

## MATHEMATICS STANDARDS

- Standard I.** Number Concepts: The mathematics teacher understands and uses numbers, number systems and their structure, operations and algorithms, quantitative reasoning, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.
- Standard II.** Patterns and Algebra: The mathematics teacher understands and uses patterns, relations, functions, algebraic reasoning, analysis, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.
- Standard III.** Geometry and Measurement: The mathematics teacher understands and uses geometry, spatial reasoning, measurement concepts and principles, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.
- Standard IV.** Probability and Statistics: The mathematics teacher understands and uses probability and statistics, their applications, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.
- Standard V.** Mathematical Processes: The mathematics teacher understands and uses mathematical processes to reason mathematically, to solve mathematical problems, to make mathematical connections within and outside of mathematics, and to communicate mathematically.
- Standard VI.** Mathematical Perspectives: The mathematics teacher understands the historical development of mathematical ideas, the interrelationship between society and mathematics, the structure of mathematics, and the evolving nature of mathematics and mathematical knowledge.
- Standard VII.** Mathematical Learning and Instruction: The mathematics teacher understands how children learn and develop mathematical skills, procedures, and concepts, knows typical errors students make, and uses this knowledge to plan, organize, and implement instruction; to meet curriculum goals; and to teach all students to understand and use mathematics.
- Standard VIII.** Mathematical Assessment: The mathematics teacher understands assessment and uses a variety of formal and informal assessment techniques appropriate to the learner on an ongoing basis to monitor and guide instruction and to evaluate and report student progress.
- Standard IX.** Professional Development: The mathematics teacher understands mathematics teaching as a profession, knows the value and rewards of being a reflective practitioner, and realizes the importance of making a lifelong commitment to professional growth and development.

**Standard I. Number Concepts: The mathematics teacher understands and uses numbers, number systems and their structure, operations and algorithms, quantitative reasoning, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.**

**Teacher Knowledge: What Teachers Know**

***Teachers of Students in Grades 8–12***

The beginning teacher of mathematics knows and understands:

- 1.1k the structure of number systems, the development of a sense of quantity, and the relationship between quantity and symbolic representation;
- 1.2k the connections of operations, algorithms, and relations with their associated concrete and visual representations;
- 1.3k the relationship among number concepts, operations and algorithms, and the properties of numbers, including ideas of number theory;
- 1.4k how to model, construct, and solve problems within and outside of mathematics; and
- 1.5k how number concepts, operations, and algorithms are developmental and connected across grade levels.

**Application: What Teachers Can Do**

***Teachers of Students in Grades EC–4\****

The beginning teacher of mathematics is able to:

- 1.1s compare and contrast numeration systems;
- 1.2s analyze, explain, and model the structure of numeration systems and, in particular, the role of place value and zero in the base ten system;
- 1.3s demonstrate a sense of quantity and number for whole numbers, integers, rational numbers, and real numbers;
- 1.4s analyze, explain, and model the four basic operations with whole numbers, integers, and rational numbers;
- 1.5s recognize, model, and describe different ways to interpret the four basic operations involving whole numbers, integers, and rational numbers;
- 1.6s analyze and describe relationships among number properties, operations, and algorithms involving the four basic operations with whole and rational numbers;
- 1.7s work proficiently with real numbers and demonstrate, explain, and model how some situations that have no solution in the whole, integer, or rational number systems have solutions in the real number system;
- 1.8s analyze error patterns that often occur when students use algorithms to perform operations;
- 1.9s recognize and analyze appropriate nontraditional algorithms for the four basic operations with whole numbers;
- 1.10s describe ideas from number theory (e.g., prime numbers, composite numbers, greatest common factors) as they apply to whole numbers, integers, and rational numbers and use these ideas in problem situations;

\*See 1.13s below.

**Standard I. Number Concepts: The mathematics teacher understands and uses numbers, number systems and their structure, operations and algorithms, quantitative reasoning, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.**

**Application: What Teachers Can Do**

***Teachers of Students in Grades EC–4 (continued)***

- 1.11s use whole numbers and rational numbers to describe and quantify phenomena such as time, temperature, and money; and
- 1.12s apply place value and other number properties to develop techniques of mental mathematics and computational estimation.

**Standard I. Number Concepts: The mathematics teacher understands and uses numbers, number systems and their structure, operations and algorithms, quantitative reasoning, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.**

**Application: What Teachers Can Do**

***Teachers of Students in Grades 4–8\*\****

The beginning teacher of mathematics is able to:

- 1.13s     apply all skills specified for teachers in grades EC–4, using content and contexts appropriate for grades 4–8;
- 1.14s     demonstrate a sense of equivalency among different representations of rational numbers;
- 1.15s     select appropriate representations of real numbers (e.g., fractions, decimals, percents, roots, exponents, scientific notation) for particular situations and justify that selection;
- 1.16s     analyze, explain, and model the four basic operations involving integers and real numbers;
- 1.17s     analyze and describe relationships between number properties, operations, and algorithms for the four basic operations involving integers, rational numbers, and real numbers;
- 1.18s     work with complex numbers and demonstrate, explain, and model how some situations that have no solution in the integer, rational, or real number systems have solutions in the complex number system;
- 1.19s     explain and justify the traditional algorithms for the four basic operations with integers, rational numbers, and real numbers and analyze common error patterns that may occur in their application;
- 1.20s     use integers, rational numbers, and real numbers to describe and quantify phenomena such as money, length, area, volume, and density; and

**\*\*See 1.22s below.**

**Standard I. Number Concepts:** The mathematics teacher understands and uses numbers, number systems and their structure, operations and algorithms, quantitative reasoning, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.

**Application: What Teachers Can Do**

*Teachers of Students in Grades 4–8 (continued)*

- 1.21s      extend and generalize the operations on rationals and integers to include exponents, their operations, their properties, and their applications to the real numbers.

**Standard I. Number Concepts: The mathematics teacher understands and uses numbers, number systems and their structure, operations and algorithms, quantitative reasoning, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.**

**Application: What Teachers Can Do**

***Teachers of Students in Grades 8–12***

The beginning teacher of mathematics is able to:

- 1.22s     apply all skills specified for teachers in grades EC–8, using content and contexts appropriate for grades 8–12;
- 1.23s     demonstrate an understanding of the real and complex number systems as algebraic fields;
- 1.24s     describe and analyze properties of subsets of the real numbers (e.g., rational, irrational, algebraic, transcendental) and the complex numbers (e.g., real numbers, imaginary numbers);
- 1.25s     select appropriate representations of complex numbers (e.g., vector, ordered pair, polar, exponential) for particular situations and justify that selection;
- 1.26s     describe real and complex number operations and their interrelationships using geometric and symbolic representations;
- 1.27s     apply properties of the real and complex numbers to explain and justify algebraic algorithms; and
- 1.28s     investigate and apply fundamental number theory concepts and principles (e.g., divisibility, Euclidean algorithm, congruence classes, modular arithmetic, the fundamental theorem of arithmetic) in a variety of situations.

**Standard II. Patterns and Algebra: The mathematics teacher understands and uses patterns, relations, functions, algebraic reasoning, analysis, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.**

**Teacher Knowledge: What Teachers Know**

***Teachers of Students in Grades 8–12***

The beginning teacher of mathematics knows and understands:

- 2.1k how to use algebraic concepts and reasoning to investigate patterns, make generalizations, formulate mathematical models, make predictions, and validate results;
- 2.2k how to use properties, graphs, and applications of relations and functions to analyze, model, and solve problems;
- 2.3k the concept of and relationships among variables, expressions, equations, inequalities, and systems in order to analyze, model, and solve problems;
- 2.4k the connections among geometric, graphic, numeric, and symbolic representations of functions and relations;
- 2.5k that patterns are sometimes misleading;
- 2.6k that in many situations, a pattern is only a trend and is accompanied by random variation from the trend; and
- 2.7k how patterns, relations, functions, algebraic reasoning, and analysis are developmental and connected across grade levels.

**Application: What Teachers Can Do**

***Teachers of Students in Grades EC–4\****

The beginning teacher of mathematics is able to:

- 2.1s use inductive reasoning to identify, extend, and create patterns using concrete models, figures, numbers, and algebraic expressions;
- 2.2s formulate implicit and explicit rules to describe and construct sequences verbally, numerically, graphically, and symbolically;
- 2.3s illustrate concepts of relations and functions using concrete models, tables, graphs, and symbolic expressions;
- 2.4s apply relations and functions to represent mathematical and real-world situations;
- 2.5s translate problem-solving situations into expressions and equations involving variables and unknowns;
- 2.6s model and solve problems, including proportion problems, using concrete, numeric, tabular, graphic, and algebraic methods; and
- 2.7s recognize misleading patterns.

\*See 2.8s below.

**Standard II. Patterns and Algebra: The mathematics teacher understands and uses patterns, relations, functions, algebraic reasoning, analysis, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.**

**Application: What Teachers Can Do**

***Teachers of Students in Grades 4–8\*\****

The beginning teacher of mathematics is able to:

- 2.8s     apply all skills specified for teachers in grades EC–4, using content and contexts appropriate for grades 4–8;
- 2.9s     make, test, validate, and use conjectures about patterns and relationships in data presented in tables, sequences, or graphs;
- 2.10s    use linear and nonlinear functions and relations, including polynomial, absolute value, trigonometric, rational, radical, exponential, logarithmic, and piecewise functions, to model problems;
- 2.11s    use a variety of representations and methods (e.g., numerical methods, tables, graphs, algebraic techniques) to solve linear and nonlinear equations, inequalities, and systems;
- 2.12s    use transformations to illustrate properties of functions and relations and to solve problems;
- 2.13s    give appropriate justification of the manipulation of algebraic expressions, equations, and inequalities;
- 2.14s    relate the concept of limit as a conceptual foundation of calculus to middle school mathematics;
- 2.15s    relate the rate of change as a conceptual foundation of calculus to middle school mathematics;
- 2.16s    relate the area under a curve as a conceptual foundation of calculus to middle school mathematics; and
- 2.17s    work with patterns with random variations.

**\*\*See 2.18s below.**

**Standard II. Patterns and Algebra: The mathematics teacher understands and uses patterns, relations, functions, algebraic reasoning, analysis, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.**

**Application: What Teachers Can Do**

***Teachers of Students in Grades 8–12***

The beginning teacher of mathematics is able to:

- 2.18s     apply all skills specified for teachers in grades EC–8, using content and contexts appropriate for grades 8–12;
- 2.19s     use methods of recursion and iteration to model and solve problems;
- 2.20s     analyze the properties of sequences and series and use them to solve problems involving finite and infinite processes; including problems related to simple, compound, and continuous interest rates, as well as annuities;
- 2.21s     use the method of mathematical induction to prove theorems;
- 2.22s     use deductive reasoning to simplify and justify algebraic processes;
- 2.23s     analyze attributes of functions and relations (e.g., domain, range, one-to-one functions, composite functions, inverse functions, odd and even functions, continuous functions) and their graphs;
- 2.24s     describe linear, quadratic, and other polynomial functions, analyze their algebraic and graphical properties, and use these to model and solve problems using a variety of methods, including technology;
- 2.25s     describe exponential, logarithmic, and logistic functions algebraically and graphically, analyze their algebraic and graphical properties, and use these to model and solve problems using a variety of methods, including technology;
- 2.26s     describe trigonometric and circular functions algebraically and graphically, analyze their algebraic and graphical properties, and use these to model and solve problems using a variety of methods, including technology;

**Standard II. Patterns and Algebra: The mathematics teacher understands and uses patterns, relations, functions, algebraic reasoning, analysis, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.**

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p><b>Application: What Teachers Can Do</b></p> <p><i>Teachers of Students in Grades 8–12 (continued)</i></p> <p>2.27s describe rational, radical, absolute value, and piecewise functions algebraically and graphically, analyze their algebraic and graphical properties, and use these to model and solve problems using a variety of methods, including technology;</p> <p>2.28s investigate and solve problems using techniques of differential and integral calculus along with a variety of other methods, including technology;</p> <p>2.29s represent and solve problems using techniques of linear and matrix algebra;</p> <p>2.30s apply the properties of vectors and vector algebra to solve pure and applied problems;</p> <p>2.31s demonstrate an understanding of algebraic structures (e.g., groups, rings, fields, vector spaces) and their relationship to secondary mathematics; and</p> <p>2.32s demonstrate an understanding of analysis (e.g., analytic geometry and calculus) and its relationship to secondary mathematics.</p> |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Standard III. Geometry and Measurement: The mathematics teacher understands and uses geometry, spatial reasoning, measurement concepts and principles, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.**

**Teacher Knowledge: What Teachers Know**

***Teachers of Students in Grades 8–12***

The beginning teacher of mathematics knows and understands:

- 3.1k how to use spatial reasoning to investigate concepts such as direction, orientation, perspective, shape, and structure;
- 3.2k the use of mathematical reasoning to develop, generalize, justify, and prove geometric relationships;
- 3.3k connections among geometric ideas and number concepts, measurement, probability and statistics, algebra, and analysis;
- 3.4k measurement as a process;
- 3.5k methods of approximation and estimation and the effects of error on measurement;
- 3.6k how to use measurement to collect data, to recognize relationships, and to develop generalizations, including formulas;
- 3.7k how to locate, develop, and solve real-world problems using measurement and geometry concepts;
- 3.8k how to explore geometry from synthetic, coordinate, and transformational approaches;
- 3.9k logical reasoning, justification, and proof in relation to the axiomatic structure of geometry; and
- 3.10k how geometry, spatial reasoning, and measurement concepts and principles are developmental and connected across grade levels.

**Application: What Teachers Can Do**

***Teachers of Students in Grades EC–4\****

The beginning teacher of mathematics is able to:

- 3.1s extend the understanding of shape in terms of dimension, direction, orientation, perspective, and relationships among these concepts;
- 3.2s develop, explain, and use formulas to find length, perimeter, area, and volume of basic geometrical figures;
- 3.3s explain and illustrate the use of numbers and units of measurement for quantities such as temperature, money, percent, speed, and acceleration;
- 3.4s develop, justify, and use conversions within and between different measurement systems;
- 3.5s use translations, rotations, reflections, dilations, and contractions to illustrate similarities, congruencies, and symmetries of figures; and
- 3.6s identify attributes to be measured, quantify the attributes by selecting and using appropriate units, and communicate information about the attributes using the unit measure.

\*See 3.7s below.

**Standard III. Geometry and Measurement: The mathematics teacher understands and uses geometry, spatial reasoning, measurement concepts and principles, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.**

**Application: What Teachers Can Do**

***Teachers of Students in Grades 4–8\*\****

The beginning teacher of mathematics is able to:

- 3.7s     apply all skills specified for teachers in grades EC–4, using content and contexts appropriate for grades 4–8;
- 3.8s     develop, justify, and perform geometric constructions using compass, straightedge, and reflection devices and other appropriate technology;
- 3.9s     investigate and prove geometric relationships within the axiomatic structure of Euclidean geometry;
- 3.10s    analyze and solve problems involving one-, two-, and three-dimensional objects such as lines, angles, circles, triangles, polygons, cylinders, prisms, and spheres;
- 3.11s    analyze the relationship among three-dimensional figures and related two-dimensional representations (e.g., projections, cross sections, nets) and use these representations to solve problems;
- 3.12s    apply measurement concepts and dimensional analysis to derive units and formulas for a variety of situations, including rates of change of one variable with respect to another;
- 3.13s    use symmetry to describe tessellations and show how they can be used to illustrate concepts, properties, and relationships;
- 3.14s    relate geometry to algebra and trigonometry by using the Cartesian coordinate system and use this relationship to solve problems; and
- 3.15s    use calculus concepts to answer questions about rates of change, areas, volumes, and properties of functions and their graphs.

**\*\*See 3.16s below.**

**Standard III. Geometry and Measurement: The mathematics teacher understands and uses geometry, spatial reasoning, measurement concepts and principles, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.**

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p><b>Application: What Teachers Can Do</b></p> <p><i>Teachers of Students in Grades 8–12</i></p> <p>The beginning teacher of mathematics is able to:</p> <p>3.16s    apply all skills specified for teachers in grades EC–8, using content and contexts appropriate for grades 8–12;</p> <p>3.17s    illustrate axiomatic systems and their components, such as undefined terms, defined terms, theorems, examples, and counter-examples, and in particular, describe and analyze axioms for Euclidean geometry;</p> <p>3.18s    demonstrate an understanding of the methods, uses, and results of Euclidean geometry;</p> <p>3.19s    discuss finite geometries, non-Euclidean geometries, fractal geometry, and networks and graphs;</p> <p>3.20s    show how differential calculus is used to answer questions about rates of change and optimization;</p> <p>3.21s    use integral calculus to compute various measurements associated with curves and regions in the plane, and measurements associated with curves, surfaces, and regions in three-space;</p> <p>3.22s    illustrate geometry from several perspectives, including the use of coordinate systems, transformations, and vectors;</p> <p>3.23s    investigate and explore geometric concepts and properties using technology; and</p> <p>3.24s    relate geometry to algebra by representing transformations as matrices and use this relationship to solve problems.</p> |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Standard IV. Probability and Statistics: The mathematics teacher understands and uses probability and statistics, their applications, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.**

**Teacher Knowledge: What Teachers Know**

***Teachers of Students in Grades 8–12***

The beginning teacher of mathematics knows and understands:

- 4.1k how to use graphical and numerical techniques to explore data, characterize patterns, and describe departures from patterns;
- 4.2k how to design experiments and surveys to answer questions and solve problems;
- 4.3k the theory of probability and its relationship to sampling and statistical inference;
- 4.4k statistical inference and how it is used in making and evaluating predictions; and
- 4.5k how probability and statistics are developmental and connected across grade levels.

**Application: What Teachers Can Do**

***Teachers of Students in Grades EC–4\****

The beginning teacher of mathematics is able to:

- 4.1s investigate and answer questions by collecting, organizing, and displaying data from real-world situations;
- 4.2s support arguments, make predictions, and draw conclusions using summary statistics and graphs to analyze and interpret one-variable data;
- 4.3s communicate the results of a statistical investigation using appropriate language;
- 4.4s investigate real-world problems by designing, administering, analyzing and interpreting surveys;
- 4.5s use the concepts and principles of probability to describe the outcome of simple and compound events;
- 4.6s explore concepts of probability through data collection, experiments, and simulations;
- 4.7s generate, simulate, and use probability models to represent a situation; and
- 4.8s use the graph of the normal distribution as a basis for making inferences about a population.

\*See 4.9s below.

**Standard IV. Probability and Statistics:** The mathematics teacher understands and uses probability and statistics, their applications, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.

**Application: What Teachers Can Do**

***Teachers of Students in Grades 4–8\*\****

The beginning teacher of mathematics is able to:

- 4.9s     apply all skills specified for teachers in grades EC–4, using content and contexts appropriate for grades 4–8;
- 4.10s    investigate real-world problems by designing, conducting, analyzing, and interpreting statistical experiments;
- 4.11s    develop and justify concepts and measures of central tendency (e.g., mean, median, mode) and dispersion (e.g., range, interquartile range, variance, standard deviation) and use those measures to describe a set of data;
- 4.12s    calculate and interpret percentiles and quartiles;
- 4.13s    explore, describe, and analyze bivariate data using techniques such as scatter plots, regression lines, correlation coefficients, and residual analysis;
- 4.14s    explain and use precise probability language to make observations and draw conclusions from single variable data and to describe the level of confidence in the conclusion;
- 4.15s    determine probability by constructing sample spaces to model situations; and
- 4.16s    make inferences about a population using the binomial and geometric distributions.

\*\*See 4.17s below.

**Standard IV. Probability and Statistics: The mathematics teacher understands and uses probability and statistics, their applications, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.**

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p><b>Application: What Teachers Can Do</b></p> <p><i>Teachers of Students in Grades 8–12</i></p> <p>The beginning teacher of mathematics is able to:</p> <p>4.17s    apply all skills specified for teachers in grades EC–8, using content and contexts appropriate for grades 8–12;</p> <p>4.18s    identify and understand the selection of a measurement scale (i.e. nominal, ordinal, interval, ratio) used to answer research questions and analyze data;</p> <p>4.19s    organize, display, and interpret data in a variety of formats, (e.g. tables, frequency tallies, box plots, stem-and-leaf plots, histograms) and discuss the advantages or disadvantages of a given format;</p> <p>4.20s    apply linear transformations (translating, stretching, shrinking) to convert data and describe the effect of linear transformations on measures of central tendency and dispersion;</p> <p>4.21s    calculate probabilities using the axioms of probability and related theorems and concepts such as the addition rule, multiplication rule, conditional probability, and independence;</p> <p>4.22s    apply concepts and properties of discrete and continuous random variables to model and solve a variety of problems involving probability and probability distributions;</p> <p>4.23s    describe and analyze bivariate data using various techniques (e.g. scatterplots, regression lines, outliers, residual analysis and correlation coefficients);</p> <p>4.24s    transform nonlinear data into a linear form in order to apply linear regression techniques to develop exponential, logarithmic, and power regression models;</p> <p>4.25s    describe and apply the characteristics of a well-designed and well-conducted survey or experiment;</p> |
|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Standard IV. Probability and Statistics:** The mathematics teacher understands and uses probability and statistics, their applications, and technology appropriate to teach the statewide curriculum (Texas Essential Knowledge and Skills [TEKS]) in order to prepare students to use mathematics.

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p><b>Application: What Teachers Can Do</b></p> <p><i>Teachers of Students in Grades 8–12 (continued)</i></p> <p>4.26s     analyze and interpret statistical information from the media, such as the results of polls and surveys, and recognize valid and misleading uses of statistics;</p> <p>4.27s     use the law of large numbers and the central limit theorem to describe the role of probability theory in the process of statistical sampling and inference; and</p> <p>4.28s     use confidence interval arguments to formulate and test hypotheses.</p> |
|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Standard V. Mathematical Processes: The mathematics teacher understands and uses mathematical processes to reason mathematically, to solve mathematical problems, to make mathematical connections within and outside of mathematics, and to communicate mathematically.**

**Teacher Knowledge: What Teachers Know**

***Teachers of Students in Grades 8–12***

The beginning teacher of mathematics knows and understands:

- 5.1k logical reasoning, justification, and proof in relation to the structure of and relationships within an axiomatic system;
- 5.2k the role of logical reasoning in mathematics, and age-appropriate methods and uses of informal and formal reasoning;
- 5.3k the process of identifying, posing, exploring, and solving mathematical problems in age-appropriate ways;
- 5.4k connections among mathematical concepts, procedures, and equivalent representations;
- 5.5k connections between mathematics, daily living, and other disciplines;
- 5.6k how to communicate mathematical ideas and concepts in age-appropriate oral, written, and visual forms; and
- 5.7k how to use age-appropriate mathematical manipulatives and drawings and a wide range of technological tools to develop and explore mathematical concepts and ideas.

**Application: What Teachers Can Do**

***Teachers of Students in Grades 8–12***

**Logical Reasoning**

The beginning teacher of mathematics is able to:

- 5.1s apply correct mathematical reasoning to derive valid conclusions from a set of premises;
- 5.2s apply principles of inductive reasoning to make conjectures and use deductive methods to evaluate the validity of conjectures;
- 5.3s use formal and informal reasoning to explore, investigate, and justify mathematical ideas;
- 5.4s recognize examples of fallacious reasoning;
- 5.5s evaluate mathematical arguments and proofs; and
- 5.6s provide convincing arguments or proofs for mathematical theorems.

**Standard V. Mathematical Processes: The mathematics teacher understands and uses mathematical processes to reason mathematically, to solve mathematical problems, to make mathematical connections within and outside of mathematics, and to communicate mathematically.**

**Application: What Teachers Can Do**

***Teachers of Students in Grades 8–12 (continued)***

**Problem Solving**

The beginning teacher of mathematics is able to:

- 5.7s recognize that a mathematical problem can be solved in a variety of ways, evaluate the appropriateness of various strategies, and select an appropriate strategy for a given problem;
- 5.8s evaluate the reasonableness of a solution to a given problem;
- 5.9s use physical and numerical models to represent a given problem or mathematical procedure;
- 5.10s recognize that assumptions are made when solving problems and identify and evaluate those assumptions;
- 5.11s investigate and explore problems that have multiple solutions;
- 5.12s apply content knowledge to develop a mathematical model of a real-world situation and analyze and evaluate how well the model represents the situation;
- 5.13s develop and use simulations as a tool to model and solve problems; and
- 5.14s develop and use iteration and recursion to model and solve problems.

**Standard V. Mathematical Processes: The mathematics teacher understands and uses mathematical processes to reason mathematically, to solve mathematical problems, to make mathematical connections within and outside of mathematics, and to communicate mathematically.**

**Application: What Teachers Can Do**

***Teachers of Students in Grades 8–12 (continued)***

**Connections**

The beginning teacher of mathematics is able to:

- 5.15s explore problems using verbal, graphical, numerical, physical, and algebraic representations;
- 5.16s recognize and use multiple representations of a mathematical concept (e.g., a point and its coordinates, the area of a circle as a quadratic function in  $r$ , probability as a ratio of two areas);
- 5.17s apply mathematical methods to analyze practical situations; and
- 5.18s use mathematics to model and solve problems in other disciplines, such as art, music, science, social science, and business.

**Standard V. Mathematical Processes: The mathematics teacher understands and uses mathematical processes to reason mathematically, to solve mathematical problems, to make mathematical connections within and outside of mathematics, and to communicate mathematically.**

**Application: What Teachers Can Do**

***Teachers of Students in Grades 8–12 (continued)***

**Communication**

The beginning teacher of mathematics is able to:

- 5.19s facilitate discourse between the teacher and students and among students to explore, build, and refine mathematical ideas;
- 5.20s use questioning strategies to identify, support, monitor, and challenge students' mathematical thinking;
- 5.21s translate mathematical statements among developmentally appropriate language, standard English, mathematical language, and symbolic mathematics;
- 5.22s provide students with opportunities to demonstrate their understanding of mathematics in a variety of ways using a variety of tools;
- 5.23s use visual media such as graphs, tables, diagrams, and animations to communicate mathematical information; and
- 5.24s use the language of mathematics as a precise means of expressing mathematical ideas.

**Standard VI. Mathematical Perspectives: The mathematics teacher understands the historical development of mathematical ideas, the interrelationship between society and mathematics, the structure of mathematics, and the evolving nature of mathematics and mathematical knowledge.**

| <b>Teacher Knowledge: What Teachers Know</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>Application: What Teachers Can Do</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Teachers of Students in Grades 8–12</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <i>Teachers of Students in Grades 8–12</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <p>The beginning teacher of mathematics knows and understands:</p> <ul style="list-style-type: none"> <li>6.1k the history and evolution of mathematical concepts, procedures, and ideas;</li> <li>6.2k the contributions that different cultures have made to the field of mathematics and the impact mathematics has on society and culture;</li> <li>6.3k the role society plays in shaping personal views and perspectives of mathematics;</li> <li>6.4k the impact of technological advances on mathematical knowledge and skills and of mathematics on technology;</li> <li>6.5k how mathematics is used in a variety of careers and professions;</li> <li>6.6k the structural properties common to the mathematical disciplines; and</li> <li>6.7k the implications of current trends and research in mathematics and mathematics education.</li> </ul> | <p>The beginning teacher of mathematics is able to:</p> <ul style="list-style-type: none"> <li>6.1s use key events and knowledge of specific individuals throughout the history of mathematics to illustrate age-appropriate mathematical concepts;</li> <li>6.2s design age-appropriate activities that emphasize mathematical contributions from various cultures;</li> <li>6.3s use the historical developments of mathematical ideas to illustrate how mathematics progresses from concrete applications to abstract generalizations;</li> <li>6.4s use historic mathematical problems as a tool for assessing the mathematical knowledge of a particular period or culture;</li> <li>6.5s select age-appropriate activities that relate to the linguistic, cultural, and socioeconomic background of students;</li> <li>6.6s plan age-appropriate instruction that emphasizes the role of mathematics in the workplace and demonstrate how mathematics is used in a variety of careers; and</li> <li>6.7s analyze the structure of mathematical systems and use the structural properties of mathematical systems to make age-appropriate connections among mathematical concepts.</li> </ul> |

**Standard VII. Mathematical Learning and Instruction: The mathematics teacher understands how children learn and develop mathematical skills, procedures, and concepts, knows typical errors students make, and uses this knowledge to plan, organize, and implement instruction; to meet curriculum goals; and to teach all students to understand and use mathematics.**

**Teacher Knowledge: What Teachers Know**

***Teachers of Students in Grades 8–12***

The beginning teacher of mathematics knows and understands:

- 7.1k current theories, research, and practice on how students learn mathematics;
- 7.2k how students differ in their approaches to learning with regards to linguistic, cultural, socioeconomic, and developmental diversity;
- 7.3k strategies, techniques, and procedures for helping students understand mathematics;
- 7.4k how students' prior knowledge of and attitudes towards mathematics may affect their learning;
- 7.5k the process by which students construct mathematical knowledge;
- 7.6k common mathematical misconceptions and errors;
- 7.7k how learning may be assisted through the use of mathematics manipulatives, drawings, and technological tools;
- 7.8k how individual and group instruction can promote learning and create a learning environment that actively engages students in learning and encourages self-motivation;
- 7.9k a variety of instructional methods, tools, and tasks that promote students' confidence, curiosity, and inventiveness while using mathematics described in the TEKS;
- 7.10k planning strategies for developing mathematical instruction as a discipline of interconnected concepts and procedures;

**Application: What Teachers Can Do**

***Teachers of Students in Grades 8–12***

The beginning teacher of mathematics is able to:

- 7.1s apply theories and principles of learning mathematics to plan appropriate instructional activities for all students;
- 7.2s use students' prior mathematical knowledge to build conceptual links to new knowledge;
- 7.3s employ instructional strategies that build on the linguistic, cultural, and socioeconomic diversity of students;
- 7.4s develop a variety of instructional activities to guide students in constructing mathematical knowledge;
- 7.5s teach students to recognize and correct common mathematical misconceptions and errors;
- 7.6s engage students in tasks that require students to communicate their mathematical reasoning;
- 7.7s motivate students and actively engage them in the learning process by using a variety of interesting, challenging, and worthwhile mathematical tasks in individual, small-, and large-group settings;
- 7.8s use a variety of tools, including, but not limited to, rulers, protractors, scales, stopwatches, measuring containers, money, calculators, and software, to strengthen comprehension and understanding;
- 7.9s provide instruction along a continuum from concrete to abstract and plan instruction that builds on strengths and addresses needs;

**Standard VII. Mathematical Learning and Instruction: The mathematics teacher understands how children learn and develop mathematical skills, procedures, and concepts, knows typical errors students make, and uses this knowledge to plan, organize, and implement instruction; to meet curriculum goals; and to teach all students to understand and use mathematics.**

| <b>Teacher Knowledge: What Teachers Know</b><br><b><i>Teachers of Students in Grades 8–12 (continued)</i></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Application: What Teachers Can Do</b><br><b><i>Teachers of Students in Grades 8–12 (continued)</i></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>7.11k procedures for selecting, developing, and implementing worthwhile mathematical tasks that meet the diverse needs of the student population and require students to reason, make connections, solve problems, and communicate mathematically;</p> <p>7.12k procedures for developing instruction that connects concrete, symbolic, and abstract representations of mathematical knowledge;</p> <p>7.13k methods for locating, selecting, developing, and evaluating learning opportunities that emphasize the connections between mathematics and real-world phenomena;</p> <p>7.14k how technological tools and manipulatives can be used appropriately to assist students in developing, comprehending, and applying mathematical concepts and skills;</p> <p>7.15k procedures for creating a variety of mathematical exploratory activities;</p> <p>7.16k how to relate mathematics to students’ lives and daily living;</p> <p>7.17k strategies that students with diverse strengths and needs can use to determine word meaning in content-related texts;</p> <p>7.18k strategies that students with diverse strengths and needs can use to develop content-area vocabulary; and</p> <p>7.19k strategies that students with diverse strengths and needs can use to facilitate comprehension before, during, and after reading content-related texts.</p> | <p>7.10s model appropriate mathematical problem-solving techniques, reasoning, discourse, and enthusiasm for mathematics as an example to help students develop positive attitudes towards mathematics;</p> <p>7.11s develop clear learning goals to plan, deliver, assess, and reevaluate instruction based upon the TEKS;</p> <p>7.12s select and create worthwhile mathematical tasks based on the TEKS that actively engage students in the learning process;</p> <p>7.13s provide students with opportunities to develop and improve mathematical skills and procedures;</p> <p>7.14s use a variety of instructional delivery methods, such as individual, structured, small-group, and large-group formats;</p> <p>7.15s use a variety of questioning strategies to encourage mathematical discourse and to help students analyze and evaluate their mathematical thinking;</p> <p>7.16s create strategies for integrating writing as appropriate in the mathematics class;</p> <p>7.17s use challenging tasks that make connections between mathematics, the real world, and other disciplines to motivate learning;</p> <p>7.18s use mathematics labs, simulations, open-ended investigations, research projects, and other activities when appropriate to guide students’ learning;</p> <p>7.19s apply appropriate technology to promote mathematical learning;</p> <p>7.20s use appropriate mathematical manipulatives to promote abstract understanding;</p> |

**Standard VII. Mathematical Learning and Instruction:** The mathematics teacher understands how children learn and develop mathematical skills, procedures, and concepts, knows typical errors students make, and uses this knowledge to plan, organize, and implement instruction; to meet curriculum goals; and to teach all students to understand and use mathematics.

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p><b>Application: What Teachers Can Do</b></p> <p><i>Teachers of Students in Grades 8–12 (continued)</i></p> <p>7.21s    select and use mathematical activities that relate to students’ lives and communities;</p> <p>7.22s    use a variety of instructional strategies to ensure all students’ reading comprehension of content-related texts, including helping students link the content of texts to their lives and connect related ideas across different texts;</p> <p>7.23s    teach students how to locate, retrieve, and retain content-related information from a range of texts and technologies; and</p> <p>7.24s    teach students how to locate the meanings and pronunciations of unfamiliar content-related words using appropriate sources, such as dictionaries, thesauruses, and glossaries.</p> |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Standard VIII. Mathematical Assessment: The mathematics teacher understands assessment and uses a variety of formal and informal assessment techniques appropriate to the learner on an ongoing basis to monitor and guide instruction and to evaluate and report student progress.**

**Teacher Knowledge: What Teachers Know**

***Teachers of Students in Grades 8–12***

The beginning teacher of mathematics knows and understands:

- 8.1k the purpose, characteristics, and uses of various assessments in mathematics, including formative and summative assessments;
- 8.2k the importance of carefully selecting or designing formative and summative assessments for the specific decisions they are intended to inform;
- 8.3k how to select and administer appropriate assessment instruments that evaluate students' knowledge of and ability to use mathematics;
- 8.4k appropriate procedures for sharing assessment information with students, parents, and school personnel;
- 8.5k how to select and develop assessment methods that are consistent with what is taught and how it is taught;
- 8.6k how to evaluate a variety of assessment methods and materials for reliability, validity, absence of bias, clarity of language, and appropriateness of mathematical level;
- 8.7k the reciprocal nature of assessment and instruction and how to evaluate assessment results to design, monitor, and modify instruction to improve mathematical learning; and
- 8.8k how to diagnose and correct common mathematical misconceptions and errors.

**Application: What Teachers Can Do**

***Teachers of Students in Grades 8–12***

The beginning teacher of mathematics is able to:

- 8.1s select or design and administer a variety of appropriate assessment instruments and/or methods (e.g., formal/informal, formative/summative) to monitor student understanding of mathematics and progress over time;
- 8.2s develop a variety of formal and informal assessments and scoring procedures that consist of worthwhile tasks that assess mathematical understanding, common misconceptions, and error patterns;
- 8.3s align assessment methods with what is taught and how it is taught;
- 8.4s interpret the results of formal and informal assessments and use results to evaluate and modify instructional approaches;
- 8.5s establish criteria consistent with ethical and legal principles regarding the sharing of assessment results with students, parents, and appropriate school personnel;
- 8.6s develop a valid student grading system based on the results of students' assessments; and
- 8.7s communicate assessment results to students' parents/caregivers and other appropriate personnel.

**Standard IX. Professional Development: The mathematics teacher understands mathematics teaching as a profession, knows the value and rewards of being a reflective practitioner, and realizes the importance of making a lifelong commitment to professional growth and development.**

**Teacher Knowledge: What Teachers Know**

***Teachers of Students in Grades 8–12***

The beginning teacher of mathematics knows and understands:

- 9.1k the importance of establishing collegial relationships with other teachers and professional staff;
- 9.2k the advantages of participating in workshops, courses, conferences, and other professional activities that address topics related to the teaching of mathematics, including the use of technology;
- 9.3k the value of joining and actively participating in the professional community of mathematics educators;
- 9.4k the advantages of discussing with colleagues current ideas, trends, and directions in mathematics and mathematics education through local organizations, professional publications, and electronic communities;
- 9.5k the importance of participating in school, community, and political efforts to effect positive change in mathematics education;
- 9.6k national and statewide curriculum in mathematics curriculum development, instruction, and assessment; and
- 9.7k the availability of state resources to support teachers of mathematics.

**Application: What Teachers Can Do**

***Teachers of Students in Grades 8–12***

The beginning teacher of mathematics is able to:

- 9.1s communicate with colleagues to create professional interactions across all disciplines at the building and district level;
- 9.2s exchange information with mathematics teachers at lower and higher grade levels to ensure continuity in students' mathematics education;
- 9.3s use professional relationships to gather information for creating links between the mathematics curriculum and other disciplines;
- 9.4s use workshops and professional development activities as an opportunity to keep up with current technology, obtain new instructional materials and ideas, discover new approaches for delivering mathematical lessons, and continue to learn new mathematics;
- 9.5s select materials from appropriate publications produced by professional mathematics organizations to develop lesson plans, instructional activities, and assessments;
- 9.6s use local organizations and electronic communities as a forum for exchanging, discussing, and evaluating ideas regarding mathematics and mathematical instruction, and as an opportunity for professional self-assessment; and
- 9.7s organize and participate in a variety of methods (e.g., newsletters, Web pages, fundraisers, math nights, volunteer programs, field trips) to promote communication among parents, students, and the community.