sum, a difference, and a product ● 14.2 Find the limit of a polynomial ● 14.2 Find the limit of a power or a root ● 14.2 Find the limit of a quotient ● 14.2 Find the limit of an average rate of change ● 14.3 Find the one-sided limits of a function ● 14.3 Determine whether a function is continuous at a number	**KEY VOCABULARY** ● Limit notation ● Limit properties ● One-sided limit ● Right-hand limit ● Continuous ● Discontinuous	
ESSENTIAL QUESTION(S) ● Describe what defines that a limit does not exist. ● How do limits and one-sided limits compare? Explain. ● Are f(x) and the limit always equal? Explain.	**PRIOR KNOWLEDGE** ● Piecewise functions ● Rationalize a numerator ● Average rate of change ● Polynomial functions ● Properties of rational, exponential, logarithmic, and trigonometric functions	

FORMATIVE ASSESSMENT	SUMMATIVE ASSESSMENT

ACTIVITIES & RESOURCES	
RTI	**EXTENSION OPPORTUNITIES**

UNIT 12: Vectors	DURATION: 3 weeks
CONTENT STANDARDS	
PRIORITY STANDARDS ● 8. Explain that vector quantities have both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes. ● 9. Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point. ● 12. Add and subtract vectors. ○ a. Add vectors end-to-end, component-wise, and by the parallelogram rule, understanding that the magnitude of a sum of two vectors is not always the sum of the magnitudes. ○ b. Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum. ○ c. Explain vector subtraction, v – w, as v + (–w), where –w is the additive inverse of w, with the same magnitude as w and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise. ● 13. Multiply a vector by a scalar. ○ a. Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise. ○ b. Compute the magnitude of a scalar multiple cv using $\|cv\| = \|c\|v$. Compute the direction of cv knowing that when $\|c\|v \neq 0$, the direction of cv is either along v (for $c > 0$) or against v (for $c < 0$).	SUPPORTING STANDARDS ●

KNOWLEDGE (students need to know):	SKILLS (students need to be able to do):	BLOOM'S TAXONOMY	QUAD	ACT
	9.4 Graph vectors	Applying	B	

9.4 Find a position vector		**Understand**	**B**	
	9.4 Add and subtract vectors algebraically	**Applying**	**B**	
9.4 Find a scalar multiple and the magnitude of a vector		**Understand**	**B**	
9.4 Find a unit vector		**Understand**	**B**	
9.4 Find a vector from its direction and magnitude		**Understand**	**B**	
	9.4 Model with vectors	**Applying**	**B**	

KEY COMPONENTS		
LEARNING TARGETS ● 9.4 Graph vectors ● 9.4 Find a position vector ● 9.4 Add and subtract vectors algebraically ● 9.4 Find a scalar multiple and the magnitude of a vector ● 9.4 Find a unit vector ● 9.4 Find a vector from its direction and magnitude ● 9.4 Model with vectors	**KEY VOCABULARY** ● Vector ● Magnitude ● Direction ● Geometric vector ● Initial point ● Terminal point ● Zero vector ● Scalar ● Unit vector ● Components ● Velocity vector ● Force vector	
ESSENTIAL QUESTION(S) ● What components are required for a vector? How are they related to the vector? ● How are vectors used in the real world? ● Which vectors represent speed and push/pull?	**PRIOR KNOWLEDGE** ● Complex numbers ● Rectangular form ● Modulus ● Argument	

FORMATIVE ASSESSMENT	SUMMATIVE ASSESSMENT

ACTIVITIES & RESOURCES	
RTI	EXTENSION OPPORTUNITIES

UNIT 13: Applied Vectors	DURATION: 4 weeks
CONTENT STANDARDS	
PRIORITY STANDARDS • 10. Solve problems involving velocity and other quantities that can be represented by vectors. • 11. Find the scalar (dot) product of two vectors as the sum of the products of corresponding components and explain its relationship to the cosine of the angle formed by two vectors. • 14. Multiply a vector (regarded as a matrix with one column) by a matrix of suitable dimensions to produce another vector. Work with matrices as transformations of vectors. • 22. Represent a system of linear equations as a single matrix equation in a vector variable.	SUPPORTING STANDARDS • 23. Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension 3 x 3 or greater).

KNOWLEDGE (students need to know):	SKILLS (students need to be able to do):	BLOOM'S TAXONOMY	QUAD	ACT
9.5 Find the dot product of two vectors		Understand	B	
9.5 Find the angle between two vectors		Understand	B	

9.5 Determine whether two vectors are parallel, orthogonal, or neither		**Understand**	**B**	
	9.5 Decompose a vector into two orthogonal vectors	**Create**	**D**	
9.7 Find the cross product of two vectors		**Understand**	**B**	
	9.4 Model with vectors			

KEY COMPONENTS		
LEARNING TARGETS ● **9.5 Find the dot product of two vectors** ● **9.5 Find the angle between two vectors** ● **9.5 Determine whether two vectors are parallel, orthogonal, or neither** ● **9.5 Decompose a vector into two orthogonal vectors** ● **9.7 Find the cross product of two vectors**	**KEY VOCABULARY** ● **Dot product** ● **Angle between vectors** ● **Parallel orthogonal** ● **Decomposition** ● **Vector projection** ● **Cross product** ● **Vector product** ● **Determinant**	
ESSENTIAL QUESTION(S) ● **Which operations are vectors closed under?** ● **How can the dot product describe the relation between two vectors?** ● **How are vectors and matrices related? Explain.**	**PRIOR KNOWLEDGE** ● **Law of cosines**	

FORMATIVE ASSESSMENT	SUMMATIVE ASSESSMENT

ACTIVITIES & RESOURCES

RTI	EXTENSION OPPORTUNITIES