

## Secondary Mathematics for Grades 7-12 (Ed 612.18) Self-Assessment Worksheet

### Ed 612.18 Secondary Mathematics For Grades 7-12

**Directions:** This matrix worksheet should be completed by the program. It should contain information that serves as an index or guide for the reviewers as they review all evidence provided. Evidence referenced on this worksheet should be clearly marked according to the standards. The same piece of evidence may meet more than one standard. Please reference specific parts of evidence whenever possible, particularly for large pieces of evidence.

<b>Ed 612.18 SECONDARY MATHEMATICS 7-12</b>	<b>DESCRIPTION OF HOW THE PROGRAM ADDRESSES THE STANDARD. INDICATE THE RELATIONSHIP TO ED 610.02 PROFESSIONAL EDUCATION STANDARDS (IF ANY).</b>	<b>DESCRIPTION OF THE ASSESSMENT SYSTEM USED TO PROVIDE EVIDENCE AND DATA AND TO INFORM CONTINUOUS IMPROVEMENT.</b>
(a) In compliance with RSA 193-C:3, IV(f) and consistent with RSA 193-C:3, III, the teacher preparation program in secondary mathematics for grades 7-12 shall require the candidate to demonstrate competency in the area of secondary mathematics, including techniques for enhancing student learning and the use of assessment results to improve instruction.		
(b) The mathematics program for grades 7-12 shall provide the teaching candidate with the skills, competencies, and knowledge gained through a combination of academic and supervised field-based experience in the following areas:		
(1) In the area of pedagogy, the candidate shall have the ability to:		

<p>a. Plan and conduct units and lessons appropriate for the grade range which:</p> <ol style="list-style-type: none"><li>1. Enable students to construct new concepts through active participation in mathematical modeling, investigations, and problem- solving;</li><li>2. Include multiple explanations and representations, including, but not limited to intuitive and formal arguments or proofs;</li><li>3. Incorporate literacy strategies that assist students in reading and understanding mathematics;</li><li>4. Provide opportunities for students to use written, oral, and other creative expressions to demonstrate their understanding of mathematical concepts to a variety of audiences;</li><li>5. Emphasize connections within and between mathematics and other disciplines;</li><li>6. Incorporate:<ol style="list-style-type: none"><li>(i) Manipulatives, including, but not limited to:<ol style="list-style-type: none"><li>i. Pattern Blocks™;</li><li>ii. Virtual manipulatives;</li><li>iii. Geoboards; and</li><li>iv. Algebra tiles; and</li></ol></li><li>(ii) Current technologies, including, but not limited to:<ol style="list-style-type: none"><li>i. Dynamic statistical and geometric programs;</li><li>ii. Data collection devices; and</li><li>iii. 21<sup>st</sup> century tools;</li></ol></li></ol></li><li>7. Model and nurture habits of minds within the context of</li></ol>		
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<p>mathematics; and</p> <p>8. Use technology appropriately and effectively in the learning and teaching of mathematics, including, but not limited to:</p> <ul style="list-style-type: none"> <li>(i) Scientific and graphing calculators;</li> <li>(ii) Computer-based laboratory (CBL) units;</li> <li>(iii) The internet; and</li> <li>(iv) Computer software including the 4 areas of: <ul style="list-style-type: none"> <li>i. Symbolic manipulators;</li> <li>ii. Dynamic geometry programs;</li> <li>iii. Spreadsheets; and</li> <li>iv. Statistical packages;</li> </ul> </li> </ul>		
<p>b. Apply an understanding of learning theories and styles to the teaching of mathematics appropriate for the grade range which articulate:</p> <ul style="list-style-type: none"> <li>1. Why conceptual knowledge of mathematics is needed in conjunction with the teaching of procedures or algorithms; and</li> <li>2. The role of teacher beliefs about mathematics and its effect on student learning;</li> </ul>		
<p>c. Plan and conduct a variety of assessments and evaluations appropriate for the grade range that:</p> <ul style="list-style-type: none"> <li>1. Diagnose students' preconceptions, misconceptions, and understandings of mathematics and continuously monitor students' understandings; and</li> <li>2. Evaluate procedural and conceptual understanding, and interpret students' mathematical</li> </ul>		

<p>processes and communication skills; and</p>		
<p>d. Demonstrate a capacity to appreciate and recognize the value of professional practices which include:</p> <ol style="list-style-type: none"> <li>1. Learning mathematics content independently and collaboratively; and</li> <li>2. Demonstrating knowledge of current state, national, and international research, standards, and recommendations regarding the teaching of the mathematics;</li> </ol>		
<p>(2) In the area of knowledge of mathematical processes and habits of mind, the candidate shall have the ability to:</p>		
<p>a. Use problem-solving to investigate and understand increasingly complex mathematical content, including, but not limited to, the ability to:</p> <ol style="list-style-type: none"> <li>1. Apply and adapt a problem-solving process using a variety of heuristics or strategies to solve problems that arise in mathematics and other contexts;</li> <li>2. Use problem-solving to develop one's own mathematical knowledge;</li> <li>3. Reflect upon solutions and the problem-solving process; and</li> <li>4. Refine problem-solving strategies, as needed;</li> </ol>		
<p>b. Use mathematical reasoning and proof, including, but not limited to, the ability to:</p> <ol style="list-style-type: none"> <li>1. Develop and evaluate mathematical conjectures;</li> <li>2. Construct and evaluate proofs and logical arguments to verify conjectures;</li> <li>3. Select and use various types of reasoning and methods of proof;</li> </ol>		

<p>and 4. Demonstrate the capacity to articulate an understanding of how reasoning and proof are integral components of mathematics;</p>		
<p>c. Communicate an understanding of mathematics, including, but not limited to, the ability to:</p> <ol style="list-style-type: none"> <li>1. Demonstrate the capacity to communicate coherently about mathematics and mathematics education in both written and oral ways using appropriate mathematical language and notation;</li> <li>2. Interpret and explain mathematical ideas acquired through reading mathematics in professional publications; and</li> <li>3. Analyze and assess the mathematical thinking and strategies of others;</li> </ol>		
<p>d. Create and use representations, including, but not limited to, the ability to:</p> <ol style="list-style-type: none"> <li>1. Illustrate learning progression from concrete to abstract representations;</li> <li>2. Articulate how the use of formal language and notation increases in importance as mathematical concepts are developed in the mathematics curriculum;</li> <li>3. Select, apply, and translate among mathematical representations to investigate mathematical concepts and solve mathematical problems; and</li> <li>4. Develop and use models to explain mathematical concepts;</li> </ol>		

<p>e. Recognize, explore, and develop mathematical connections, including, but not limited to, the ability to:</p> <ol style="list-style-type: none"> <li>1. Provide examples of how mathematics is practiced in various fields; and</li> <li>2. Build mathematical understanding by             <ol style="list-style-type: none"> <li>(i) Identifying and applying connections among mathematical ideas; and</li> <li>(ii) Showing how ideas build on one another across grade levels to form a coherent discipline;</li> </ol> </li> </ol>		
<p>f. Develop additional habits of the mind related to mathematics, including, but not limited to, the ability to:</p> <ol style="list-style-type: none"> <li>1. Learn mathematics independently;</li> <li>2. Exhibit a curiosity for mathematics;</li> <li>3. Recognize that learning from mistakes is an essential component when working mathematically;</li> <li>4. Recognize the power and value of estimation and mental computation when working mathematically;</li> <li>5. Understand the value and power of strategic use of technology when solving mathematical problems;</li> <li>6. Recognize that mathematics is the language of science and nature; and</li> <li>7. Recognize that mathematics is a tool for quantitative reasoning;</li> </ol>		
<p>(3) In the area of knowledge of the learner, including developmental and environmental characteristics appropriate for the grade range, the candidate shall have the ability to:</p>		

<p>a. Demonstrate appropriate strategies for helping students to:</p> <ol style="list-style-type: none"> <li>1. Move from concrete to abstract representations of mathematical concepts; and</li> <li>2. Connect conceptual and procedural knowledge;</li> </ol>		
<p>b. Communicate understanding of mathematics anxiety, including signs of it, issues related to it, and strategies to help students overcome it;</p>		
<p>c. Recognize that poor attitudes about mathematics solidify in the middle school years so that teachers need to address the affective domain; and</p>		
<p>d. Demonstrate knowledge of how exceptional students learn mathematics and strategies to use with exceptional students;</p>		
<p>(4) In the subject area of number and operations, the candidate shall have the ability to:</p>		
<p>a. Demonstrate a capacity to use models to explore and explain relationships, including magnitude, among fractions, decimals, percents, ratios, and proportions;</p>		
<p>b. Demonstrate knowledge of the historical development of number and number systems;</p>		
<p>c. Apply, explain, and justify concepts in number and number theory;</p>		
<p>d. Demonstrate computational proficiency and fluency, including the use of a variety of algorithms, estimation strategies, and mental mathematics techniques to judge the reasonableness of answers or approximate solutions;</p>		
<p>e. Demonstrate knowledge of concepts and applications of limits and infinity;</p>		

f. Demonstrate a capacity to apply the concepts of proportional reasoning;		
g. Demonstrate a capacity to make sense of large and small numbers and use scientific notation in mathematical and scientific modeling;		
h. Demonstrate a capacity to use physical materials and models to explore and explain the operations and properties of real and complex numbers with extensions to matrices and vectors;		
i. Identify and illustrate the mathematics underlying the theory of groups, rings and fields and the relationships among them; and		
j. Demonstrate a capacity to apply the concepts of integer and rational exponents through modeling and applications;		
(5) In the subject area of geometry and measurement, the candidate shall have the ability to:		
a. Build and manipulate representations of 2-and 3-dimensional objects and perceive an object from different perspectives;		
b. Analyze properties of and relationships among geometric shapes and structures;		
c. Apply transformations with connections to congruency and similarity;		
d. Demonstrate knowledge of non-Euclidean geometries and the historical development of the various geometries;		
e. Connect the ideas of algebra and geometry through the use of coordinate geometry, graphing, vectors, and motion geometry;		

f. Recognize measurement attributes and their effect on the choice of appropriate tools and units;		
g. Apply strategies, techniques, tools and formulas to determine measurements and their application in a variety of contexts;		
h. Demonstrate knowledge of the historical development of measurement and measurement systems;		
i. Employ estimation as a way of understanding measurement processes and units;		
j. Complete error analysis through determination of the reliability of numbers obtained from measurement;		
k. Understand and apply measurement conversion strategies;		
l. Apply geometric ideas and tools relating to the Pythagorean theorem, similar triangles, and trigonometry to solve problems;		
m. Use constructions, models, and dynamic geometric software to explore geometric relationships;		
n. Derive and explain formulas found in Euclidean geometry; and		
o. Construct proofs using the axioms of Euclidean and non-Euclidean geometries;		
(6) In the subject area of functions and algebra, the candidate shall have the ability to:		
a. Model and analyze change and rates of change in various contexts;		
b. Use mathematical models to understand, represent, and communicate quantitative relationships, including, but not limited to equality, equations, inequalities, and proportional		

relationships;		
c. Explore, analyze, and generalize a wide variety of patterns and functions using multiple representations including tables, graphs, written word, and symbolic rules;		
d. Represent information and solve problems using matrices;		
e. Use graphing utilities and other technological tools to represent, explain, and explore algebraic ideas including functions, equations, and expressions;		
f. Demonstrate knowledge of the historical development of algebra;		
g. Generalize patterns and functions using recursive and explicit representations;		
h. Articulate the meaning of functions and their inverse relationships, both formally and informally, with the use of concrete materials and graphing utilities;		
i. Understand and compare the properties of classes of functions and their inverses, including exponential, polynomial, rational, step, absolute value, root, logarithmic, and periodic, including trigonometric;		
j. Understand and apply major concepts of: <ul style="list-style-type: none"> <li>1. Linear algebra, including vector spaces and matrices; and</li> <li>2. Abstract algebra, including groups, rings, and fields;</li> </ul>		
k. Connect major concepts of linear and abstract algebra to the complex number system and other mathematical structures; and		
l. Understand, identify, and apply arithmetic and geometric sequences, including partial sums of infinite		

arithmetic and geometric sequences, with connections to linear and exponential functions;		
(7) In the subject area of data, statistics, and probability, the candidate shall have the ability to:		
a. Design investigations, collect data, display data in a variety of ways, and interpret data representations including bivariate data, conditional probability and geometric probability;		
b. Use appropriate methods to estimate population characteristics, test conjectured relationships among variables, and analyze data;		
c. Use appropriate statistical methods and technology to analyze data and describe shape, spread, and center;		
d. Use both descriptive and inferential statistics to analyze data, make predictions, test hypotheses, and make decisions;		
e. Draw conclusions involving uncertainty by using hands-on and computer-based simulations;		
f. Apply probability concepts in identifying odds, fair games, mathematical expectation, and invalid conclusions;		
g. Judge the validity of a statistical argument, including evaluating the sample from which the statistics were developed and identify misuses of statistics;		
h. Demonstrate knowledge of the historical development of probability and statistics;		
i. Determine and compare experimental, theoretical, and conditional probabilities; and		
j. Use statistical models to explore the connections between statistics and probability including correlation,		

regression, and analysis of variance;		
(8) In the subject area of calculus, the candidate shall have the ability to:		
a. Use mathematical modeling and the concepts of calculus to represent and solve problems from real-world contexts;		
b. Use technology to explore and represent fundamental concepts of calculus;		
c. Demonstrate knowledge of the historical development of calculus;		
d. Understand and describe the connection of calculus to middle and high school mathematics topics;		
e. Demonstrate a conceptual understanding of and procedural facility with basic calculus concepts including limits, continuity, differentiation, and integration; and		
f. Demonstrate an understanding of the basic concepts of multivariable calculus; and		
(9) In the subject area of discrete mathematics, the candidate shall:		
a. Have the ability to: <ol style="list-style-type: none"> <li>1. Apply the fundamental ideas of discrete mathematics in the formulation and solution of problems arising from real-world situations; and</li> <li>2. Use technology to solve problems involving the use of discrete structures; and</li> </ol>		
b. Demonstrate knowledge of the: <ol style="list-style-type: none"> <li>1. Historical development of discrete mathematics; and</li> <li>2. Basic elements of discrete mathematics, including but not limited to:             <ol style="list-style-type: none"> <li>(i) Graph theory;</li> </ol> </li> </ol>		

(ii) Propositional logic; (iii) Mathematical induction; (iv) Recurrence relations; (v) Finite differences; (vi) Linear programming; and (vii) Combinatorics.		
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Source. #2055, eff 6-16-82; ss by #2714, eff 5-16-84, EXPIRED 5-16-90

New. #4851, eff 6-25-90; EXPIRED 6-25-96

New. #6366, eff 10-30-96; ss by #7273, eff 7-1-00; (See Revision Note at part heading for Ed 612) (renumbered from Ed 612.11), EXPIRED: 7-1-08

New. #9715, eff 5-14-10