

## Mathematics Middle Level (4-8)

Standard 1: Knowledge of Mathematical Problem Solving			
Description	Indicators	Map to Field Experience / Map to Curriculum and Course Experiences	Assessment Strategies
Candidates know, understand, and apply the process of mathematical problem solving.	<p>Candidates can:</p> <ul style="list-style-type: none"> <li>• Apply and adapt a variety of appropriate strategies to solve problems.</li> <li>• Solve problems that arise in mathematics and those involving mathematics in other contexts.</li> <li>• Build new mathematical knowledge through problem solving.</li> <li>• Monitor and reflect on the process of mathematical problem solving.</li> </ul>		

Standard 2: Knowledge of Reasoning and Proof			
Description	Indicators	Map to Field Experience / Map to Curriculum and Course Experiences	Assessment Strategies
Candidates reason, construct, and evaluate mathematical arguments and develop an appreciation for mathematical rigor and	<p>Candidates can:</p> <ul style="list-style-type: none"> <li>• Recognize reasoning and proof as fundamental aspects of mathematics.</li> <li>• Make and investigate mathematical conjectures.</li> </ul>		

inquiry.	<ul style="list-style-type: none"> <li>• Develop and evaluate mathematical arguments and proofs.</li> <li>• Select and use various types of reasoning and methods of proof.</li> </ul>		
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### Standard 3: Knowledge of Mathematical Communication

Description	Indicators	Map to Field Experience / Map to Curriculum and Course Experiences	Assessment Strategies
Candidates communicate their mathematical thinking orally and in writing to peers, faculty, and others.	<p>Candidates can:</p> <ul style="list-style-type: none"> <li>• Communicate their mathematical thinking coherently and clearly to peers, faculty, and others.</li> <li>• Use the language of mathematics to express ideas precisely.</li> <li>• Organize mathematical thinking through communication.</li> <li>• Analyze and evaluate the mathematical thinking and strategies of others.</li> </ul>		

### Standard 4: Knowledge of Mathematical Connections

Description	Indicators	Map to Field Experience / Map to Curriculum and Course Experiences	Assessment Strategies
Candidates recognize, use, and make connections between and among mathematical ideas and in contexts outside mathematics to	<p>Candidates can:</p> <ul style="list-style-type: none"> <li>• Recognize and use connections among mathematical ideas.</li> <li>• Recognize and apply mathematics in contexts outside of mathematics.</li> </ul>		

build mathematical understanding.	<ul style="list-style-type: none"> <li>• Demonstrate how mathematical ideas interconnect and build on one another to produce a coherent whole.</li> </ul>		
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### Standard 5: Knowledge of Mathematical Representation

Description	Indicators	Map to Field Experience / Map to Curriculum and Course Experiences	Assessment Strategies
Candidates use varied representations of mathematical ideas to support and deepen students' mathematical understanding.	<p>Candidates can:</p> <ul style="list-style-type: none"> <li>• Use representations to model and interpret physical, social, and mathematical phenomena.</li> <li>• Create and use representations to organize, record, and communicate mathematical ideas.</li> <li>• Select, apply, and translate among mathematical representations to solve problems.</li> </ul>		

### Standard 6: Knowledge of Technology

Description	Indicator	Map to Field Experience / Map to Curriculum and Course Experiences	Assessment Strategies
Candidates embrace technology as an essential tool for teaching and learning mathematics.	<p>Candidates can:</p> <ul style="list-style-type: none"> <li>• Use knowledge of mathematics to select and use appropriate technological tools, such as but not limited to, spreadsheets, dynamic graphing tools, computer algebra systems, dynamic statistical</li> </ul>		

	packages, graphing calculators, data-collection devices, and presentation software.		
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### Standard 7: Dispositions

Description	Indicators	Map to Field Experience / Map to Curriculum and Course Experiences	Assessment Strategies
Candidates support a positive disposition toward mathematical processes and mathematical learning.	Candidates can: <ul style="list-style-type: none"> <li>• Attention to equity</li> <li>• Use of stimulating curricula</li> <li>• Effective teaching</li> <li>• Commitment to learning with understanding</li> <li>• Use of various assessments</li> <li>• Use of various teaching tools including technology</li> </ul>		

### Standard 8: Knowledge of Mathematics Pedagogy

Description	Indicators	Map to Field Experience / Map to Curriculum and Course Experiences	Assessment Strategies
Candidates possess a deep understanding of how students learn mathematics and of the pedagogical knowledge specific to mathematics teaching and learning.	Candidates can: <ul style="list-style-type: none"> <li>• Selects, uses, and determines suitability of the wide variety of available mathematics curricula and teaching materials for all students including those with special needs such as the gifted, challenged and speakers of other languages.</li> <li>• Selects and uses appropriate</li> </ul>		

	<p>concrete materials for learning mathematics.</p> <ul style="list-style-type: none"> <li>• Uses multiple strategies, including listening to and understanding the ways students think about mathematics, to assess students' mathematical knowledge.</li> <li>• Plans lessons, units and courses that address appropriate learning goals, including those that address local, state, and national mathematics standards and legislative mandates.</li> <li>• Participates in professional mathematics organizations and uses their print and on-line resources.</li> <li>• Demonstrates knowledge of research results in the teaching and learning of mathematics.</li> <li>• Uses knowledge of different types of instructional strategies in planning mathematics lessons.</li> <li>• Demonstrates the ability to lead classes in mathematical problem solving and in developing in-depth conceptual understanding, and to help students develop and test generalizations.</li> <li>• Develop lessons that use technology's potential for building understanding of mathematical concepts and developing important mathematical ideas.</li> </ul>		
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**Standard 9: Knowledge of Number and Operation**

Description	Indicators	Map to Field Experience / Map to Curriculum and Course Experiences	Assessment Strategies
Candidates demonstrate computational proficiency, including a conceptual understanding of numbers, ways of representing number, relationships among number and number systems, and meanings of operations.	<p>Candidates can:</p> <ul style="list-style-type: none"><li>• Develop the mathematics that underlies the procedures used for operations involving whole numbers, integers, and rational numbers.</li><li>• Use properties involving number and operations, mental computation, and computational estimation.</li><li>• Provide equivalent representations of fractions, decimals, and percents.</li><li>• Create, solve, and apply proportions.</li><li>• Apply the fundamental ideas of number theory.</li><li>• Make sense of large and small numbers and use scientific notation.</li><li>• Analyze and explain the distinctions among whole numbers, integers, rational numbers, and real numbers and whether or not the field axioms hold.</li><li>• Demonstrate knowledge of the historical development of number and number systems including contributions from diverse cultures.</li></ul>		

**Standard 10: Knowledge of Different Perspectives on Algebra**

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Description	Indicators	Map to Field Experience / Map to Curriculum and Course Experiences	Assessment Strategies
Candidates emphasize relationships among quantities including functions, ways of representing mathematical relationships, and the analysis of change.	<p>Candidates can:</p> <ul style="list-style-type: none"><li>• Explore, analyze, and represent patterns, relations, and functions.</li><li>• Represent and analyze mathematical structures.</li><li>• Investigate equality, equations, and proportional relationships.</li><li>• Use mathematical models to represent quantitative relationships.</li><li>• Analyze change in various contexts.</li><li>• Demonstrate knowledge of the historical development of algebra including contributions from diverse cultures.</li></ul>		

**Standard 11: Knowledge of Geometries**

Standard 11: Knowledge of Geometries			
Description	Indicators	Map to Field Experience / Map to Curriculum and Course Experiences	Assessment Strategies
Candidates use spatial visualization and geometric modeling to explore and analyze geometric shapes, structures, and their properties.	<p>Candidates can:</p> <ul style="list-style-type: none"><li>• Demonstrate knowledge of core concepts and principles of Euclidean and non-Euclidean geometries in two and three dimensions from both formal and informal perspectives.</li><li>• Exhibit knowledge of the role of axiomatic systems and proofs in</li></ul>		

	<p>geometry.</p> <ul style="list-style-type: none"> <li>• Analyze characteristics and relationships of geometric shapes and structures.</li> <li>• Build and manipulate representations of two- and three- dimensional objects and visualize objects from different perspectives.</li> <li>• Specify locations and describe spatial relationships using coordinate geometry, vectors, and other representational systems.</li> <li>• Apply transformations and use symmetry, similarity, and congruence to analyze mathematical situations.</li> <li>• Use concrete models, drawings, and dynamic geometric software to explore geometric ideas and their applications in real-world contexts.</li> <li>• Demonstrate knowledge of the historical development of Euclidean and non-Euclidean geometries including contributions from diverse cultures.</li> </ul>		
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## Standard 12: Knowledge of Calculus

Description	Indicators	Map to Field Experience / Map to Curriculum and Course Experiences	Assessment Strategies
Candidates demonstrate a conceptual understanding of limit, continuity, differentiation, and integration and a thorough background in the	<p>Candidates can:</p> <ul style="list-style-type: none"> <li>• Demonstrate a conceptual understanding of basic calculus concepts.</li> </ul> <p>Demonstrate knowledge of the</p>		



techniques and application of the calculus.	historical development of calculus including contributions from diverse cultures.		
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### Standard 13: Knowledge of Discrete Mathematics

Description	Indicators	Map to Field Experience / Map to Curriculum and Course Experiences	Assessment Strategies
Candidates apply the fundamental ideas of discrete mathematics in the formulation and solution of problems.	<p>Candidates can:</p> <ul style="list-style-type: none"> <li>• Demonstrate a conceptual understanding of the fundamental ideas of discrete mathematics</li> <li>• Use technological tools to apply the fundamental concepts of discrete mathematics.</li> <li>• Demonstrate knowledge of the historical development of discrete mathematics including contributions from diverse cultures.</li> </ul>		

### Standard 14: Knowledge of Data Analysis, Statistics, and Probability

Description	Indicators	Map to Field Experience / Map to Curriculum and Course Experiences	Assessment Strategies
Candidates demonstrate an understanding of concepts and practices related to data analysis, statistics, and probability.	<p>Candidates can:</p> <ul style="list-style-type: none"> <li>• Design investigations, collect data through random sampling or random assignment to treatments, and use a variety of ways to display the data and interpret data representations.</li> </ul>		

	<ul style="list-style-type: none"> <li>• Draw conclusions involving uncertainty by using hands-on and computer-based simulation for estimating probabilities and gathering data to make inferences and decisions.</li> <li>• Identify misuses of statistics and invalid conclusions from probability.</li> <li>• Use appropriate statistical methods and technological tools to analyze data and describe shape, spread, and center.</li> <li>• Investigate, interpret, and construct representations for conditional probability, geometric probability, and for bivariate data.</li> <li>• Demonstrate knowledge of the historical development of probability and statistics including contributions from diverse cultures.</li> </ul>		
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### Standard 15: Knowledge of Measurement

Description	Indicators	Map to Field Experience / Map to Curriculum and Course Experiences	Assessment Strategies
Candidates apply and use measurement concepts and tools.	<p>Candidates can:</p> <ul style="list-style-type: none"> <li>• Recognize measurement attributes and their effect on the choice of appropriate tools and units.</li> <li>• Apply techniques, tools, and formulas to determine measurements.</li> <li>• Employ estimation as a way of understanding measurement units and processes.</li> </ul>		

	<ul style="list-style-type: none"> <li>• Completes error analysis through determining the reliability of the numbers obtained from measurement.</li> <li>• Demonstrate knowledge of the historical development of measurement and measurement systems including contributions from diverse cultures.</li> </ul>		
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### Standard 16: Field-Based Experiences

Description	Indicators	Map to Field Experience / Map to Curriculum and Course Experiences	Assessment Strategies
Candidates complete field-based experiences in mathematics classrooms.	<p>Candidates can:</p> <ul style="list-style-type: none"> <li>• Engage in a sequence of planned opportunities prior to student teaching that includes observing and participating in middle grades mathematics classrooms under the supervision of experienced and highly qualified teachers.</li> <li>• Experience full-time student teaching in middle grades mathematics that is supervised by an experienced and highly qualified teacher and a university or college supervisor with middle grades mathematics teaching experience.</li> <li>• Demonstrate the ability to increase students' knowledge of mathematics.</li> </ul>		