

## Calculus

State Standard Number	State Standard Area/Description	Unit Name	Course Topic Description
1	Quantitative Literacy and Logic		
L1	Based on their knowledge of the properties of arithmetic, students understand and reason about numbers, number systems, and the relationships between them. They represent quantitative relationships using mathematical symbols, and interpret relationships from those representations.		
L1.1	Number Systems and Number Sense		
L1.1.1	Know the different properties that hold in different number systems and recognize that the applicable properties change in the transition from the positive integers to all integers, to the rational numbers, and to the real numbers.	Logarithmic, Exponential, and Other Transcendental Functions	The Natural Logarithmic Function
L1.1.2	Explain why the multiplicative inverse of a number has the same sign as the number, while the additive inverse of a number has the opposite sign.		
L1.1.3	Explain how the properties of associativity, commutativity, and distributivity, as well as identity and inverse elements, are used in arithmetic and algebraic		

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	calculations.		
L1.1.4	Describe the reasons for the different effects of multiplication by, or exponentiation of, a positive number by a number less than 0, a number between 0 and 1, and a number greater than 1.		
L1.1.5	Justify numerical relationships		
L1.1.6	Explain the importance of the irrational numbers the square root of 2 and the square root of 3 in basic right triangle trigonometry, and the importance of pi because of its role in circle relationships.		
L1.2	Representations and Relationships		
L1.2.1	Use mathematical symbols to represent quantitative relationships and situations.	Throughout	Throughout
L1.2.2	Interpret representations that reflect absolute value relationships in such contexts as error tolerance.		
L1.2.3	Use vectors to represent quantities that have magnitude and direction, interpret direction and magnitude of a vector numerically, and calculate the sum and difference of two vectors.		
L1.2.4	Organize and summarize a data set in a table, plot, chart, or spreadsheet; find patterns in a display of data; understand and critique data displays in the media.		

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L1.2.5	Read and interpret representations from various technological sources, such as contour or isobar diagrams.		
L1.3	Counting and Probabilistic Reasoning		
L1.3.1	Describe, explain, and apply various counting techniques; relate combinations to Pascal's triangle; know when to use each technique.		
L1.3.2	Define and interpret commonly used expressions of probability.		
L1.3.3	Recognize and explain common probability misconceptions such as "hot streaks" and "being due."		
L2	Students calculate fluently, estimate proficiently, and describe and use algorithms in appropriate situations (e.g., approximating solutions to equations). They understand the basic ideas of iteration and algorithms.		
L2.1	Calculation Using Real and Complex Numbers		
L2.1.1	Explain the meaning and uses of weighted averages.		

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L2.1.2	Calculate fluently with numerical expressions involving exponents; use the rules of exponents; evaluate numerical expressions involving rational and negative exponents; transition easily between roots and exponents.	Logarithmic, Exponential, and Other Transcendental Functions	Inverse Functions and Exponential Functions
L2.1.3	Explain the exponential relationship between a number and its base 10 logarithm and use it to relate rules of logarithms to those of exponents in expressions involving numbers.	Logarithmic, Exponential, and Other Transcendental Functions	Inverse Functions and Exponential Functions
L2.1.4	Know that the complex number $i$ is one of two solutions to $x^2 = -1$ .		
L2.1.5	Add, subtract, and multiply complex numbers; use conjugates to simplify quotients of complex numbers.		
L2.1.7	Understand the mathematical bases for the differences among voting procedures.		
L2.2	Sequences and Iteration		
L2.2.1	Find the $n$ th term in arithmetic, geometric, or other simple sequences.		
L2.2.2	Compute sums of finite arithmetic and geometric sequences.		

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L2.2.3	Use iterative processes in such examples as computing compound interest or applying approximation procedures.	Logarithmic, Exponential, and Other Transcendental Functions	Inverse Functions and Exponential Functions
L2.2.4	Compute sums of infinite geometric sequences.		
L2.3	Measurement Units, Calculations, and Scales		
L2.3.1	Convert units of measurement within and between systems; explain how arithmetic operations on measurements affect units, and carry units through calculations correctly.		
L2.3.2	Describe and interpret logarithmic relationships in such contexts as the Richter scale, the pH scale, or decibel measurements; solve applied problems.		
L2.4	Understanding Error		
L2.4.1	Determine what degree of accuracy is reasonable for measurements in a given situation; express accuracy through use of significant digits, error tolerance, or percent of error; describe how errors in measurements are magnified by computation; recognize accumulated error in applied situations.	Applications of Differentiation	Optimization, Newton's Method, and Differentials
L2.4.2	Describe and explain round-off error, rounding, and truncating.		

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L2.4.3	Know the meaning of and interpret statistical significance, margin of error, and confidence level.		
L3	Students understand mathematical reasoning as being grounded in logic and proof and can distinguish mathematical arguments from other types of arguments. They can interpret arguments made about quantitative situations in the popular media. Students know the language and laws of logic and can apply them in both mathematical and everyday settings. They write proofs using direct and indirect methods and use counterexamples appropriately to show that statements are false.		
L3.1	Mathematical Reasoning		
L3.1.1	Distinguish between inductive and deductive reasoning, identifying and providing examples of each.		
L3.1.2	Differentiate between statistical arguments (statements verified empirically using examples or data) and logical arguments based on the rules of logic.		
L3.1.3	Define and explain the roles of axioms (postulates), definitions, theorems, counterexamples, and proofs in the logical structure of mathematics. Identify and give examples of each.		
L3.2	Language and Laws of Logic		

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L3.2.1	Know and use the terms of basic logic.	Throughout	Throughout
L3.2.2	Use the connectives "not," "and," "or," and "if..., then," in mathematical and everyday settings. Know the truth table of each connective and how to logically negate statements involving these connectives.		
L3.2.3	Use the quantifiers "there exists" and "all" in mathematical and everyday settings and know how to logically negate statements involving them.		
L3.2.4	Write the converse, inverse, and contrapositive of an "if..., then..." statement. Use the fact, in mathematical and everyday settings, that the contrapositive is logically equivalent to the original, while the inverse and converse are not.		
L3.3	Proof		
L3.3.1	Know the basic structure for the proof of an "if..., then..." statement (assuming the hypothesis and ending with the conclusion) and that proving the contrapositive is equivalent.		
L3.3.2	Construct proofs by contradiction. Use counterexamples, when appropriate, to disprove a statement.		
L3.3.3	Explain the difference between a necessary and a sufficient condition within the statement of a theorem. Determine the correct conclusions based on interpreting a theorem in which necessary or		



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	sufficient conditions in the theorem or hypothesis are satisfied.		
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