CERTIFICATION EXAMINATIONS
FOR OKLAHOMA EDUCATORS™ (CEOE™)

OKLAHOMA SUBJECT AREA TESTS™ (OSAT™)

FIELD 082: ELEMENTARY MATHEMATICS SPECIALIST
TEST FRAMEWORK

July 2013

Subarea	Range of Competencies
I. Number Concepts and Operations	0001–0002
II. Algebra and Functions	0003–0004
III. Geometry and Measurement	0005–0006
IV. Data Analysis and Probability	0007–0008
V. Pedagogical Knowledge and Instructional Leadership	0009–0011

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SUBAREA I—NUMBER CONCEPTS AND OPERATIONS

Competency 0001

Analyze the structure of number systems and the properties of the real number system.

The following topics are examples of content that may be covered under this competency.

- Analyze prenumber concepts (e.g., one-to-one correspondence, cardinality, order operations).

- Analyze the roles of place value and zero in a variety of base systems.

- Represent, compare, and order numbers using a variety of models (e.g., number lines, base-ten blocks, diagrams).

- Identify different representations of equivalent rational numbers (e.g., fractions, decimals, percents) and convert between them in mathematical and real-world situations.

- Analyze the characteristics of numbers (e.g., absolute value, odd and even) and of the sets of whole numbers, integers, rational numbers, real numbers, and complex numbers (e.g., inverse elements, density).

- Recognize common student misconceptions and errors related to the structure of number systems and the properties of the real number system and identify appropriate interventions to develop student understanding.

- Promote teachers' abilities to use results of various types of assessments to identify and differentiate instruction on the basis of students' needs (e.g., remediation, enrichment, extension) and to plan strategies that enhance student mathematical understanding in relation to the structure of number systems and the properties of the real number system.

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Competency 0002

Analyze number operations and computational algorithms.

The following topics are examples of content that may be covered under this competency.

- Apply basic concepts of number theory (e.g., factors, prime numbers, least common multiple).

- Analyze customary algorithms involving basic operations and their inverses with real and complex numbers, and use number properties and the order of operations to justify procedures and solve problems.

- Analyze alternative algorithms and multiple representations (e.g., rectangular arrays, partitioning, decomposing) of basic operations with whole numbers, fractions, and decimals.

- Apply a variety of algorithms appropriately and demonstrate knowledge of their advantages, limitations, and relationships.

- Apply estimation techniques and mental math strategies to real-world problems involving integers, fractions, decimals, and percents.

- Solve a variety of mathematical and real-world problems using whole numbers, integers, fractions, decimals, roots, powers, and rational exponents.

- Recognize common student misconceptions and errors related to number operations and computational algorithms and identify appropriate interventions to develop student understanding.

- Promote teachers' abilities to use results of various types of assessments to identify and differentiate instruction on the basis of students' needs (e.g., remediation, enrichment, extension) and to plan strategies that enhance student mathematical understanding in relation to number operations and computational algorithms.

SUBAREA II—ALGEBRA AND FUNCTIONS

Competency 0003

Analyze patterns, algebraic expressions, and functions.

The following topics are examples of content that may be covered under this competency.

- Identify and extend a variety of patterns (e.g., numbers, figures, expressions) and use a variety of number patterns to explore number properties.

- Analyze verbal, numeric, graphic, and symbolic representations of sequences.

- Justify the manipulation of algebraic expressions, equations, and inequalities.

- Manipulate and simplify algebraic expressions (e.g., factoring, laws of exponents) and solve equations and inequalities in both mathematical and real-world problems.

- Analyze the attributes of functions and relations (e.g., domain, one-to-one, inverse) and multiple representations (e.g., graphic, verbal, algebraic) of them.

- Analyze mathematical and real-world problems and translate them into algebraic expressions and equations.

- Recognize common student misconceptions and errors related to patterns, algebraic expressions, and functions and identify appropriate interventions to develop student understanding.

- Promote teachers' abilities to use results of various types of assessments to identify and differentiate instruction on the basis of students' needs (e.g., remediation, enrichment, extension) and to plan strategies that enhance student mathematical understanding in relation to patterns, algebraic expressions, and functions.

Competency 0004

Apply linear functions to model and solve problems.

The following topics are examples of content that may be covered under this competency.

- Identify the relationships among linear functions, proportions, and direct variation.

- Analyze the relationships among a linear function, its average rate of change, and its graph.

- Analyze the effects of transformations on the graphs of linear functions.

- Analyze linear functions and inequalities, using a variety of representations (e.g., tabular, graphic, verbal).

- Analyze and solve systems of linear equations and inequalities using a variety of techniques (e.g., algebraic, graphic).

- Model and solve mathematical and real-world problems involving linear functions, using a variety of representations (e.g., tabular, graphic, algebraic).

- Identify nonlinear functions (e.g., quadratic, exponential) in various representations (e.g., numeric, algebraic, graphic).

- Recognize common student misconceptions and errors related to modeling and problem solving with linear functions and identify appropriate interventions to develop student understanding.

- Promote teachers' abilities to use results of various types of assessments to identify and differentiate instruction on the basis of students' needs (e.g., remediation, enrichment, extension) and to plan strategies that enhance student mathematical understanding in relation to modeling and problem solving with linear functions.

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SUBAREA III—GEOMETRY AND MEASUREMENT

Competency 0005

Apply concepts of measurement.

The following topics are examples of content that may be covered under this competency.

- Use the customary and metric systems appropriately and convert within and between them.

- Use dimensional analysis to represent and solve problems in a variety of situations.

- Analyze and solve a variety of measurement problems involving length, perimeter, circumference, angles, area and surface area, volume, temperature, time, percentage, speed, and acceleration.

- Represent and solve mathematical and real-world problems involving ratios and proportions (e.g., percentages, rates, scale factors).

- Analyze and solve measurement problems involving composite geometric figures.

- Recognize the precision of measurements and estimate the effects of error on measurement.

- Use proportional reasoning to solve real-world measurement problems.

- Recognize common student misconceptions and errors related to concepts of measurement and identify appropriate interventions to develop student understanding.

- Promote teachers' abilities to use results of various types of assessments to identify and differentiate instruction on the basis of students' needs (e.g., remediation, enrichment, extension) and to plan strategies that enhance student mathematical understanding in relation to concepts of measurement.

Competency 0006

Apply concepts of Euclidean, transformational, and coordinate geometry.

The following topics are examples of content that may be covered under this competency.

- Demonstrate knowledge of Euclidean geometry as an axiomatic system.

- Justify geometric constructions and use logical reasoning to prove geometric relationships.

- Use concepts of Euclidean geometry (e.g., congruence and similarity, parallel and perpendicular lines) to solve mathematical and real-world problems involving one-, two-, and three-dimensional figures and shapes.

- Apply the Pythagorean theorem to solve problems.

- Analyze three-dimensional figures using two-dimensional representations (e.g., cross sections, perspective drawings).

- Analyze representations of polygons in the coordinate plane.

- Analyze polygons in the coordinate plane in terms of distance, midpoint, slope, and parallel and perpendicular lines.

- Analyze translations, reflections, glide reflections, rotations, and dilations of figures in terms of congruence and symmetry.

- Analyze tessellations in terms of symmetry and other geometric concepts, properties, and relationships.

- Apply concepts and properties of lines in the coordinate plane (e.g., distance, midpoint, slope) to explore the properties of geometric figures and to solve problems.

- Recognize common student misconceptions and errors related to concepts of Euclidean, transformational, and coordinate geometry and identify appropriate interventions to develop student understanding.

- Promote teachers' abilities to use results of various types of assessments to identify and differentiate instruction on the basis of students' needs (e.g., remediation, enrichment, extension) and to plan strategies that enhance student mathematical understanding in relation to concepts of Euclidean, transformational, and coordinate geometry.

SUBAREA IV—DATA ANALYSIS AND PROBABILITY

Competency 0007

Analyze and interpret data.

The following topics are examples of content that may be covered under this competency.

- Select appropriate formats for presenting different types of data.

- Compare and analyze data presented in a variety of formats (e.g., frequency distribution, boxplot, circle graph).

- Apply concepts of central tendency (e.g., mean, median, mode) and dispersion (e.g., range, standard deviation, percentiles) to data sets and data distributions.

- Analyze experimental designs, interpret results, and draw inferences from observations and experiments that investigate real-world problems.

- Analyze sampling techniques and select the appropriate approach in real-world situations.

- Analyze the relationship between sample size and the level of confidence in conclusions.

- Recognize common student misconceptions and errors related to the analysis and interpretation of data and identify appropriate interventions to develop student understanding.

- Promote teachers' abilities to use results of various types of assessments to identify and differentiate instruction on the basis of students' needs (e.g., remediation, enrichment, extension) and to plan strategies that enhance student mathematical understanding in relation to the analysis and interpretation of data.

Competency 0008

Apply concepts of probability.

The following topics are examples of content that may be covered under this competency.

- Solve problems involving counting techniques, combinations, and permutations.

- Identify the appropriate sample space in problems involving probability.

- Apply concepts of probability to solve problems involving simple and compound events.

- Use concepts of probability to identify simulations that model real-world and experimental situations.

- Apply appropriate probability distributions (e.g., uniform, normal, binomial) in given situations.

- Represent and solve problems using multiple representations (e.g., tree diagrams, Venn diagrams) of real-world situations.

- Recognize common student misconceptions and errors related to concepts of probability and identify appropriate interventions to develop student understanding.

- Promote teachers' abilities to use results of various types of assessments to identify and differentiate instruction on the basis of students' needs (e.g., remediation, enrichment, extension) and to plan strategies that enhance student mathematical understanding in relation to concepts of probability.

SUBAREA V—PEDAGOGICAL KNOWLEDGE AND INSTRUCTIONAL LEADERSHIP

Competency 0009

Demonstrate knowledge of mathematics instruction and assessment.

The following topics are examples of content that may be covered under this competency.

- Identify appropriate questions to assess students' mathematical understanding and advance their mathematical learning.

- Identify ways to support student learning and use of academic language and vocabulary.

- Identify sequences of instruction that develop students' content knowledge, reasoning skills, conceptual understanding, and computational fluency and precision.

- Identify problem-solving tasks that develop students' content knowledge, reasoning skills, conceptual understanding, and computational fluency and precision.

- Demonstrate knowledge of how tools (e.g., manipulatives, technology) can be used to enhance student understanding.

- Analyze and use assessment results from various types of instruments (e.g., diagnostic, formative, summative) to plan, inform, and adjust instruction.

- Recognize and use the vertical alignment of mathematical topics and concepts across grade levels to plan instruction based on state standards.

- Demonstrate knowledge of ways to promote equity for all students in mathematical instruction.

- Demonstrate knowledge of established research evidence on how students learn and use mathematics.

Competency 0010

Demonstrate knowledge of instructional leadership in mathematics.

The following topics are examples of content that may be covered under this competency.

- Recognize ways to establish a culture of collaboration in regard to the use of data to plan, evaluate, and improve mathematics instruction and to promote positive changes in the school mathematics program.

- Identify ways to promote and support a rigorous district instructional program based on research-supported best practices regarding curriculum, instruction, technology, and assessment.

- Demonstrate knowledge of ways to use professional resources (e.g., organizations, journals, discussion groups) to stay current regarding critical issues related to mathematics teaching and learning.

- Select appropriate and effective methods for communicating professionally with educational stakeholders about students, curriculum, instruction, use of technology, and assessment.

- Demonstrate knowledge of educational structures and policies that affect students' equitable access to quality mathematics instruction and promote the use of practices with proven effectiveness in promoting academic success for students with diverse characteristics and needs.

- Demonstrate knowledge of ways to use professional development (e.g., mentoring, coaching, peer-teaching, workshops) to facilitate appropriate research-supported, standards-based mathematical instruction and to promote the use of instructional methods supported by research.

In addition to answering selected-response questions, candidates will prepare a written response to an assignment summarized in the competency statement below.

Competency 0011

Prepare an organized analysis of student work and a response to this work.

Using your knowledge of instruction and assessment in mathematics, prepare an organized analysis of student work in one of the content areas described in subareas I–IV in which you identify any errors and misconceptions in the student work and create and justify a lesson plan or unit that could be used to reteach the mathematical topic.