ETS PPAT

Measuring the Power of Learning.®

PPAT® Assessment

Alignment with *Praxis*® Test Specifications for Mathematics: Content Knowledge

ETS® Professional Educator PROGRAMS

PPAT® Assessment Alignment with *Praxis®* Test Specifications for Mathematics: Content Knowledge

PPAT® assessment Tasks 2 through 4 all require candidates to provide evidence of content knowledge, both in their teaching practices as well as in the assessment of student learning.

While all of the prompts for each task do not prescribe the specific content that must be included, they do draw upon a broad spectrum of content knowledge relevant to an individual candidate's particular area. Candidate responses, which include content, are scored by trained raters who have expertise in the same content area.

Given that PPAT assessment tasks are limited to the content teacher candidates are allowed or instructed to deliver in their assigned clinical experience classrooms, the PPAT assessment does not cover the full breadth and depth of a content discipline. However, successful completion of the PPAT assessment does require that candidates demonstrate the ability to accurately and effectively teach the content that they choose or are given, and also requires raters to evaluate whether the instructional delivery of the content is accurate and effective.

The PPAT assessment emphasizes that the appropriateness and relevance of content selected by candidates in the completion of the assessment in the area of Mathematics may include, but is not limited to, the following categories.

PPAT® Assessment Task 1: Knowledge of Students and the Learning Environment

Task 1 Steps	*Praxis*® Test Specifications
Step 1 **Knowledge of Students** Candidates' ability to familiarize themselves with their students and the characteristics and circumstances of the environment in which they learn	**I. Number and Quantity, Algebra, Functions, and Calculus** **A. Number and Quantity** 1. Understand the properties of exponents: use the properties of exponents to rewrite expressions that have radicals or rational exponents 3. Understand how to solve problems by reasoning quantitatively (e.g., dimensional analysis, reasonableness of solutions): use units as a way to understand problems and to guide the solution of multistep problems 6. Understand how to perform operations on matrices and how to use matrices in applications 7. Understand how to solve problems involving ratios, proportions, averages, percents, and metric and traditional unit conversions **B. Algebra** 4. Understand how to use polynomial identities (e.g., difference of squares, sum and difference of cubes) to solve problems 7. Understand how to justify the reasoning process used to solve equations, including analysis of potential extraneous solutions **D. Calculus** 8. Understand how to apply derivatives to solve problems (e.g., related rates, optimization) 11. Understand how to use integration to compute area, volume, distance, or other accumulation processes **II. Geometry, Probability and Statistics, and Discrete Mathematics** **A. Geometry** 10. Understand how to use coordinate geometry to algebraically prove simple geometric theorems **B. Probability and Statistics** 9. Understand how to use simulations to construct experimental probability distributions and to make informal inferences about theoretical probability distributions
Step 2 **Resources and Procedures** Candidates' ability to identify available instructional resources, student interests, rules and procedures, and a method of communication with students and families	**II. Geometry, Probability and Statistics, and Discrete Mathematics** **A. Geometry** 13. Know how to apply geometric concepts in real-world situations **B. Probability and Statistics** 1. Understand how to summarize, represent, and interpret data collected from measurements on a single variable (e.g., box plots, dot plots, normal distributions) 5. Understand how to make inferences and justify conclusions from samples, experiments, and observational studies

PPAT® Assessment Task 2: Assessment and Data Collection to Measure and Inform Student Learning

Task 2 Steps	*Praxis*® Test Specifications
Step 1 **Planning the Assessment** Candidates' ability to plan an assessment that uses appropriate assessment tools to meet student needs and the learning goal(s)	**I. Number and Quantity, Algebra, Functions, and Calculus** **A. Number and Quantity** 1. Understand the properties of exponents 2. Understand the properties of rational and irrational numbers, and the interactions between those sets of numbers 3. Understand how to solve problems by reasoning quantitatively (e.g., dimensional analysis, reasonableness of solutions) 4. Understand the structure of the natural, integer, rational, real, and complex number systems and how the basic operations (+, –, x, and ÷) on numbers in these systems are performed 5. Understand how to work with complex numbers when solving polynomial equations and rewriting polynomial expressions 6. Understand how to perform operations on matrices and how to use matrices in applications 7. Understand how to solve problems involving ratios, proportions, averages, percents, and metric and traditional unit conversions 8. Know how to analyze both precision and accuracy in measurement situations 9. Understand various ways to represent and compare very large and very small numbers (e.g., scientific notation, orders of magnitude) 10. Understand how to both estimate and perform calculations on very large and very small quantities **B. Algebra** 1. Understand how to write algebraic expressions in equivalent forms 2. Understand how to perform arithmetic operations on polynomials 3. Understand the relationship between zeros of polynomial functions (including their graphical representation) and factors of the related polynomial expressions 4. Understand how to use polynomial identities (e.g., difference of squares, sum and difference of cubes) to solve problems 5. Understand how to rewrite rational expressions and perform arithmetic operations on rational expressions 6. Understand how to create equations and inequalities that describe relationships 7. Understand how to justify the reasoning process used to solve equations, including analysis of potential extraneous solutions 8. Understand how varied techniques (e.g., graphical, algebraic) are used to solve equations and inequalities in one variable 9. Understand how varied techniques (e.g., graphical, algebraic, matrix) are used to solve systems of equations and inequalities 10. Understand the properties of number systems under various operations

Task 2 Steps	*Praxis*® Test Specifications
	11. Understand the concept of rate of change of nonlinear functions 12. Understand the concepts of intercept(s) of a line and slope as a rate of change 13. Understand how to find the zero(s) of functions **C. Functions** 1. Understand the function concept and the use of function notation 2. Understand how to find the domain and range of a function and a relation 3. Understand how function behavior is analyzed using different representations (e.g., graphs, mappings, tables) 4. Understand how functions and relations are used to model relationships between quantities 5. Understand how new functions are obtained from existing functions (e.g., compositions, transformations, inverses) 6. Understand differences between linear, quadratic, and exponential models, including how their equations are created and used to solve problems 7. Understand how to construct the unit circle and how to use it to find values of trigonometric functions for all angle measures in their domains 8. Understand how periodic phenomena are modeled using trigonometric functions 9. Understand the application of trigonometric identities (e.g., Pythagorean, double angle, half angle, sum of angles, difference of angles) 10. Know how to interpret representations of functions of two variables (e.g., three-dimensional graphs, tables) 11. Understand how to solve equations (e.g., trigonometric, logarithmic, exponential) **D. Calculus** 1. Understand the meaning of a limit of a function and how to calculate limits of functions, determine when the limit does not exist, and solve problems using the properties of limits 2. Understand the derivative of a function as a limit, as the slope of a line tangent to a curve, and as a rate of change 3. Understand how to show that a particular function is continuous 4. Know the relationship between continuity and differentiability 5. Understand how to approximate derivatives and integrals numerically 6. Understand how and when to use standard differentiation and integration techniques 7. Understand how to analyze the behavior of a function (e.g., extrema, concavity, symmetry) 8. Understand how to apply derivatives to solve problems (e.g., related rates, optimization) 9. Understand the foundational theorems of calculus (e.g., fundamental theorems of calculus, mean value theorem, intermediate value theorem) 10. Understand integration as a limit of Riemann sums

Task 2 Steps	*Praxis*® Test Specifications
	11. Understand how to use integration to compute area, volume, distance, or other accumulation processes 12. Know how to determine the limits of sequences, if they exist 13. Is familiar with simple infinite series **II. Geometry, Probability and Statistics, and Discrete Mathematics** **A. Geometry** 1. Understand transformations in a plane 2. Understand how to prove geometric theorems, such as those about lines and angles, triangles, and parallelograms 3. Understand how geometric constructions are made with a variety of tools and methods 4. Understand congruence and similarity in terms of transformations 5. Understand how trigonometric ratios are defined in right triangles 6. Understand how trigonometry is applied to general triangles 7. Understand and apply theorems about circles 8. Understand arc length and area measurements of sectors of circles 9. Know how to translate between a geometric description (e.g., focus, asymptotes, directrix) and an equation for a conic section 10. Understand how to use coordinate geometry to algebraically prove simple geometric theorems 11. Understand how perimeter, area, surface area, and volume formulas are used to solve problems 12.Know how to visualize relationships (e.g., cross section, nets, rotations) between two-dimensional and three-dimensional objects 13. Know how to apply geometric concepts in real-world situations 14. Understand the properties of parallel and perpendicular lines, triangles, quadrilaterals, polygons, and circles and how they can be used in problem solving **B. Probability and Statistics** 1. Understand how to summarize, represent, and interpret data collected from measurements on a single variable (e.g., box plots, dot plots, normal distributions) 2. Understand how to summarize, represent, and interpret data collected from measurements on two variables, either categorical or quantitative (e.g., scatterplots, time series) 3. Understand how to create and interpret linear regression models (e.g., rate of change, intercepts, correlation coefficient) 4. Understand statistical processes and how to evaluate them 5. Understand how to make inferences and justify conclusions from samples, experiments, and observational studies 6. Understand the concepts of independence and conditional probability and how to apply these concepts to data 7. Understand how to compute probabilities of simple events, probabilities of compound events, and conditional probabilities 8. Know how to make informed decisions using probabilities and expected values

Task 2 Steps	*Praxis*® Test Specifications
	9. Understand how to use simulations to construct experimental probability distributions and to make informal inferences about theoretical probability distributions 10. Understand how to find probabilities involving finite sample spaces and independent trials **C. Discrete Mathematics** 1. Understand sequences (e.g., arithmetic, recursively defined, geometric) 2. Is familiar with how recursion can be used to model various phenomena 3. Has knowledge of equivalence relations 4. Understand the differences between discrete and continuous representations (e.g., data, functions) and how each ca can be used to model various phenomena 5. Understand basic terminology and symbols of logic 6. Understand how to use counting techniques such as the multiplication principle, permutations, and combinations 7. Understand basic set theory (e.g., unions, differences, Venn diagrams)
Step 2 **Administering the Assessment and Analyzing the Data** Candidates' ability to administer their assessment and to collect, record, and analyze the data	**II. Geometry, Probability and Statistics, and Discrete Mathematics** **B. Probability and Statistics** 1. Understand how to summarize, represent, and interpret data collected from measurements on a single variable (e.g., box plots, dot plots, normal distributions) 5. Understand how to make inferences and justify conclusions from samples, experiments, and observational studies
Step 3 **Reflecting** Candidates' ability to reflect on their assessment by providing evidence of student learning that resulted from the administered assessment plan Candidates' ability to reflect on the data-based decisions that occurred through data analysis	**II. Geometry, Probability and Statistics, and Discrete Mathematics** **B. Probability and Statistics** 1. Understand how to summarize, represent, and interpret data collected from measurements on a single variable (e.g., box plots, dot plots, normal distributions) 5. Understand how to make inferences and justify conclusions from samples, experiments, and observational studies

PPAT® Assessment Task 3: Designing Instruction for Student Learning

Task 3 Steps	*Praxis*® Test Specifications
Step 1 **Planning the Lesson** Candidates' ability to plan an effective lesson that facilitates student learning	**I. Number and Quantity, Algebra, Functions, and Calculus** **A. Number and Quantity** 1. Understand the properties of exponents 2. Understand the properties of rational and irrational numbers, and the interactions between those sets of numbers 3. Understand how to solve problems by reasoning quantitatively (e.g., dimensional analysis, reasonableness of solutions) 4. Understand the structure of the natural, integer, rational, real, and complex number systems and how the basic operations (+, –, x, and ÷) on numbers in these systems are performed 5. Understand how to work with complex numbers when solving polynomial equations and rewriting polynomial expressions 6. Understand how to perform operations on matrices and how to use matrices in applications 7. Understand how to solve problems involving ratios, proportions, averages, percents, and metric and traditional unit conversions 8. Know how to analyze both precision and accuracy in measurement situations 9. Understand various ways to represent and compare very large and very small numbers (e.g., scientific notation, orders of magnitude) 10. Understand how to both estimate and perform calculations on very large and very small quantities **B. Algebra** 1. Understand how to write algebraic expressions in equivalent forms 2. Understand how to perform arithmetic operations on polynomials 3. Understand the relationship between zeros of polynomial functions (including their graphical representation) and factors of the related polynomial expressions 4. Understand how to use polynomial identities (e.g., difference of squares, sum and difference of cubes) to solve problems 5. Understand how to rewrite rational expressions and perform arithmetic operations on rational expressions 6. Understand how to create equations and inequalities that describe relationships 7. Understand how to justify the reasoning process used to solve equations, including analysis of potential extraneous solutions 8. Understand how varied techniques (e.g., graphical, algebraic) are used to solve equations and inequalities in one variable 9. Understand how varied techniques (e.g., graphical, algebraic, matrix) are used to solve systems of equations and inequalities 10. Understand the properties of number systems under various operations 11. Understand the concept of rate of change of nonlinear functions

Task 3 Steps	*Praxis*® Test Specifications
	12. Understand the concepts of intercept(s) of a line and slope as a rate of change 13. Understand how to find the zero(s) of functions **C. Functions** 1. Understand the function concept and the use of function notation 2. Understand how to find the domain and range of a function and a relation 3. Understand how function behavior is analyzed using different representations (e.g., graphs, mappings, tables) 4. Understand how functions and relations are used to model relationships between quantities 5. Understand how new functions are obtained from existing functions (e.g., compositions, transformations, inverses) 6. Understand differences between linear, quadratic, and exponential models, including how their equations are created and used to solve problems 7. Understand how to construct the unit circle and how to use it to find values of trigonometric functions for all angle measures in their domains 8. Understand how periodic phenomena are modeled using trigonometric functions 9. Understand the application of trigonometric identities (e.g., Pythagorean, double angle, half angle, sum of angles, difference of angles) 10. Know how to interpret representations of functions of two variables (e.g., three-dimensional graphs, tables) 11. Understand how to solve equations (e.g., trigonometric, logarithmic, exponential) **D. Calculus** 1. Understand the meaning of a limit of a function and how to calculate limits of functions, determine when the limit does not exist, and solve problems using the properties of limits 2. Understand the derivative of a function as a limit, as the slope of a line tangent to a curve, and as a rate of change 3. Understand how to show that a particular function is continuous 4. Know the relationship between continuity and differentiability 5. Understand how to approximate derivatives and integrals numerically 6. Understand how and when to use standard differentiation and integration techniques 7. Understand how to analyze the behavior of a function (e.g., extrema, concavity, symmetry) 8. Understand how to apply derivatives to solve problems (e.g., related rates, optimization) 9. Understand the foundational theorems of calculus (e.g., fundamental theorems of calculus, mean value theorem, intermediate value theorem) 10. Understand integration as a limit of Riemann sums 11. Understand how to use integration to compute area, volume, distance, or other accumulation processes

Task 3 Steps	*Praxis*® Test Specifications
	12. Know how to determine the limits of sequences, if they exist 13. Is familiar with simple infinite series **II. Geometry, Probability and Statistics, and Discrete Mathematics** **A. Geometry** 1. Understand transformations in a plane 2. Understand how to prove geometric theorems, such as those about lines and angles, triangles, and parallelograms 3. Understand how geometric constructions are made with a variety of tools and methods 4. Understand congruence and similarity in terms of transformations 5. Understand how trigonometric ratios are defined in right triangles 6. Understand how trigonometry is applied to general triangles 7. Understand and apply theorems about circles 8. Understand arc length and area measurements of sectors of circles 9. Know how to translate between a geometric description (e.g., focus, asymptotes, directrix) and an equation for a conic section 10. Understand how to use coordinate geometry to algebraically prove simple geometric theorems 11. Understand how perimeter, area, surface area, and volume formulas are used to solve problems 12.Know how to visualize relationships (e.g., cross section, nets, rotations) between two-dimensional and three-dimensional objects 13. Know how to apply geometric concepts in real-world situations 14. Understand the properties of parallel and perpendicular lines, triangles, quadrilaterals, polygons, and circles and how they can be used in problem solving **B. Probability and Statistics** 1. Understand how to summarize, represent, and interpret data collected from measurements on a single variable (e.g., box plots, dot plots, normal distributions) 2. Understand how to summarize, represent, and interpret data collected from measurements on two variables, either categorical or quantitative (e.g., scatterplots, time series) 3. Understand how to create and interpret linear regression models (e.g., rate of change, intercepts, correlation coefficient) 4. Understand statistical processes and how to evaluate them 5. Understand how to make inferences and justify conclusions from samples, experiments, and observational studies 6. Understand the concepts of independence and conditional probability and how to apply these concepts to data 7. Understand how to compute probabilities of simple events, probabilities of compound events, and conditional probabilities 8. Know how to make informed decisions using probabilities and expected values

Task 3 Steps	*Praxis*® Test Specifications
	9. Understand how to use simulations to construct experimental probability distributions and to make informal inferences about theoretical probability distributions 10. Understand how to find probabilities involving finite sample spaces and independent trials **C. Discrete Mathematics** 1. Understand sequences (e.g., arithmetic, recursively defined, geometric) 2. Is familiar with how recursion can be used to model various phenomena 3. Has knowledge of equivalence relations 4. Understand the differences between discrete and continuous representations (e.g., data, functions) and how each can be used to model various phenomena 5. Understand basic terminology and symbols of logic 6. Understand how to use counting techniques such as the multiplication principle, permutations, and combinations 7. Understand basic set theory (e.g., unions, differences, Venn diagrams)
Step 2 **The Focus Students** Candidates' ability to differentiate instruction for individual students	**II. Geometry, Probability and Statistics, and Discrete Mathematics** **B. Probability and Statistics** 1. Understand how to summarize, represent, and interpret data collected from measurements on a single variable (e.g., box plots, dot plots, normal distributions) 5. Understand how to make inferences and justify conclusions from samples, experiments, and observational studies
Step 3 **Analyzing the Instruction** Candidates' ability to analyze their lesson plan and evidence of student learning	**I. Number and Quantity, Algebra, Functions, and Calculus** **A. Number and Quantity** 1. Understand the properties of exponents 2. Understand the properties of rational and irrational numbers, and the interactions between those sets of numbers 3. Understand how to solve problems by reasoning quantitatively (e.g., dimensional analysis, reasonableness of solutions) 4. Understand the structure of the natural, integer, rational, real, and complex number systems and how the basic operations (+, –, x, and ÷) on numbers in these systems are performed 5. Understand how to work with complex numbers when solving polynomial equations and rewriting polynomial expressions 6. Understand how to perform operations on matrices and how to use matrices in applications 7. Understand how to solve problems involving ratios, proportions, averages, percents, and metric and traditional unit conversions 8. Know how to analyze both precision and accuracy in measurement situations 9. Understand various ways to represent and compare very large and very small numbers (e.g., scientific notation, orders of magnitude) 10. Understand how to both estimate and perform calculations on very large and very small quantities **B. Algebra**

Task 3 Steps	*Praxis*® Test Specifications
	1. Understand how to write algebraic expressions in equivalent forms 2. Understand how to perform arithmetic operations on polynomials 3. Understand the relationship between zeros of polynomial functions (including their graphical representation) and factors of the related polynomial expressions 4. Understand how to use polynomial identities (e.g., difference of squares, sum and difference of cubes) to solve problems 5. Understand how to rewrite rational expressions and perform arithmetic operations on rational expressions 6. Understand how to create equations and inequalities that describe relationships 7. Understand how to justify the reasoning process used to solve equations, including analysis of potential extraneous solutions 8. Understand how varied techniques (e.g., graphical, algebraic) are used to solve equations and inequalities in one variable 9. Understand how varied techniques (e.g., graphical, algebraic, matrix) are used to solve systems of equations and inequalities 10. Understand the properties of number systems under various operations 11. Understand the concept of rate of change of nonlinear functions 12. Understand the concepts of intercept(s) of a line and slope as a rate of change 13. Understand how to find the zero(s) of functions **C. Functions** 1. Understand the function concept and the use of function notation 2. Understand how to find the domain and range of a function and a relation 3. Understand how function behavior is analyzed using different representations (e.g., graphs, mappings, tables) 4. Understand how functions and relations are used to model relationships between quantities 5. Understand how new functions are obtained from existing functions (e.g., compositions, transformations, inverses) 6. Understand differences between linear, quadratic, and exponential models, including how their equations are created and used to solve problems 7. Understand how to construct the unit circle and how to use it to find values of trigonometric functions for all angle measures in their domains 8. Understand how periodic phenomena are modeled using trigonometric functions 9. Understand the application of trigonometric identities (e.g., Pythagorean, double angle, half angle, sum of angles, difference of angles) 10. Know how to interpret representations of functions of two variables (e.g., three-dimensional graphs, tables) 11. Understand how to solve equations (e.g., trigonometric, logarithmic, exponential)

Task 3 Steps	*Praxis*® Test Specifications
	D. Calculus 1. Understand the meaning of a limit of a function and how to calculate limits of functions, determine when the limit does not exist, and solve problems using the properties of limits 2. Understand the derivative of a function as a limit, as the slope of a line tangent to a curve, and as a rate of change 3. Understand how to show that a particular function is continuous 4. Know the relationship between continuity and differentiability 5. Understand how to approximate derivatives and integrals numerically 6. Understand how and when to use standard differentiation and integration techniques 7. Understand how to analyze the behavior of a function (e.g., extrema, concavity, symmetry) 8. Understand how to apply derivatives to solve problems (e.g., related rates, optimization) 9. Understand the foundational theorems of calculus (e.g., fundamental theorems of calculus, mean value theorem, intermediate value theorem) 10. Understand integration as a limit of Riemann sums 11. Understand how to use integration to compute area, volume, distance, or other accumulation processes 12. Know how to determine the limits of sequences, if they exist 13. Is familiar with simple infinite series **II. Geometry, Probability and Statistics, and Discrete Mathematics** **A. Geometry** 1. Understand transformations in a plane 2. Understand how to prove geometric theorems, such as those about lines and angles, triangles, and parallelograms 3. Understand how geometric constructions are made with a variety of tools and methods 4. Understand congruence and similarity in terms of transformations 5. Understand how trigonometric ratios are defined in right triangles 6. Understand how trigonometry is applied to general triangles 7. Understand and apply theorems about circles 8. Understand arc length and area measurements of sectors of circles 9. Know how to translate between a geometric description (e.g., focus, asymptotes, directrix) and an equation for a conic section 10. Understand how to use coordinate geometry to algebraically prove simple geometric theorems 11. Understand how perimeter, area, surface area, and volume formulas are used to solve problems 12.Know how to visualize relationships (e.g., cross section, nets, rotations) between two-dimensional and three-dimensional objects 13. Know how to apply geometric concepts in real-world situations

Task 3 Steps	*Praxis*® Test Specifications
	14. Understand the properties of parallel and perpendicular lines, triangles, quadrilaterals, polygons, and circles and how they can be used in problem solving **B. Probability and Statistics** 1. Understand how to summarize, represent, and interpret data collected from measurements on a single variable (e.g., box plots, dot plots, normal distributions) 2. Understand how to summarize, represent, and interpret data collected from measurements on two variables, either categorical or quantitative (e.g., scatterplots, time series) 3. Understand how to create and interpret linear regression models (e.g., rate of change, intercepts, correlation coefficient) 4. Understand statistical processes and how to evaluate them 5. Understand how to make inferences and justify conclusions from samples, experiments, and observational studies 6. Understand the concepts of independence and conditional probability and how to apply these concepts to data 7. Understand how to compute probabilities of simple events, probabilities of compound events, and conditional probabilities 8. Know how to make informed decisions using probabilities and expected values 9. Understand how to use simulations to construct experimental probability distributions and to make informal inferences about theoretical probability distributions 10. Understand how to find probabilities involving finite sample spaces and independent trials **C. Discrete Mathematics** 1. Understand sequences (e.g., arithmetic, recursively defined, geometric) 2. Is familiar with how recursion can be used to model various phenomena 3. Has knowledge of equivalence relations 4. Understand the differences between discrete and continuous representations (e.g., data, functions) and how each can be used to model various phenomena 5. Understand basic terminology and symbols of logic 6. Understand how to use counting techniques such as the multiplication principle, permutations, and combinations 7. Understand basic set theory (e.g., unions, differences, Venn diagrams)
Step 4 **Reflecting** Candidates' ability to reflect on the strengths of their lesson plan as well as on the components of the lesson that are in need of improvement	**Geometry, Probability and Statistics, and Discrete Mathematics** **B. Probability and Statistics** 1. Understand how to summarize, represent, and interpret data collected from measurements on a single variable (e.g., box plots, dot plots, normal distributions) 5. Understand how to make inferences and justify conclusions from samples, experiments, and observational studies

PPAT® Assessment Task 4: Implementing and Analyzing Instruction to Promote Student Learning

Task 4 Steps	*Praxis*® Test Specifications
Step 1 **Planning** Candidates' ability to plan an effective lesson that facilitates student learning	**I. Number and Quantity, Algebra, Functions, and Calculus** **A. Number and Quantity** 1. Understand the properties of exponents 2. Understand the properties of rational and irrational numbers, and the interactions between those sets of numbers 3. Understand how to solve problems by reasoning quantitatively (e.g., dimensional analysis, reasonableness of solutions) 4. Understand the structure of the natural, integer, rational, real, and complex number systems and how the basic operations (+, –, x, and ÷) on numbers in these systems are performed 5. Understand how to work with complex numbers when solving polynomial equations and rewriting polynomial expressions 6. Understand how to perform operations on matrices and how to use matrices in applications 7. Understand how to solve problems involving ratios, proportions, averages, percents, and metric and traditional unit conversions 8. Know how to analyze both precision and accuracy in measurement situations 9. Understand various ways to represent and compare very large and very small numbers (e.g., scientific notation, orders of magnitude) 10. Understand how to both estimate and perform calculations on very large and very small quantities **B. Algebra** 1. Understand how to write algebraic expressions in equivalent forms 2. Understand how to perform arithmetic operations on polynomials 3. Understand the relationship between zeros of polynomial functions (including their graphical representation) and factors of the related polynomial expressions 4. Understand how to use polynomial identities (e.g., difference of squares, sum and difference of cubes) to solve problems 5. Understand how to rewrite rational expressions and perform arithmetic operations on rational expressions 6. Understand how to create equations and inequalities that describe relationships 7. Understand how to justify the reasoning process used to solve equations, including analysis of potential extraneous solutions 8. Understand how varied techniques (e.g., graphical, algebraic) are used to solve equations and inequalities in one variable 9. Understand how varied techniques (e.g., graphical, algebraic, matrix) are used to solve systems of equations and inequalities 10. Understand the properties of number systems under various operations

Task 4 Steps	*Praxis*® Test Specifications
	11. Understand the concept of rate of change of nonlinear functions 12. Understand the concepts of intercept(s) of a line and slope as a rate of change 13. Understand how to find the zero(s) of functions **C. Functions** 1. Understand the function concept and the use of function notation 2. Understand how to find the domain and range of a function and a relation 3. Understand how function behavior is analyzed using different representations (e.g., graphs, mappings, tables) 4. Understand how functions and relations are used to model relationships between quantities 5. Understand how new functions are obtained from existing functions (e.g., compositions, transformations, inverses) 6. Understand differences between linear, quadratic, and exponential models, including how their equations are created and used to solve problems 7. Understand how to construct the unit circle and how to use it to find values of trigonometric functions for all angle measures in their domains 8. Understand how periodic phenomena are modeled using trigonometric functions 9. Understand the application of trigonometric identities (e.g., Pythagorean, double angle, half angle, sum of angles, difference of angles) 10. Know how to interpret representations of functions of two variables (e.g., three-dimensional graphs, tables) 11. Understand how to solve equations (e.g., trigonometric, logarithmic, exponential) **D. Calculus** 1. Understand the meaning of a limit of a function and how to calculate limits of functions, determine when the limit does not exist, and solve problems using the properties of limits 2. Understand the derivative of a function as a limit, as the slope of a line tangent to a curve, and as a rate of change 3. Understand how to show that a particular function is continuous 4. Know the relationship between continuity and differentiability 5. Understand how to approximate derivatives and integrals numerically 6. Understand how and when to use standard differentiation and integration techniques 7. Understand how to analyze the behavior of a function (e.g., extrema, concavity, symmetry) 8. Understand how to apply derivatives to solve problems (e.g., related rates, optimization) 9. Understand the foundational theorems of calculus (e.g., fundamental theorems of calculus, mean value theorem, intermediate value theorem) 10. Understand integration as a limit of Riemann sums

Task 4 Steps	*Praxis*® Test Specifications
	11. Understand how to use integration to compute area, volume, distance, or other accumulation processes 12. Know how to determine the limits of sequences, if they exist 13. Is familiar with simple infinite series **II. Geometry, Probability and Statistics, and Discrete Mathematics** **A. Geometry** 1. Understand transformations in a plane 2. Understand how to prove geometric theorems, such as those about lines and angles, triangles, and parallelograms 3. Understand how geometric constructions are made with a variety of tools and methods 4. Understand congruence and similarity in terms of transformations 5. Understand how trigonometric ratios are defined in right triangles 6. Understand how trigonometry is applied to general triangles 7. Understand and apply theorems about circles 8. Understand arc length and area measurements of sectors of circles 9. Know how to translate between a geometric description (e.g., focus, asymptotes, directrix) and an equation for a conic section 10. Understand how to use coordinate geometry to algebraically prove simple geometric theorems 11. Understand how perimeter, area, surface area, and volume formulas are used to solve problems 12.Know how to visualize relationships (e.g., cross section, nets, rotations) between two-dimensional and three-dimensional objects 13. Know how to apply geometric concepts in real-world situations 14. Understand the properties of parallel and perpendicular lines, triangles, quadrilaterals, polygons, and circles and how they can be used in problem solving **B. Probability and Statistics** 1. Understand how to summarize, represent, and interpret data collected from measurements on a single variable (e.g., box plots, dot plots, normal distributions) 2. Understand how to summarize, represent, and interpret data collected from measurements on two variables, either categorical or quantitative (e.g., scatterplots, time series) 3. Understand how to create and interpret linear regression models (e.g., rate of change, intercepts, correlation coefficient) 4. Understand statistical processes and how to evaluate them 5. Understand how to make inferences and justify conclusions from samples, experiments, and observational studies 6. Understand the concepts of independence and conditional probability and how to apply these concepts to data 7. Understand how to compute probabilities of simple events, probabilities of compound events, and conditional probabilities 8. Know how to make informed decisions using probabilities and expected values

Task 4 Steps	*Praxis*® Test Specifications
	9. Understand how to use simulations to construct experimental probability distributions and to make informal inferences about theoretical probability distributions 10. Understand how to find probabilities involving finite sample spaces and independent trials **C. Discrete Mathematics** 1. Understand sequences (e.g., arithmetic, recursively defined, geometric) 2. Is familiar with how recursion can be used to model various phenomena 3. Has knowledge of equivalence relations 4. Understand the differences between discrete and continuous representations (e.g., data, functions) and how each can be used to model various phenomena 5. Understand basic terminology and symbols of logic 6. Understand how to use counting techniques such as the multiplication principle, permutations, and combinations 7. Understand basic set theory (e.g., unions, differences, Venn diagrams)
Step 2 **Implementing the Plan** Candidates' ability to implement the lesson plan, interact with their students, and analyze their practice	**I. Number and Quantity, Algebra, Functions, and Calculus** **A. Number and Quantity** 1. Understand the properties of exponents 2. Understand the properties of rational and irrational numbers, and the interactions between those sets of numbers 3. Understand how to solve problems by reasoning quantitatively (e.g., dimensional analysis, reasonableness of solutions) 4. Understand the structure of the natural, integer, rational, real, and complex number systems and how the basic operations (+, –, x, and ÷) on numbers in these systems are performed 5. Understand how to work with complex numbers when solving polynomial equations and rewriting polynomial expressions 6. Understand how to perform operations on matrices and how to use matrices in applications 7. Understand how to solve problems involving ratios, proportions, averages, percents, and metric and traditional unit conversions 8. Know how to analyze both precision and accuracy in measurement situations 9. Understand various ways to represent and compare very large and very small numbers (e.g., scientific notation, orders of magnitude) 10. Understand how to both estimate and perform calculations on very large and very small quantities **B. Algebra** 1. Understand how to write algebraic expressions in equivalent forms 2. Understand how to perform arithmetic operations on polynomials 3. Understand the relationship between zeros of polynomial functions (including their graphical representation) and factors of the related polynomial expressions 4. Understand how to use polynomial identities (e.g., difference of squares, sum and difference of cubes) to solve problems

Task 4 Steps	*Praxis*® Test Specifications
	5. Understand how to rewrite rational expressions and perform arithmetic operations on rational expressions 6. Understand how to create equations and inequalities that describe relationships 7. Understand how to justify the reasoning process used to solve equations, including analysis of potential extraneous solutions 8. Understand how varied techniques (e.g., graphical, algebraic) are used to solve equations and inequalities in one variable 9. Understand how varied techniques (e.g., graphical, algebraic, matrix) are used to solve systems of equations and inequalities 10. Understand the properties of number systems under various operations 11. Understand the concept of rate of change of nonlinear functions 12. Understand the concepts of intercept(s) of a line and slope as a rate of change 13. Understand how to find the zero(s) of functions **C. Functions** 1. Understand the function concept and the use of function notation 2. Understand how to find the domain and range of a function and a relation 3. Understand how function behavior is analyzed using different representations (e.g., graphs, mappings, tables) 4. Understand how functions and relations are used to model relationships between quantities 5. Understand how new functions are obtained from existing functions (e.g., compositions, transformations, inverses) 6. Understand differences between linear, quadratic, and exponential models, including how their equations are created and used to solve problems 7. Understand how to construct the unit circle and how to use it to find values of trigonometric functions for all angle measures in their domains 8. Understand how periodic phenomena are modeled using trigonometric functions 9. Understand the application of trigonometric identities (e.g., Pythagorean, double angle, half angle, sum of angles, difference of angles) 10. Know how to interpret representations of functions of two variables (e.g., three- dimensional graphs, tables) 11. Understand how to solve equations (e.g., trigonometric, logarithmic, exponential) **D. Calculus** 1. Understand the meaning of a limit of a function and how to calculate limits of functions, determine when the limit does not exist, and solve problems using the properties of limits 2. Understand the derivative of a function as a limit, as the slope of a line tangent to a curve, and as a rate of change 3. Understand how to show that a particular function is continuous

Task 4 Steps	*Praxis*® Test Specifications
	4. Know the relationship between continuity and differentiability 5. Understand how to approximate derivatives and integrals numerically 6. Understand how and when to use standard differentiation and integration techniques 7. Understand how to analyze the behavior of a function (e.g., extrema, concavity, symmetry) 8. Understand how to apply derivatives to solve problems (e.g., related rates, optimization) 9. Understand the foundational theorems of calculus (e.g., fundamental theorems of calculus, mean value theorem, intermediate value theorem) 10. Understand integration as a limit of Riemann sums 11. Understand how to use integration to compute area, volume, distance, or other accumulation processes 12. Know how to determine the limits of sequences, if they exist 13. Is familiar with simple infinite series **II. Geometry, Probability and Statistics, and Discrete Mathematics** **A. Geometry** 1. Understand transformations in a plane 2. Understand how to prove geometric theorems, such as those about lines and angles, triangles, and parallelograms 3. Understand how geometric constructions are made with a variety of tools and methods 4. Understand congruence and similarity in terms of transformations 5. Understand how trigonometric ratios are defined in right triangles 6. Understand how trigonometry is applied to general triangles 7. Understand and apply theorems about circles 8. Understand arc length and area measurements of sectors of circles 9. Know how to translate between a geometric description (e.g., focus, asymptotes, directrix) and an equation for a conic section 10. Understand how to use coordinate geometry to algebraically prove simple geometric theorems 11. Understand how perimeter, area, surface area, and volume formulas are used to solve problems 12.Know how to visualize relationships (e.g., cross section, nets, rotations) between two-dimensional and three-dimensional objects 13. Know how to apply geometric concepts in real-world situations 14. Understand the properties of parallel and perpendicular lines, triangles, quadrilaterals, polygons, and circles and how they can be used in problem solving **B. Probability and Statistics** 1. Understand how to summarize, represent, and interpret data collected from measurements on a single variable (e.g., box plots, dot plots, normal distributions) 2. Understand how to summarize, represent, and interpret data collected from measurements on two variables, either categorical or quantitative (e.g., scatterplots, time series)

Task 4 Steps	*Praxis*® Test Specifications
	3. Understand how to create and interpret linear regression models (e.g., rate of change, intercepts, correlation coefficient) 4. Understand statistical processes and how to evaluate them 5. Understand how to make inferences and justify conclusions from samples, experiments, and observational studies 6. Understand the concepts of independence and conditional probability and how to apply these concepts to data 7. Understand how to compute probabilities of simple events, probabilities of compound events, and conditional probabilities 8. Know how to make informed decisions using probabilities and expected values 9. Understand how to use simulations to construct experimental probability distributions and to make informal inferences about theoretical probability distributions 10. Understand how to find probabilities involving finite sample spaces and independent trials **C. Discrete Mathematics** 1. Understand sequences (e.g., arithmetic, recursively defined, geometric) 2. Is familiar with how recursion can be used to model various phenomena 3. Has knowledge of equivalence relations 4. Understand the differences between discrete and continuous representations (e.g., data, functions) and how each can be used to model various phenomena 5. Understand basic terminology and symbols of logic 6. Understand how to use counting techniques such as the multiplication principle, permutations, and combinations 7. Understand basic set theory (e.g., unions, differences, Venn diagrams)
Step 3 **Understanding the Two Focus Students** Candidates' ability to provide evidence of student learning resulting from the implemented lesson	**II. Geometry, Probability and Statistics, and Discrete Mathematics** **B. Probability and Statistics** 1. Understand how to summarize, represent, and interpret data collected from measurements on a single variable (e.g., box plots, dot plots, normal distributions) 5. Understand how to make inferences and justify conclusions from samples, experiments, and observational studies
Step 4 **Reflecting** Candidates' ability to reflect on the effectiveness of their lesson for the entire class	**II. Geometry, Probability and Statistics, and Discrete Mathematics** **B. Probability and Statistics** 5. Understand how to make inferences and justify conclusions from samples, experiments, and observational studies