



TExES® Physics/Mathematics 7–12 Curriculum Crosswalk

Required Course Numbers									
Test Content Categories									
Domain I — Number Concepts									
Competency 001: <i>The teacher understands the real number system and its structure, operations, algorithms and representations.</i>									
A. Understands the concepts of place value, number base and decimal representations of real numbers and rational numbers, including benchmark fractions.									
B. Understands the algebraic structure and properties of the real number system and its subsets (e.g., real numbers as a field, integers as an additive group, ordering of rational and real numbers).									
C. Describes and analyzes properties of subsets of the real numbers (e.g., closure, identities).									
D. Selects and uses appropriate representations of real numbers (e.g., fractions, decimals, percents, roots, exponents, scientific notation) for particular situations.									
E. Uses a variety of models (e.g., geometric, symbolic) to represent operations, algorithms and real numbers.									
F. Uses real numbers to model and solve a variety of problems.									

Required Course Numbers										
Test Content Categories										
G. Uses deductive reasoning to simplify and justify algebraic processes.										
H. Demonstrates how some problems that have no solution in the integer or rational number systems have a solution in the real number system.										
Competency 002: <i>The teacher understands the complex number system and its structure, operations, algorithms and representations.</i>										
A. Demonstrates how some problems that have no solution in the real number system have a solution in the complex number system.										
B. Understands the properties of complex numbers (e.g., complex conjugate, magnitude/modulus, multiplicative inverse).										
C. Understands the algebraic structure of the complex number system and its subsets (e.g., complex numbers as a field, complex addition as vector addition).										
D. Selects and uses appropriate representations of complex numbers (e.g., vector, ordered pair, polar, exponential) for particular situations.										
E. Describes complex number operations (e.g., addition, multiplication, roots) using symbolic and geometric representations.										

Required Course Numbers											
Test Content Categories											
Competency 003: <i>The teacher understands number theory concepts and principles and uses numbers to model and solve problems in a variety of situations.</i>											
A. Applies ideas from number theory (e.g., prime numbers and factorization, the Euclidean algorithm, divisibility, congruence classes, modular arithmetic, the fundamental theorem of arithmetic) to solve problems.											
B. Applies number theory concepts and principles to justify and prove number relationships.											
C. Compares and contrasts properties of vectors and matrices with properties of number systems (e.g., existence of inverses, noncommutative operations).											
D. Uses properties of numbers (e.g., fractions, decimals, percents, ratios, proportions) to model and solve real-world problems.											
E. Applies counting techniques such as permutations and combinations to quantify situations and solve problems.											
F. Uses estimation techniques to solve problems and judge the reasonableness of solutions.											

Required Course Numbers										
Test Content Categories										
Domain II — Patterns and Algebra										
Competency 004: <i>The teacher uses patterns to model and solve problems and formulate conjectures.</i>										
A. Recognizes and extends patterns and relationships in data presented in tables, sequences or graphs.										
B. Uses methods of recursion and iteration to model and solve problems.										
C. Uses the principle of mathematical induction.										
D. Analyzes the properties of sequences and series (e.g., Fibonacci, arithmetic, geometric) and uses them to solve problems involving finite and infinite processes.										
E. Understands how sequences and series are applied to solve problems in the mathematics of finance (e.g., simple, compound and continuous interest rates; annuities).										
F. Determines the validity of logical arguments that include compound conditional statements by constructing truth tables.										
Competency 005: <i>The teacher understands attributes of functions, relations and their graphs.</i>										
A. Understands when a relation is a function.										

Required Course Numbers											
Test Content Categories											
B.	Identifies the mathematical domain and range of functions and relations and determines reasonable domains for given situations.										
C.	Understands that a function represents a dependence of one quantity on another and can be represented in a variety of ways (e.g., concrete models, tables, graphs, diagrams, verbal descriptions, symbols).										
D.	Identifies and analyzes even and odd functions, one-to-one functions, inverse functions and their graphs.										
E.	Applies basic transformations [e.g., $k f(x)$, $f(x) + k$, $f(x - k)$, $f(kx)$, $ f(x) $] to a parent function, f , and describes the effects on the graph of $y = f(x)$.										
F.	Performs operations (e.g., sum, difference, composition) on functions, finds inverse relations and describes results symbolically and graphically.										
G.	Uses graphs of functions to formulate conjectures of identities [e.g., $y = x^2 - 1$ and $y = (x - 1)(x + 1)$, $y = \log x^3$ and $y = 3 \log x$, $y = \sin(x + \frac{\pi}{2})$ and $y = \cos x$].										
Competency 006: <i>The teacher understands linear and quadratic functions, analyzes their algebraic and graphical properties and uses them to model and solve problems.</i>											

Required Course Numbers									
Test Content Categories									
A. Understands the concept of slope as a rate of change, interprets the meaning of slope and intercept in a variety of situations and understands slope using similar triangles.									
B. Writes equations of lines given various characteristics (e.g., two points, a point and slope, slope and y -intercept).									
C. Applies techniques of linear and matrix algebra to represent and solve problems involving linear systems and uses arrays to efficiently manage large collections of data and add, subtract and multiply matrices to solve applied problems, including geometric transformations.									
D. Analyzes the zeros (real and complex) of quadratic functions.									
E. Makes connections between the $y = ax^2 + bx + c$ and the $y = a(x - h)^2 + k$ representations of a quadratic function and its graph.									
F. Solves problems involving quadratic functions using a variety of methods (e.g., factoring, completing the square, using the quadratic formula, using a graphing calculator).									
G. Models and solves problems involving linear and quadratic equations and inequalities using a variety of methods, including technology.									

Required Course Numbers											
Test Content Categories											
Competency 007: <i>The teacher understands polynomial, rational, radical, absolute value and piecewise functions, analyzes their algebraic and graphical properties and uses them to model and solve problems.</i>											
A. Recognizes and translates among various representations (e.g., written, tabular, graphical, algebraic) of polynomial, rational, radical, absolute value and piecewise functions.											
B. Describes restrictions on the domains and ranges of polynomial, rational, radical, absolute value and piecewise functions.											
C. Makes and uses connections among the significant points (e.g., zeros, local extrema, points where a function is not continuous or differentiable) of a function, the graph of the function and the function's symbolic representation.											
D. Analyzes functions in terms of vertical, horizontal and slant asymptotes.											
E. Analyzes and applies the relationship between inverse variation and rational functions.											
F. Solves equations and inequalities involving polynomial, rational, radical, absolute value and piecewise functions, using a variety of methods (e.g., tables, algebraic methods, graphs, use of a graphing calculator) and evaluates the reasonableness of solutions.											

Required Course Numbers										
Test Content Categories										
G. Models situations using polynomial, rational, radical, absolute value and piecewise functions and solves problems using a variety of methods, including technology.										
H. Models situations using proportional and inverse variations, including describing physical laws such as Hook's law, Newton's second law of motion and Boyle's law.										
I. Uses precision and accuracy in real-life situations related to measurement and significant figures.										
J. Applies and analyzes published ratings, weighted averages and indices to make informed decisions.										
K. Uses proportionality to solve problems involving quantities that are not easily measured.										
Competency 008: <i>The teacher understands exponential and logarithmic functions, analyzes their algebraic and graphical properties and uses them to model and solve problems.</i>										
A. Recognizes and translates among various representations (e.g., written, numerical, tabular, graphical, algebraic) of exponential and logarithmic functions.										
B. Recognizes and uses connections among significant characteristics (e.g., intercepts, asymptotes) of a function involving exponential or logarithmic expressions, the graph of the function and the function's symbolic representation.										

Required Course Numbers										
Test Content Categories										
C. Understands the relationship between exponential and logarithmic functions and uses the laws and properties of exponents and logarithms to simplify expressions and solve problems.										
D. Uses a variety of representations and techniques (e.g., numerical methods, tables, graphs, analytic techniques, graphing calculators) to solve equations, inequalities and systems involving exponential and logarithmic functions.										
E. Models and solves problems involving exponential growth and decay.										
F. Uses logarithmic scales (e.g., Richter, decibel) to describe phenomena and solve problems.										
G. Uses exponential and logarithmic functions to model and solve problems involving the mathematics of finance (e.g., compound interest).										
H. Uses the exponential function to model situations and solve problems in which the rate of change of a quantity is proportional to the current amount of the quantity [i.e., $f'(x) = k f(x)$].										

Required Course Numbers									
Test Content Categories									
Competency 009: <i>The teacher understands trigonometric and circular functions, analyzes their algebraic and graphical properties and uses them to model and solve problems.</i>									
A. Analyzes the relationships among the unit circle in the coordinate plane, circular functions and trigonometric functions.									
B. Recognizes and translates among various representations (e.g., written, numerical, tabular, graphical, algebraic) of trigonometric functions and their inverses.									
C. Recognizes and uses connections among significant properties (e.g., zeros, axes of symmetry, local extrema) and characteristics (e.g., amplitude, frequency, phase shift) of trigonometric functions, the graphs of functions and the functions' symbolic representations.									
D. Understands the relationships between trigonometric functions and their inverses and uses those relationships to solve problems.									
E. Uses trigonometric identities to simplify expressions and solve equations.									
F. Models and solves a variety of problems (e.g., analyzing periodic phenomena) using trigonometric functions.									
G. Uses graphing calculators to analyze and solve problems involving trigonometric functions.									

Required Course Numbers										
Test Content Categories										
Competency 010: <i>The teacher understands and solves problems using differential and integral calculus.</i>										
A. Understands the concept of limit and the relationship between limits and continuity.										
B. Relates the concepts of proportionality, rates and average rate of change and applies those concepts to the slope of the secant line and the concept of instantaneous rate of change to the slope of the tangent line.										
C. Uses the first and second derivatives to analyze the graph of a function (e.g., local extrema, concavity, points of inflection).										
D. Understands and applies the fundamental theorem of calculus and the relationship between differentiation and integration.										
E. Models and solves a variety of problems (e.g., velocity, acceleration, optimization, related rates, work, center of mass) using differential and integral calculus.										
F. Analyzes how technology can be used to solve problems and illustrate concepts involving differential and integral calculus.										

Required Course Numbers										
Test Content Categories										
Domain III — Geometry and Measurement										
Competency 011: <i>The teacher understands measurement as a process.</i>										
A. Applies dimensional analysis to derive units and formulas in a variety of situations (e.g., rates of change of one variable with respect to another) and to find and evaluate solutions to problems.										
B. Applies formulas for perimeter, area, surface area and volume of geometric figures and shapes (e.g., polygons, pyramids, prisms, cylinders, cones, spheres) to solve problems.										
C. Recognizes the effects on length, area or volume when the linear dimensions of plane figures or solids are changed.										
D. Applies the Pythagorean theorem, proportional reasoning and right triangle trigonometry to solve measurement problems.										
E. Relates the concept of area under a curve to the limit of a Riemann sum.										
F. Uses integral calculus to compute various measurements associated with curves and regions (e.g., area, arc length) in the plane and measurements associated with curves, surfaces and regions in three-space.										

Required Course Numbers											
Test Content Categories											
Competency 012: <i>The teacher understands geometries, in particular Euclidian geometry, as axiomatic systems.</i>											
A.	Understands axiomatic systems and their components (e.g., undefined terms, defined terms, theorems, examples, counterexamples).										
B.	Uses properties of points, lines, planes, angles, lengths and distances to solve problems.										
C.	Applies the properties of parallel and perpendicular lines to solve problems.										
D.	Uses properties of congruence and similarity to explore geometric relationships, justify conjectures and prove theorems.										
E.	Describes and justifies geometric constructions made using compass and straightedge, reflection devices and other appropriate technologies.										
F.	Demonstrates an understanding of the use of appropriate software to explore attributes of geometric figures and to make and evaluate conjectures about geometric relationships.										
G.	Compares and contrasts the axioms of Euclidean geometry with those of non-Euclidean geometry (i.e., hyperbolic and elliptic geometry).										

Required Course Numbers										
Test Content Categories										
Competency 013: <i>The teacher understands the results, uses and applications of Euclidian geometry.</i>										
A. Analyzes the properties of polygons and their components.										
B. Analyzes the properties of circles and the lines that intersect them.										
C. Uses geometric patterns and properties (e.g., similarity, congruence) to make generalizations about two- and three-dimensional figures and shapes (e.g., relationships of sides, angles).										
D. Computes the perimeter, area and volume of figures and shapes created by subdividing and combining other figures and shapes (e.g., arc length, area of sectors).										
E. Analyzes cross sections and nets of three-dimensional shapes.										
F. Uses top, front, side and corner views of three-dimensional shapes to create complete representations and solve problems.										
G. Applies properties of two- and three-dimensional shapes to solve problems across the curriculum and in everyday life, including in art, architecture and music.										
H. Uses similarity, geometric transformations, symmetry and perspective drawings to describe mathematical patterns and structure in architecture.										

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Test Content Categories										
I. Uses scale factors with two-dimensional and three-dimensional objects to demonstrate proportional and non-proportional changes in surface area and volume as applied to fields.										
J. Uses the Pythagorean theorem and special right-triangle relationships to calculate distances.										
K. Uses trigonometric ratios to calculate distances and angle measures as applied to fields, including using models of periodic behavior in art and music.										
L. Solves geometric problems involving indirect measurement, including similar triangles, the Pythagorean theorem, law of sines, law of cosines and the use of dynamic geometry software.										
Competency 014: <i>The teacher understands coordinate, transformational and vector geometry and their connections.</i>										
A. Identifies transformations (i.e., reflections, translations, glide reflections, rotations and dilations) and explores their properties.										
B. Uses the properties of transformations and their compositions to solve problems.										
C. Uses transformations to explore and describe reflectional, rotational and translational symmetry.										
D. Applies transformations in the coordinate plane.										

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Test Content Categories										
E. Applies concepts and properties of slope, midpoint, parallelism, perpendicularity and distance to explore properties of geometric figures and solve problems in the coordinate plane.										
F. Uses coordinate geometry to derive and explore the equations, properties and applications of conic sections (i.e., lines, circles, hyperbolas, ellipses, parabolas).										
G. Relates geometry and algebra by representing transformations as matrices and uses this relationship to solve problems.										
H. Explores the relationship between geometric and algebraic representations of vectors and uses this relationship to solve problems.										
Domain IV – Probability and Statistics										
Competency 015: <i>The teacher understands how to use appropriate graphical and numerical techniques to explore data, characterize patterns and describe departures from patterns.</i>										
A. Selects and uses an appropriate measurement scale (i.e., nominal, ordinal, interval, ratio) to answer research questions and analyze data.										
B. Organizes, displays and interprets data in a variety of formats (e.g., tables, frequency distributions, scatterplots, stem-and-leaf plots, box-and-whisker plots, histograms, pie charts).										

Required Course Numbers										
Test Content Categories										
C. Applies concepts of center, spread, shape and skewness to describe a data distribution.										
D. Understands measures of central tendency (i.e., mean, median and mode) and dispersion (i.e., range, interquartile range, variance, standard deviation).										
E. Applies linear transformations (i.e., translating, stretching, shrinking) to convert data and describes the effect of linear transformations on measures of central tendency and dispersion.										
F. Analyzes connections among concepts of center and spread, data clusters and gaps, data outliers and measures of central tendency and dispersion.										
G. Supports arguments, makes predictions and draws conclusions using summary statistics and graphs to analyze and interpret one-variable data.										
Competency 016: <i>The teacher understands concepts and applications of probability.</i>										
A. Understands how to explore concepts of probability through sampling, experiments and simulations and generates and uses probability models to represent situations.										
B. Uses the concepts and principles of probability to describe the outcomes of simple and compound events.										

Required Course Numbers										
Test Content Categories										
C. Determines probabilities by constructing sample spaces to model situations; uses a two-way frequency table as a sample space to identify whether two events are independent and to interpret the results; calculates expected value to analyze mathematical fairness, payoff and risk.										
D. Solves a variety of probability problems using combinations, permutations, and solves problems involving large quantities using combinatorics.										
E. Solves a variety of probability problems using ratios of areas of geometric regions.										
F. Calculates probabilities using the axioms of probability and related theorems and concepts (i.e., addition rule, multiplication rule, conditional probability, independence).										
G. Understands expected value, variance and standard deviation of probability distributions (e.g., binomial, geometric, uniform, normal).										
H. Applies concepts and properties of discrete and continuous random variables to model and solve a variety of problems involving probability and probability distributions (e.g., binomial, geometric, uniform, normal).										

Required Course Numbers										
Test Content Categories										
Competency 017: <i>The teacher understands the relationships among probability theory, sampling and statistical inference, and how statistical inference is used in making and evaluating predictions.</i>										
A. Applies knowledge of designing, conducting, analyzing and interpreting statistical experiments to investigate real-world problems.										
B. Analyzes and interprets statistical information (e.g., the results of polls and surveys) and recognizes misleading as well as valid uses of statistics.										
C. Understands random samples and sample statistics (e.g., the relationship between sample size and confidence intervals, biased or unbiased estimators).										
D. Makes inferences about a population using binomial, normal and geometric distributions.										
E. Describes, calculates and analyzes bivariate data using various techniques (e.g., scatterplots, regression lines, outliers, residual analysis, correlation coefficients).										
F. Understands how to transform nonlinear data into linear form in order to apply linear regression techniques to develop exponential, logarithmic and power regression models.										
G. Uses the law of large numbers and the central limit theorem in the process of statistical inference.										

Required Course Numbers										
Test Content Categories										
H. Estimates parameters (e.g., population mean and variance) using point estimators (e.g., sample mean and variance).										
I. Understands the principles of hypotheses testing.										
J. Determines the number of ways an event may occur using combinations, permutations and the fundamental counting principle.										
K. Compares theoretical to empirical probability.										
L. Uses experiments to determine the reasonableness of a theoretical model (i.e., binomial, geometric).										
M. Identifies limitations and lack of relevant information in studies reporting statistical information, especially when studies are reported in condensed form.										
N. Interprets and compares statistical results using appropriate technology given a margin of error.										
O. Identifies the variables to be used in a study.										
P. Analyzes possible sources of data variability, including those that can be controlled and those that cannot be controlled.										
Q. Reports results of statistical studies to a particular audience by selecting an appropriate presentation format, creating graphical data displays and interpreting results in terms of the question studied.										

Required Course Numbers										
Test Content Categories										
Domain V — Mathematical Processes and Perspectives										
Competency 018: <i>The teacher understands mathematical reasoning and problem solving.</i>										
A. Understands the nature of proof, including indirect proof, in mathematics.										
B. Applies correct mathematical reasoning to derive valid conclusions from a set of premises.										
C. Uses inductive reasoning to make conjectures and uses deductive methods to evaluate the validity of conjectures.										
D. Uses formal and informal reasoning to justify mathematical ideas.										
E. Understands the problem-solving process (i.e., recognizing that a mathematical problem can be solved in a variety of ways, selecting an appropriate strategy, evaluating the reasonableness of a solution).										
F. Evaluates how well a mathematical model represents a real-world situation.										

Required Course Numbers											
Test Content Categories											
Competency 019: <i>The teacher understands mathematical connections both within and outside of mathematics and how to communicate mathematical ideas and concepts.</i>											
A. Recognizes and uses multiple representations of a mathematical concept (e.g., a point and its coordinates, the area of a circle as a quadratic function of the radius, probability as the ratio of two areas, area of a plane region as a definite integral).											
B. Understands how mathematics is used to model and solve problems in other disciplines (e.g., art, music, science, social science, business).											
C. Translates mathematical ideas between verbal and symbolic forms.											
D. Communicates mathematical ideas using a variety of representations (e.g., numeric, verbal, graphical, pictorial, symbolic, concrete).											
E. Understands the use of visual media (e.g., graphs, tables, diagrams, animations) to communicate mathematical information.											
F. Uses appropriate mathematical terminology to express mathematical ideas.											

Required Course Numbers										
Test Content Categories										
G. Explores and applies concepts of financial literacy as it relates to teaching students (e.g., describes the basic purpose of financial institutions, distinguishes the difference between gross income and net income, identifies various savings options, defines different types of taxes, identifies the advantages and disadvantages of different methods of payment).										
H. Applies mathematics to model and solve problems to manage financial resources effectively for lifetime financial security (e.g., distinguishes between fixed and variable expenses, calculates profit in a given situation, develops a system for keeping and using financial records, describes actions that might be taken to balance a budget when expenses exceed income, balances a simple budget).										
I. Analyzes various voting and selection processes to compare results in given situations, selects and applies an algorithm of interest to solve real-life problems (e.g., using recursion or iteration to calculate population growth or decline, fractals or compound interest; determining validity in recorded and transmitted data using checksums and hashing; evaluating sports rankings, weighted class rankings and search-engine rankings; solving problems involving scheduling or routing using vertex-edge graphs, critical paths, Euler paths or minimal spanning trees), and communicates to peers the application of the algorithm in precise mathematical and nontechnical language.										

Required Course Numbers										
Test Content Categories										
J. Determines or analyzes an appropriate cyclical model for problem situations that can be modeled with periodic functions; determines or analyzes an appropriate piecewise model for problem situations; creates, represents and analyzes mathematical models for various types of income calculations to determine the best option for a given situation; creates, represents and analyzes mathematical models for expenditures, including those involving credit, to determine the best option for a given situation; creates, represents and analyzes mathematical models and appropriate representations, including formulas and amortization tables, for various types of loans and investments to determine the best option for a given situation.										
Domain VI — Mathematical Learning, Instruction and Assessment										
Competency 020: <i>The teacher understands how children learn mathematics and plans, organizes and implements instruction using knowledge of students, subject matter and statewide curriculum (Texas Essential Knowledge and Skills [TEKS]).</i>										
A. Applies research-based theories of learning mathematics to plan appropriate instructional activities for all students.										
B. Understands how students differ in their approaches to learning mathematics.										

Required Course Numbers										
Test Content Categories										
C. Uses students' prior mathematical knowledge to build conceptual links to new knowledge and plans instruction that builds on students' strengths and addresses students' needs.										
D. Understands how learning may be enhanced through the use of manipulatives, technology and other tools (e.g., stopwatches, scales, rulers).										
E. Understands how to provide instruction along a continuum from concrete to abstract.										
F. Understands a variety of instructional strategies and tasks that promote students' abilities to do the mathematics described in the TEKS.										
G. Understands how to create a learning environment that provides all students, including English-language learners, with opportunities to develop and improve mathematical skills and procedures.										
H. Understands a variety of questioning strategies to encourage mathematical discourse and help students analyze and evaluate their mathematical thinking.										
I. Understands how to relate mathematics to students' lives and a variety of careers and professions.										

Required Course Numbers										
Test Content Categories										
Competency 021: <i>The teacher understands assessment and uses a variety of formal and informal assessment techniques to monitor and guide mathematics instruction and to evaluate student progress.</i>										
A. Understands the purpose, characteristics and uses of various assessments in mathematics, including formative and summative assessments.										
B. Understands how to select and develop assessments that are consistent with what is taught and how it is taught.										
C. Understands how to develop a variety of assessments and scoring procedures consisting of worthwhile tasks that assess mathematical understanding, common misconceptions and error patterns.										
D. Understands the relationship between assessment and instruction and knows how to evaluate assessment results to design, monitor and modify instruction to improve mathematical learning for all students, including English-language learners.										

Required Course Numbers										
Test Content Categories										
Domain VII – Scientific Inquiry and Processes										
Competency 022: <i>The teacher understands how to select and manage learning activities to ensure the safety of all students and the correct use and care of organisms, natural resources, materials, equipment and technologies.</i>										
A. Uses current sources of information about laboratory safety, including safety regulations and guidelines for the use of science facilities.										
B. Recognizes potential safety hazards in the laboratory and in the field and knows how to apply procedures, including basic first aid, for responding to accidents.										
C. Employs safe practices in planning, implementing and managing all instructional activities and designs and implements rules and procedures to maintain a safe learning environment.										
D. Understands procedures for selecting, maintaining and safely using chemicals, tools, technologies, materials, specimens and equipment, including procedures for the recycling, reuse and conservation of laboratory resources and for the safe handling and ethical treatment of organisms.										

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E. Knows how to use appropriate equipment and technology (e.g., Internet, spreadsheet, calculator) for gathering, organizing, displaying and communicating data in a variety of ways (e.g., charts, tables, graphs, diagrams, maps, satellite images, written reports, oral presentations).										
F. Understands how to use a variety of tools, techniques and technology to gather, organize and analyze data and perform calculations and knows how to apply appropriate methods of statistical measures and analysis.										
G. Knows how to apply techniques to calibrate measuring devices and understands concepts of precision, accuracy and error with regard to reading and recording numerical data from scientific instruments (e.g., significant figures).										
H. Uses the International System of Units (i.e., metric system) and performs unit conversions within and across measurement systems.										
Competency 023: <i>The teacher understands the nature of science, the process of scientific inquiry and the unifying concepts that are common to all sciences.</i>										
A. Understands the nature of science, the relationship between science and technology, the predictive power of science and limitations to the scope of science (i.e., the types of questions that science can and cannot answer).										

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B. Knows the characteristics of various types of scientific investigations (e.g., descriptive studies, controlled experiments, comparative data analysis) and how and why scientists use different types of scientific investigations.										
C. Understands principles and procedures for designing and conducting a variety of scientific investigations, with emphasis on inquiry-based investigations, and knows how to communicate and defend scientific results.										
D. Understands how logical reasoning, verifiable observational and experimental evidence and peer review are used in the process of generating and evaluating scientific knowledge.										
E. Understands how to identify potential sources of error in an investigation, evaluate the validity of scientific data and develop and analyze different explanations for a given scientific result.										
F. Knows the characteristics and general features of systems, how properties and patterns of systems can be described in terms of space, time, energy and matter and how system components and different systems interact.										
G. Knows how to apply and analyze the systems model (e.g., interacting parts, boundaries, input, output, feedback, subsystems) across the science disciplines.										

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H. Understands how shared themes and concepts (e.g., systems, order and organization; evidence, models and explanation; change, constancy and measurements; evolution and equilibrium; and form and function) provide a unifying framework in science.										
I. Understands the difference between a theory and a hypothesis, how models are used to represent the natural world and how to evaluate the strengths and limitations of a variety of scientific models (e.g., physical, conceptual, mathematical).										
Competency 024: <i>The teacher understands the history of science, how science impacts the daily lives of students and how science interacts with and influences personal and societal decisions.</i>										
A. Understands the historical development of science, key events in the history of science and the contributions that various societies and individuals of both sexes have made to scientific knowledge.										
B. Knows how to use examples from the history of science to demonstrate the changing nature of scientific theories and knowledge (i.e., that scientific theories and knowledge are always subject to revision in light of new evidence).										
C. Knows that science is a human endeavor influenced by societal-and personal views of the world and that decisions about the use and direction of science are based on factors such as ethical standards, economics and personal and societal influences and needs.										

Required Course Numbers										
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D. Understands the application of scientific ethics to the conducting, analyzing and publishing of scientific investigations.										
E. Applies scientific principles to analyze factors (e.g., diet, exercise, personal behavior) that influence personal and societal choices concerning fitness and health (e.g., physiological and psychological effects and risks associated with the use of substances and substance abuse).										
F. Applies scientific principles, the theory of probability and risk/benefit analysis to analyze the advantages of, disadvantages of or alternatives to a given decision or course of action.										
G. Understands the role science can play in helping resolve personal, societal and global issues (e.g., recycling, population growth, disease prevention, resource use, evaluating product claims).										
Domain VIII — Physics										
Competency 025: <i>The teacher understands the description of motion in one and two dimensions.</i>										
A. Generates, analyzes and interprets graphs describing the motion of a particle.										
B. Applies vector concepts to displacement, velocity and acceleration in order to analyze and describe the motion of a particle.										

Required Course Numbers										
Test Content Categories										
C. Solves problems involving uniform and accelerated motion using scalar (e.g., speed) and vector (e.g., velocity) quantities.										
D. Analyzes and solves problems involving projectile motion.										
E. Analyzes and solves problems involving uniform circular and rotary motion.										
F. Understands motion of fluids.										
G. Understands motion in terms of frames of reference and relativity concepts.										
Competency 026: <i>The teacher understands the laws of motion.</i>										
A. Identifies and analyzes the forces acting in a given situation and constructs a free-body diagram.										
B. Solves problems involving the vector nature of force (e.g., resolving forces into components, analyzing static or dynamic equilibrium of a particle).										
C. Identifies and applies Newton's laws to analyze and solve a variety of practical problems (e.g., properties of frictional forces, acceleration of a particle on an inclined plane, displacement of a mass on a spring, forces on a pendulum).										

Required Course Numbers										
Test Content Categories										
Competency 027: <i>The teacher understands the concepts of gravitational and electromagnetic forces in nature.</i>										
A. Applies the law of universal gravitation to solve a variety of problems (e.g., determining the gravitational fields of the planets, analyzing properties of satellite orbits).										
B. Calculates electrostatic forces, fields and potentials.										
C. Understands the properties of magnetic materials and the molecular theory of magnetism.										
D. Identifies the source of the magnetic field and calculates the magnetic field for various simple current distributions.										
E. Analyzes the magnetic force on charged particles and current-carrying conductors.										
F. Understands induced electric and magnetic fields and analyzes the relationship between electricity and magnetism.										
G. Understands the electromagnetic spectrum and the production of electromagnetic waves.										

Required Course Numbers											
Test Content Categories											
Competency 028: <i>The teacher understands applications of electricity and magnetism.</i>											
A.	Analyzes common examples of electrostatics (e.g., a charged balloon attached to a wall, behavior of an electroscope, charging by induction).										
B.	Understands electric current, resistance and resistivity, potential difference, capacitance and electromotive force in conductors and circuits.										
C.	Analyzes series and parallel DC circuits in terms of current, resistance, voltage and power.										
D.	Identifies basic components and characteristics of AC circuits.										
E.	Understands the operation of an electromagnet.										
F.	Understands the operation of electric meters, motors, generators and transformers.										
Competency 029: <i>The teacher understands the conservation of energy and momentum.</i>											
A.	Understands the concept of work.										
B.	Understands the relationships among work, energy and power.										
C.	Solves problems using the conservation of mechanical energy in a physical system (e.g., determining potential energy for conservative forces, conversion of potential to kinetic energy, analyzing the motion of a pendulum).										

Required Course Numbers										
Test Content Categories										
D. Applies the work-energy theorem to analyze and solve a variety of practical problems (e.g., finding the speed of an object given its potential energy, determining the work done by frictional forces on a decelerating car).										
E. Understands linear and angular momentum.										
F. Solves a variety of problems (e.g., collisions) using the conservation of linear and angular momentum.										
Competency 030: <i>The teacher understands the laws of thermodynamics.</i>										
A. Understands methods of heat transfer (i.e., convection, conduction, radiation).										
B. Understands the molecular interpretation of temperature and heat.										
C. Solves problems involving thermal expansion, heat capacity and the relationship between heat and other forms of energy.										
D. Applies the first law of thermodynamics to analyze energy transformations in a variety of everyday situations (e.g., electric light bulb, power-generating plant).										
E. Understands the concept of entropy and its relationship to the second law of thermodynamics.										

Required Course Numbers										
Test Content Categories										
Competency 031: <i>The teacher understands the characteristics and behavior of waves.</i>										
A. Understands interrelationships among wave characteristics such as velocity, frequency, wavelength and amplitude and relates them to properties of sound and light (e.g., pitch, color).										
B. Compares and contrasts transverse and longitudinal waves.										
C. Describes how various waves are propagated through different media.										
D. Applies properties of reflection and refraction to analyze optical phenomena (e.g., mirrors, lenses, fiber-optic cable).										
E. Applies principles of wave interference to analyze wave phenomena, including acoustical (e.g., harmonics) and optical phenomena (e.g., patterns created by thin films and diffraction gratings).										
F. Identifies and interprets how wave characteristics and behaviors are used in medical, industrial and other real-world applications.										
Competency 032: <i>The teacher understands the fundamental concepts of quantum physics.</i>										
A. Interprets wave-particle duality.										
B. Identifies examples and consequences of the uncertainty principle.										
C. Understands the photoelectric effect.										

Required Course Numbers										
Test Content Categories										
D. Understands the quantum model of the atom and can use it to describe and analyze absorption and emission spectra (e.g., line spectra, blackbody radiation) and other phenomenon (e.g., radioactive decay, nuclear forces, nuclear reactions).										
E. Explores real-world applications of quantum phenomena (e.g., lasers, photoelectric sensors, semiconductors, superconductivity).										
Domain IX – Science Learning, Instruction and Assessment										
Competency 033: <i>The teacher understands research-based theoretical and practical knowledge about teaching science, how students learn science and the role of scientific inquiry in science instruction.</i>										
A. Knows research-based theories about how students develop scientific understanding and how developmental characteristics, prior knowledge, experience and attitudes of students influence science learning.										
B. Understands the importance of respecting all students by planning activities that are accessible and selecting and adapting science curricula, content, instructional materials and activities to meet the interests, knowledge, understanding, abilities, possible career paths and experiences of all students, including English-language learners.										

Required Course Numbers										
Test Content Categories										
C. Knows how to plan and implement strategies to encourage student self-motivation and engagement in their own learning (e.g., linking inquiry-based investigations to students' prior knowledge, focusing inquiry-based instruction on issues relevant to students, developing instructional materials using situations from students' daily lives, fostering collaboration among students).										
D. Knows how to use a variety of instructional strategies to ensure all students comprehend content-related texts, including how to locate, retrieve and retain information from a range of texts and technologies.										
E. Understands the science teacher's role in developing the total school program by planning and implementing science instruction that incorporates schoolwide objectives and the statewide curriculum as defined in the Texas Essential Knowledge and Skills (TEKS).										
F. Knows how to design and manage the learning environment (e.g., individual, small-group, whole-class settings) to focus and support student inquiries and to provide the time, space and resources for all students to participate in field, laboratory, experimental and nonexperimental scientific investigation.										
G. Understands the rationale for using active learning and inquiry methods in science instruction and how to model scientific attitudes such as curiosity, openness to new ideas and skepticism.										

Required Course Numbers										
Test Content Categories										
H. Knows principles and procedures for designing and conducting an inquiry-based scientific investigation (e.g., making observations; generating questions; researching and reviewing current knowledge in light of existing evidence; choosing tools to gather and analyze evidence; proposing answers, explanations and predictions; and communicating and defending results).										
I. Knows how to assist students with generating, refining, focusing and testing scientific questions and hypotheses.										
J. Knows strategies for assisting students in learning to identify, refine and focus scientific ideas and questions guiding an inquiry-based scientific investigation; to develop, analyze and evaluate different explanations for a given scientific result; and to identify potential sources of error in an inquiry-based scientific investigation.										
K. Understands how to implement inquiry strategies designed to promote the use of higher-level thinking skills, logical reasoning and scientific problem solving in order to move students from concrete to more abstract understanding.										
L. Knows how to guide students in making systematic observations and measurements.										

Required Course Numbers										
Test Content Categories										
M. Knows how to sequence learning activities in a way that uncovers common misconceptions, allows students to build upon their prior knowledge and challenges them to expand their understanding of science.										
Competency 034: <i>The teacher knows how to monitor and assess science learning in laboratory, field and classroom settings.</i>										
A. Knows how to use formal and informal assessments of student performance and products (e.g., projects, laboratory and field journals, rubrics, portfolios, student profiles, checklists) to evaluate student participation in and understanding of inquiry-based scientific investigations.										
B. Understands the relationship between assessment and instruction in the science curriculum (e.g., designing assessments to match learning objectives, using assessment results to inform instructional practice).										
C. Knows the importance of monitoring and assessing students' understanding of science concepts and skills on an ongoing basis by using a variety of appropriate assessment methods (e.g., performance assessment, self-assessment, peer assessment, formal/informal assessment).										
D. Understands the purposes, characteristics and uses of various types of assessment in science, including formative and summative assessments, and the importance of limiting the use of an assessment to its intended purpose.										

Required Course Numbers										
Test Content Categories										
E. Understands strategies for assessing students' prior knowledge and misconceptions about science and how to use those assessments to develop effective ways to address the misconceptions.										
F. Understands characteristics of assessments, such as reliability, validity and the absence of partiality in order to evaluate assessment instruments and their results.										
G. Understands the role of assessment as a learning experience for students and strategies for engaging students in meaningful self-assessment.										
H. Recognizes the importance of selecting assessment instruments and methods that provide all students with adequate opportunities to demonstrate their achievements.										
I. Recognizes the importance of clarifying teacher expectations by sharing evaluation criteria and assessment results with students.										