

# DRAFT CHANGES TO SUBJECT MATTER KNOWLEDGE REQUIREMENTS FOR EDUCATOR LICENSURE

**PUBLIC COMMENT:** [WWW.SURVEYGIZMO.COM/S3/3620828/DRAFT-PUBLIC-COMMENT-SMK-UPDATES](http://WWW.SURVEYGIZMO.COM/S3/3620828/DRAFT-PUBLIC-COMMENT-SMK-UPDATES)

Subject matter knowledge requirements (SMKs) outline the minimum level of content and pedagogical skills Massachusetts educators are expected to hold. SMKs establish the content assessed in Massachusetts Tests for Educator Licensure ([MTEL](#)) and guide content-area coursework for educator preparation programs. SMKs are aligned to [Massachusetts curriculum frameworks](#).

Massachusetts regulation [603 CMR 7.06](#) requires a public comment period of at least thirty days prior to any changes to the guidelines where SMKs are published. More information on the 2017 proposed changes is available at [www.doe.mass.edu/edprep](http://www.doe.mass.edu/edprep).

## GENERAL SCIENCE

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### CURRENT SUBJECT MATTER KNOWLEDGE REQUIREMENTS 2011-2016

#### MATHEMATICS, LEVELS 1-6, 5-8, 8-12

(a) The following topics will be addressed on a subject matter knowledge test for **the 1-6 level:**

1. Basic principles and concepts related to elementary school mathematics in the areas of number sense and numeration, patterns and functions, geometry and measurement, and data analysis.
2. Algebra.
3. Euclidean geometry.

(b) The following topics will be addressed on a subject matter knowledge test for **the 5-8 level:**

1. Algebra.
2. Euclidean geometry.
3. Trigonometry.
4. Discrete/finite mathematics.
5. Introductory calculus through integration.
6. History of mathematics.

(c) The topics set forth in 603 CMR 7.06 (17) (b) and the following topics will be addressed on a subject matter knowledge test for **the 8-12 level:**

1. Abstract algebra.
2. Number theory.
3. Calculus through differential equations.
4. Probability and statistics.
5. Non-Euclidean and transformational geometries.
6. Applied mathematics or mathematics modeling



**MATHEMATICS, LEVELS 1-6, 5-8, 8-12**

The following topics will be addressed on a subject matter knowledge test for **the 1-6 level:**

(a) Comprehensive conceptual understanding, procedural knowledge, and problem-solving application skills of the following grade PreK-8 content domains:

1. Counting and Cardinality: Understand concepts of number including numbers as quantities and the concept of one to one correspondence
2. Operations and Algebraic Thinking: Understand properties of operations for computing using the operations of addition, subtraction, multiplication, and division with whole numbers, integers, and fractions and understand mathematical relationships and ways of representing relationships.
3. Numbers–Base Ten and fractions: Understand the concept of place value including decimals and understand fractions and their representations on a number line.
4. The Number System: Understand rational numbers and operations with rational numbers and know number classifications such as natural, whole, rational (including integers), and/or irrational.
5. Ratios and Proportional Relationships: Understand ratios and rates and connections to fractions and understand and apply proportional reasoning to solve problems in a variety of ways.
6. Geometry: Understand properties of two and three-dimensional shapes and understand the structure of the coordinate plane and its use to solve problems including applying the Pythagorean Theorem to solve problems.
7. Measurement: Understand length, area, and volume and their units of measure for both regular and irregular two and three-dimensional shapes.
8. Functions: Understand the concept of a function and their capacity to model relationships between quantities.
9. Expressions and Equations: Understand how expressions and equations are used to solve real-life and mathematical problems and understand correspondences between equations, verbal descriptions, tables, and graphs
10. Probability and Statistics: Understand statistical variability and statistical measures used to summarize and describe distributions of data and understand random sampling and its purposes and the probability of chance events.

The following topics will be addressed on a subject matter knowledge test for **the 5-8 level:**

(a) Comprehensive conceptual understanding, procedural knowledge, and problem solving application skills of the following grade PreK-8 content domains:

1. Operations and Algebraic Thinking: Understand properties of operations for computing using the operations of addition, subtraction, multiplication, and division with rational numbers and for representing numerical relationships in equivalent ways.
2. The Number System: Understand the system of rational numbers and their placement, ordering and absolute value on a number line.
3. Ratios and Proportional Relationships: Understand ratio and rate concepts and understand proportional reasoning and its usefulness for solving real world problems. Understand the connections between proportional relationships, lines, and linear equations.
4. Expressions and Equations: Understand properties of operations for computing with rational numbers in algebraic expressions and equations and for representing algebraic relationships in equivalent ways.
5. Functions: Understand the concept of function, and the correspondences between geometric transformations of graphs of functions and algebraic transformations of associated equations (including linear, quadratic, exponential, absolute value, and piecewise functions).
6. Measurement and Data: Understand concepts of length, area, and volume and relationships between different units of measurement. Understand representations for data measurements such as line plots.
7. Geometry: Understand properties and measurements of geometric figures and concepts of congruency and similarity and transformations in the plane.
8. Statistics and Probability: Understand data concepts, distributions, and statistical variability in data and samples and probabilities of chance events.

(b) Knowledge in these specific topics, drawn from the grades 9-12 conceptual categories and advanced mathematics subject matter:

1. Number Systems: Understand the properties of the rational and irrational number systems and complex numbers. Understand the properties of exponents extended to rational exponents.
2. Vector and Matrix Quantities: Understand vectors can represent quantities that change over time. Understand matrices and operations on matrices.
3. Algebraic operations, expressions, equations: Understand the reasoning behind the various methods for operating with expressions and for solving equations and systems of equations.
4. Polynomial, exponential, trigonometric, logarithmic, rational Functions: Understand functions in terms of their rate of growth, periodicity, zeros, asymptotes, maximum/minimum values.
5. Geometric proofs, arc length, and triangle trigonometry: Understand proofs in terms of transformations of congruent figures and rigid motion. Understand proofs based on similarity and trigonometric ratios in terms of similar right triangles as well as radian measure of an angle defined as the ratio of arc length to radius.
6. Random samples, Independence and conditional probability: Understand random processes underlying statistical experiments.
7. Limits and derivatives: Understand how limits and derivatives approximate the slope of a curve at a point on the curve.

The following topics will be addressed on a subject matter knowledge test for the **8-12 level**:

(a) Comprehensive conceptual understanding, procedural knowledge, and problem solving application skills of the following concepts.

1. Number and Quantity: Understand the difference between quantities and numbers. Understand similarities and difference in systems of numbers including real and complex numbers.
2. Algebra: Understand computations with and operations on algebraic expressions, equations and inequalities and the nature of solutions to equations and inequalities and systems of equations and equalities.
3. Functions: Understand that functions describe situations where one quantity determines another and their connections to expressions, equations, modeling, and coordinates.
4. Geometry: Understanding of the attributes and relationships of geometric objects and congruence, similarity, and symmetry from the perspective of geometric transformation.
5. Statistics and Probability: Understand statistics provides tools for describing variability in data and for making informed decisions that take it into account. Understand randomization concepts for sampling including the concept of statistically significant outcome

(b) Knowledge in these specific topics, drawn from advanced mathematics subject matter:

1. Linear Algebra: Matrices, matrix operations, and linear transformations.
2. Non-Euclidean Geometry: Spherical and Hyperbolic Geometries
3. Calculus including Series, Multi-Variable Calculus and introductory topics of Differential Equations, especially modeling
4. Discrete Mathematics, including combinatorics, set theory, recursion, and graph theory
5. Applications of mathematics and analytical modeling involving coordinates, algebra, and functions
6. Introduction to proofs, deductive reasoning: Understand axiomatic systems and their purpose in proofs and deductive reasoning.
7. Statistical Methods including experimental design, hypothesis testing, and confidence intervals.

(c) Concepts from grades K-7:

1. Conceptual understanding of fractions and decimals and their operations.
2. Conceptual understanding of place value and its relationship to algorithms.
3. Understanding of algebraic thinking.
4. Conceptual understanding of ratios, proportions, and proportional reasoning.

