HENRY COUNTY SCHOOLS

MATHEMATICS GRADUATION COMPETENCIES

Revised August 13, 2015

The goal of our mathematics curriculum is to foster solid mathematical reasoning. Mathematical reasoning allows us to devise and evaluate methods for solving problems, make and test conjectures about properties and relationships, and model the world around us.

"Pure mathematics is, in its way, the poetry of logical ideas."
Albert Einstein

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"If America is to maintain our high Competency of living, we must continue to innovate. We are competing with nations many times our size. We don't have a single brain to waste. Math and science are the engines of innovation. With these engines we can lead the world. We must demystify math and science so that all students feel the joy that follows understanding."
Dr. Michael Brown, Nobel Prize Laureate

Prepared Graduate Competencies in Mathematics

The prepared graduate competencies are the preschool through twelfth-grade concepts and skills that all students who complete the Henry County Schools education system must master to ensure their preparation and readiness for college and careers postsecondary.
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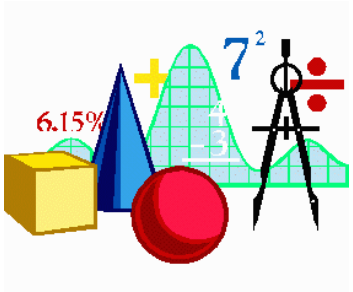
Prepared graduates in mathematics:

- ➢ Understand the structure and properties of our number system. At their most basic level numbers are abstract symbols that represent real-world quantities
- ➢ Understand quantity through estimation, precision, order of magnitude, and comparison. The reasonableness of answers relies on the ability to judge appropriateness, compare, estimate, and analyze error
- ➢ Are fluent with basic computation, and are able to select and use appropriate (mental math, paper and pencil, and technology) methods based on an understanding of their efficiency, precision, and transparency
- ➢ Make both relative (multiplicative) and absolute (arithmetic) comparisons between quantities. Multiplicative thinking underlies proportional reasoning.
- ➢ Recognize and make sense of the many ways that variability, chance, and randomness appear in a variety of contexts
- ➢ Solve problems and make decisions that depend on understanding, explaining, and quantifying the variability in data
- ➢ Understand that equivalence is a foundation of mathematics represented in numbers, shapes, measures, expressions, and equations
- ➢ Make sound predictions and generalizations based on patterns and relationships that arise from numbers, shapes, symbols, and data

- ➢ Apply transformation to numbers, shapes, functional representations, and data
- ➢ Make claims about relationships among numbers, shapes, symbols, and data and defend those claims by relying on the properties that are the structure of mathematics
- ➢ Communicate effective logical arguments using mathematical justification and proof.
- ➢ Mathematical argumentation involves making and testing conjectures, drawing valid conclusions, and justifying thinking
- ➢ Use critical thinking to recognize problematic aspects of situations, create mathematical models, and present and defend solutions

Mathematics Content Area Graduation Competencies

The Henry County Schools academic competencies in mathematics are the topical organization of the concepts and skills, including performance standards, every student should know and be able to demonstrate mastery of throughout their preschool through twelfth-grade experience.



Henry County Mathematics Scoring Criteria

Graduation Competency 1: The student uses mathematical practices to help make sense of the real world. The student can identify variables, formulate a model describing a relationship between the variables, interpret results, and validate and report conclusions and the reasoning behind them. *Student links classroom mathematics and statistics to everyday life, work, and decision-making. The student will choose and utilize appropriate mathematics and statistics to analyze empirical situations, to understand them better, and to improve decisions. When making mathematical models, technology is valuable for varying assumptions, exploring consequences, and comparing predictions with data. These practices are best interpreted not as a collection of isolated topics but rather in relation to other competencies.*

Competency #1. Performance Indicators K-12	**Addressed in this competency**	**Grade level**	**Courses**
1. Students can make sense of problems and persevere in solving them.	• explaining to themselves the meaning of a problem and looking for entry points to its solution • analyze givens, constraints, relationships, and goals • make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt • consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution • monitor and evaluate their progress and change course if necessary (older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need). • Explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. (younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem).	K-12	All

	● check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" ● understand the approaches of others to solving complex problems and identify correspondences between different approaches.		
2. Students can reason abstractly and quantitatively. MGSE9-12.N.Q.2	● make sense of quantities and their relationships in problem situations ● students have the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. ● create a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.	K-12	All
3. Students can construct viable arguments and critique the reasoning of others.	● understand and use stated assumptions, definitions, and previously established results in constructing arguments ● make conjectures and build a logical progression of statements to explore the truth of their conjectures ● analyze situations by breaking them into cases, and can recognize and use counterexamples ● justify their conclusions, communicate them to others, and respond to the arguments of others ● reason inductively about data, making plausible arguments that take into account the context from which the data arose ● compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is ● construct arguments using concrete referents such as objects, drawings, diagrams, and actions ● listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments	K-12	All
4. Students can model with mathematics.	● solve problems arising in everyday life, society, and the workplace ● comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later ● identify important quantities in a practical situation and map their relationships using	K-12	All

	such tools as diagrams, two-way tables, graphs, flowcharts and formulas and analyze those relationships mathematically to draw conclusions ● routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose		
5. Students can use appropriate tools strategically.	● consider the available tools when solving a mathematical problem (pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software) ● sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations ● detect possible errors by strategically using estimation and other mathematical knowledge ● when making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. ● identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems ● use technological tools to explore and deepen their understanding of concepts	K-12	All
6. Students can attend to precision. MGSE9-12.N.Q.1, MGSE9-12.N.Q.3	● communicate precisely to others ● use clear definitions in discussion with others and in their own reasoning ● state the meaning of the symbols they choose, including using the equal sign consistently and appropriately ● careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem ● calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context	K-12	All
7 Students can look for and make use of structure. MGSE9-12.A.SSE.1,1a,1b	● look closely to discern a pattern or structure ● recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems and can step back for an overview and shift perspective ● see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects	K-12	All
8. Students can look for and express regularity in repeated reasoning.	● notice if calculations are repeated, and look both for general methods and for shortcuts ● maintain oversight of the process, while attending to the details ● evaluate the reasonableness of their intermediate results	K-12	All

Standards for Mathematical Practice

The Georgia Standards of Excellence for Mathematics

The Standards for Mathematical Practice have been embedded in each Grade Level Expectation of the Henry County Schools Content Area Graduation Competencies for Mathematics. The following definitions and explanation of the Standards for Mathematical Practice from the Georgia Standards of Excellence can be found on pages 6, 7, and 8 in the Georgia Standards of Excellence for Mathematics.

Standards for Mathematical Practice

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important "processes and proficiencies" with longstanding importance in mathematics education. The first of these are the NCTM process standards of problem solving, reasoning and proof, communication, representation, and connections. The second are the strands of mathematical proficiency specified in the National Research Council's report Adding It Up: adaptive reasoning, strategic competence, conceptual understanding (comprehension of mathematical concepts, operations and relations), procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently and appropriately), and productive disposition (habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy).

1. Make sense of problems and persevere in solving them.

Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

2. Reason abstractly and quantitatively.

Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the

symbols involved. Quantitative reasoning entails habits of creating a coherent representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.

3. Construct viable arguments and critique the reasoning of others.

Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.

4. Model with mathematics.

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

5. Use appropriate tools strategically.

Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical

knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

6. Attend to precision.

Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

7. Look for and make use of structure.

Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see 7 × 8 equals the well remembered 7 × 5 + 7 × 3, in preparation for learning about the distributive property. In the expression $x^2 + 9x + 14$, older students can see the 14 as 2 × 7 and the 9 as 2 + 7. They recognize the significance of an

existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see 5 – 3(x – y)^2 as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers x and y.

8. Look for and express regularity in repeated reasoning.

Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through (1, 2) with slope 3, middle school students might abstract the equation (y – 2)/(x – 1) = 3. Noticing the regularity in the way terms cancel when expanding (x – 1)(x + 1), (x – 1)(x^2 + x + 1), and (x – 1)(x^3 + x^2 + x + 1) might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.

Connecting the Standards for Mathematical Practice to the Standards for Mathematical Content

The Standards for Mathematical Practice describe ways in which developing student practitioners of the discipline of mathematics increasingly ought to engage with the subject matter as they grow in mathematical maturity and expertise throughout the elementary, middle and high school years. Designers of curricula,

assessments, and professional development should all attend to the need to connect the mathematical practices to mathematical content in mathematics instruction. The Standards for Mathematical Content are a balanced combination of procedure and understanding. Expectations that begin with the word "understand" are often especially good opportunities to connect the practices to the content. Students who lack understanding of a topic may rely on procedures too heavily. Without a flexible base from which to work, they may be less likely to consider analogous problems, represent problems coherently, justify conclusions, apply the mathematics to practical situations, use technology mindfully to work with the mathematics, explain the mathematics accurately to other students, step back for an overview, or deviate from a known procedure to find a shortcut. In short, a lack of understanding effectively prevents a student from engaging in the mathematical practices. In this respect, those content standards which set an expectation of understanding are potential "points of intersection" between the Standards for Mathematical Content and the Standards for Mathematical Practice. These points of intersection are intended to be weighted toward central and generative concepts in the school mathematics curriculum that most merit the time, resources, innovative energies, and focus necessary to qualitatively improve the curriculum, instruction, assessment, professional development, and student achievement in mathematics.

Graduation Competency *#2:* **The student reasons, describes and analyzes quantitatively using units and number systems to make sense of and solve problems.** *Number sense provides students with a firm foundation in mathematics. Students build a deep understanding of quantity, ways of representing numbers, relationships among numbers, and number systems. Students learn that numbers are governed by properties and understand that these properties lead to fluency with operations.*

Performance Indicators Elementary (K-2) Competency 2.
Number and Operations in Base Ten a. The student explains and make generalizations about the patterns in the place value system and uses this understanding and the properties of operations to perform single and multi-digit arithmetic. **Measurement and Data** b. The student demonstrates an understanding of measurement concepts (time, length, and/or money) by devising an approach to measure using appropriate tools, constructing reasonable estimates and solving problems involving addition and subtraction.

Performance Indicator Scoring Criteria for Competency 2.

Performance Indicators Grades K-2	Emerging	Progressing	Competent	Exemplary
a.The student explains and makes generalizations about the patterns in the place value system and uses this understanding and the properties of operations to perform single and multi-digit arithmetic. MGSE.K.CC.1, 2, 4, 5 MGSE.K.OA.1, 2, 3, 4 MGSE.K.NBT.1	The student identifies place value and performs single and/or multi-digit arithmetic.	The student recognizes that there are patterns in the place value system and acknowledges that there are properties of operations when performing single and/or multi-digit arithmetic.	The student explains and makes generalizations about the patterns in the place value system and uses this understanding and the properties of operations to perform single and/or multi-digit arithmetic.	The competent student makes sense of and solves problems and defends a mathematical model in an authentic context and/or problems that exist across disciplines.

MGSE.1.OA.1, 2, 3, 4, 5, 6, 8 MGSE.1.NBT.1, 2, 4, 5, 6 MGSE.2.OA. 1, 2, 3, 4 MGSE.2.NBT.2, 3, 5, 6, 7, 8, 9				
b. The student demonstrates an understanding of measurement concepts (time, length, and/or money) by devising an approach to measure using appropriate tools, constructing reasonable estimates and solving problems involving addition and subtraction. MGSE.K.MD.2 MGSE.1.MD.2, 3 MGSE.2.MD.1, 2, 3, 4, 5, 6, 7, 8	The student understands time length and/or money can be measured, but uses an unreliable approach and/or inappropriate tool.	The student demonstrates an understanding of measurement concepts (time, length, and/or money) by devising an approach to measure using appropriate tools and constructing estimates.	The student demonstrates an understanding of measurement concepts (time, length, and/or money) by devising an approach to measure using appropriate tools, constructing reasonable estimates and solving problems involving addition and subtraction.	The competent student makes sense of and solves problems and defends a mathematical model in an authentic context and/or problems that exist across disciplines.
Sample Tasks: https://www.illustrativemathematics.org/content-standards/K/NBT/A/1/tasks/1404 https://www.illustrativemathematics.org/content-standards/1/NBT/B/2/tasks/1150 https://www.illustrativemathematics.org/content-standards/2/NBT/B/5/tasks/1071 http://www.insidemathematics.org/assets/common-core-math-tasks/pocket%20money.pdf http://www.insidemathematics.org/assets/problems-of-the-month/measuring%20mammals.pdf http://www.insidemathematics.org/assets/problems-of-the-month/rod%20trains.pdf https://www.illustrativemathematics.org/content-standards/1/MD/A/2/tasks/1086				

Performance Indicators Elementary (3-5) for Competency 2.

Number and Operations in Base Ten

a. The student explains and make generalizations about the patterns in the place value system and uses this understanding and the properties of operations to perform single and multi-digit arithmetic, including whole numbers and decimals.

Measurement and Data
b. The student demonstrates an understanding of measurement concepts (time, length, and/or money) by constructing reasonable estimates and solving problems involving all four operations (addition, subtraction, multiplication, and division).

Number and Operations—Fractions
c. The student demonstrates an understanding of fractions (concepts of fractional/decimal parts, estimating, equivalency, ordering) and operations with fractions by applying and extending previous understandings of whole numbers through the use of visual models to represent and explain concepts.

Performance Indicators Scoring Criteria for Competency 2.

Performance Indicators Grades 3-5	Emerging	Progressing	Competent	Exemplary
a. The student explains and make generalizations about the patterns in the place value system and uses this understanding and the properties of operations to perform single and multi-digit arithmetic, including whole numbers and decimals. MGSE.3.OA.1, 2, 3, 4, 5, 6, 7 MGSE.3.NBT.1, 2, 3 MGSE.4.NBT.1, 2, 4 MGSE.5.NBT.1, 2, 3, 4, 5, 6, 7	The student identifies place value and performs single and multi-digit arithmetic, including whole numbers and/or decimals.	The student recognizes that there are patterns in the place value system and acknowledges that there are properties of operations, but is unable to apply this understanding when performing single and multi-digit arithmetic, including whole numbers and/or decimals.	The student explains and makes generalizations about the patterns in the place value system and uses this understanding and the properties of operations to perform single and multi-digit arithmetic, including whole numbers and/or decimals.	The competent student makes sense of and solves problems and defends a mathematical model in an authentic context and/or problems that exist across disciplines.
b.The student demonstrates an understanding of	The student can relate measurement of length,	The student can measure lengths indirectly and directly	The student demonstrates an understanding of	The competent student makes sense of and solves

measurement concepts (time, length, and/or money) by constructing reasonable estimates and solving problems involving all four operations (addition, subtraction, multiplication, and division). MGSE.3.MD.1 MGSE.4.MD.1, 2, 3	time and money to addition and subtraction.	with units and relate measurement to time and money.	measurement concepts (time, length, and/or money) by constructing reasonable estimates and solving problems involving all four operations (addition, subtraction, multiplication, and division).	problems and defends a mathematical model in an authentic context and/or problems that exist across disciplines.
c. Based upon previous understanding of operations with whole numbers, the student can develop an understanding of fractions as numbers, equate them to decimal notation, and apply operations using fractions. MGSE.3.NF.1, 2, 3 MGSE.4.NF. 1, 2,3, 4, 5, 6, 7 MGSE.5.NF.1, 2, 3, 4, 5, 6, 7	The student identifies fractions as numbers and is able to build fractions from unit fractions..	The student can add and subtract fractions using equivalent fractions and can convert fractions to decimal notation.	The students can perform all arithmetic operations with fractions and their equivalent decimals by applying and extending previous understandings of operations with whole numbers.	The competent student makes sense of and solves problems and defends a mathematical model in an authentic context and/or problems that exist across disciplines.
Sample Tasks: http://www.insidemathematics.org/assets/common-core-math-tasks/leapfrog%20fractions.pdf http://www.insidemathematics.org/assets/common-core-math-tasks/adding%20numbers.pdf https://www.illustrativemathematics.org/content-standards/4/MD/A/1/tasks/1508 https://www.illustrativemathematics.org/content-standards/5/NBT/A/2/tasks/1620 https://www.illustrativemathematics.org/content-standards/4/NBT/B/5/tasks/1808 https://www.illustrativemathematics.org/content-standards/4/NBT/B/6/tasks/1774 https://www.illustrativemathematics.org/content-standards/4/MD/A/2/tasks/873				

Graduation Competency #2: The student reasons, describes and analyzes quantitatively using units and number systems to make sense of and solve problems. *Number sense provides students with a firm foundation in mathematics. Students build a deep understanding of quantity, ways of representing numbers, relationships among numbers, and number systems. Students learn that numbers are governed by properties and understand that these properties lead to fluency with operations.*

Performance Indicators Middle (6-8) for Competency 2.
Ratios and Proportional Relationships a. Understand and analyze ratio concepts and use ratio reasoning to solve problems. **The Number System** b. Apply and extend previous understandings of multiplication and division to divide fractions by fractions. c. Compute fluently with multi-digit numbers and find common factors and multiples. d. Apply and extend previous understandings of numbers to the system of rational numbers. e. Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers. f. Know that there are numbers that are not rational, and approximate them by rational numbers.

Performance Indicators Scoring Criteria for Competency 2.

Performance Indicators Grades 6-8 (MP 2,4,5,6,7)	Emerging	Progressing	Competent	Exemplary
Understand and analyze ratio concepts and use ratio reasoning to solve problems. MGSE6.RP.1, MGSE6.RP.2, MGSE6.RP.3 a-d, MGSE7.RP.1, MGSE7.RP.2 a-d, MGSE7.RP.3	The student can recall procedures involving ratios with limited understanding.	The student can use number sense to solve problems involving ratios and proportional relationships.	The student can analyze ratio concepts and solve problems using ratios. The student can also use appropriate strategies fluently (accurately, flexibly, and efficiently).	The student can defend a mathematical model in an authentic context and apply existing knowledge to a situation that solves a problem in the community or across multiple disciplines.

b. Apply and extend previous understandings of multiplication and division to divide fractions by fractions. MGSE6.NS.1	The student can calculate the product and quotient of fractions.	The student can represent division of fractions using models/diagrams.	The student can use appropriate strategies fluently (accurately, flexibly, and efficiently) to reason, describe, and analyze problems involving division of fractions by fractions.	The student can defend a mathematical model in an authentic context and apply existing knowledge to a situation that solves a problem in the community or across multiple disciplines.
c. Compute fluently with multi-digit numbers and find common factors and multiples. MGSE6.NS.2, MGSE6.NS.4, MGSE6.RP.1	The student can calculate the sum, difference, product and quotient of multi-digit numbers.	The student can use appropriate strategies to compute the sum, difference, product and quotient with multi-digit numbers to find common factors or multiples.	The student can use appropriate strategies to compute fluently (accurately, flexibly, and efficiently) with multi-digit numbers and find common factors and multiples.	The student can defend a mathematical model in an authentic context and apply existing knowledge to a situation that solves a problem in the community or across multiple disciplines.
d. Apply and extend previous understandings of numbers to the system of rational numbers. MGSE6.NS.3, MGSE6.NS.5, MGSE6.NS.6a-c, MGSE6.NS.7a-d, MGSE6.NS.8	The student can represent and describe the system of rational numbers.	The student can give examples and non-examples of rational numbers in contexts.	The student can apply and extend previous understandings of numbers to the system of rational numbers in an authentic context.	The student can defend a mathematical model in an authentic context and apply existing knowledge to a situation that solves a problem in the community or across multiple disciplines.
e. Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers. MGSE6.NS.3, MGSE7.NS.1 a-d, MGSE7.NS.2 a-d, MGSE7.NS.3	The student can calculate the sums, differences, products or quotients of rational numbers.	The student can use appropriate strategies to compute the sums, differences, products and quotients of rational numbers.	The student can apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers in an authentic context using appropriate strategies.	The competent student can defend a mathematical model in an authentic context and apply existing knowledge to a situation that solves a problem in the community or across multiple disciplines.

f. Know that there are numbers that are not rational, and approximate them by rational numbers. MGSE8.NS.1, MGSE8.NS.2	The student can define irrational numbers.	The student can give examples and non-examples of irrational numbers.	The student knows that there are numbers that are not rational, and can approximate them by rational numbers.	The competent student can defend a mathematical model in an authentic context and apply existing knowledge to a situation that solves a problem in the community or across multiple disciplines.
Sample Tasks: https://www.illustrativemathematics.org/content-standards/6/NS/A/1/tasks/692 https://www.illustrativemathematics.org/content-standards/6/NS/B/4/tasks/256 https://www.illustrativemathematics.org/content-standards/6/NS/B/4/tasks/255 https://www.illustrativemathematics.org/content-standards/6/RP/A/2/tasks/1175 https://www.illustrativemathematics.org/content-standards/7/NS/A/1/tasks/310 https://www.illustrativemathematics.org/content-standards/8/NS/A/tasks/338				

Graduation Competency *#2:* **The student reasons, describes and analyzes quantitatively using units and number systems to make sense of and solve problems.** *Number sense provides students with a firm foundation in mathematics. Students build a deep understanding of quantity, ways of representing numbers, relationships among numbers, and number systems. Students learn that numbers are governed by properties and understand that these properties lead to fluency with operations.*

Competency # 2. Performance Indicators High School (9-12)
The Real Number System a. The student extends the properties of exponents to rational exponents and uses the properties of rational and irrational numbers. **Quantities** b. The student reasons quantitatively and uses units to solve problems.

The Complex Number System
c. The student performs arithmetic operations with complex numbers, represents complex numbers and their operations on the complex plane and uses complex numbers in polynomial identities and equations.

Vector and Matrix Quantities
d. The student represents and models with vector quantities and matrices, and performs operations on vectors and matrices.

Performance Indicators Scoring Criteria for Competency 2

Performance Indicators Grades 9-12 (MP 1,2,4,5,6,7)	Emerging	Progressing	Competent	Exemplary
a. The student extends the properties of exponents to rational exponents and uses the properties of rational and irrational numbers. MGSE9-12.N.RN.1	The student identifies the properties of exponents and rational and irrational numbers.	The student performs operations using properties of exponents and rational and irrational numbers.	The student extends the properties of exponents by rewriting expressions using rational exponents and solves problems using the properties of rational and irrational numbers.	The student analyzes and defends a mathematical model using the properties of exponents and rational and irrational numbers in context.
b. The student reasons quantitatively and uses units to solve problems. MGSE9-12.N.Q.1,2,3	The student identifies the appropriate units in a given context.	The student converts between common units of length, volume, weight, and time.	The student reasons quantitatively and uses units to solve problems, converting as appropriate.	The student critically analyzes quantitatively in a context requiring multiple conversions.
c. The student performs arithmetic operations with complex numbers, represents complex numbers and their operations on the complex plane and uses complex numbers in polynomial identities and equations. MGSE9-12. N.CN.1,2,3,4,5,6,7,8,9	The student identifies complex numbers and recognizes the plotted point on the complex plane.	The student performs arithmetic operations with complex numbers and represents numbers on the complex plane.	The student performs arithmetic operations with complex numbers, represents complex numbers and their operations on the complex plane and uses complex numbers in polynomial identities and equations.	The student analyzes and defends a mathematical model using complex numbers.

d. The student represents and models with vector quantities and matrices, and performs operations on vectors and matrices. MGSE9-12.N.V.M.1,2,3,4,4a,4b,4c,5,5a,5b,6,7,8,9,10,11,12 MGSE9-12.A.REI.8,9	The student identifies the components of vectors and matrices.	The student performs operations with vectors and matrices.	The student represents and models with vector quantities and matrices, and performs operations on vectors and matrices.	The student analyzes and defends a mathematical model using vectors and matrices in context.

Graduation Competency #3: The student creates, interprets, uses, and analyzes patterns of algebraic structures to make sense of problems. *Pattern sense gives students a lens with which to understand trends and commonalities. Students recognize and represent mathematical relationships and analyze change. Students learn that the structures of algebra allow complex ideas to be expressed succinctly.*

Competency #3. Performance Indicators Elementary School (K-2)
Operations and Algebraic Thinking a. The student models, evaluates, and explains problem solving situations involving addition and subtraction, applies the properties of operations, and explains the relationship between addition and subtraction.

Elementary School (3-5)
Operations and Algebraic Thinking a. The student models, evaluates, and explains problem solving situations involving all four operations, applies the properties of operations, and can explain the relationship between addition/subtraction and multiplication/division. b. The student generates, analyzes, and explains numerical patterns and relationships.

Measurement and Data
c. The student solves problems involving measurement and estimation of intervals of time, liquid volumes, and masses of objects, and the conversion of measurements from a larger unit to a smaller unit.

Performance Indicators Scoring Criteria for Competency 3

Performance Indicators Grades K-2	Emerging	Progressing	Competent	Exemplary
a. The student models, evaluates, and explains problem solving situations involving addition and subtraction, applies the properties of operations, and explains the relationship between addition and subtraction.	The student models a problem solving situation involving addition and/or subtraction.	The student models a problem solving situation involving addition and subtraction, and applies the properties of addition.	The student models, evaluates, and explains problem solving situations involving addition and subtraction, applies the properties of operations, and explains the relationship between addition and subtraction.	The competent student makes sense of and solves problems and defends a mathematical model in an authentic context and/or problems that exist across disciplines.
Sample Tasks: https://www.illustrativemathematics.org/content-standards/K/OA/A/2/tasks/70 https://www.illustrativemathematics.org/content-standards/K/OA/A/3/tasks/176 https://www.illustrativemathematics.org/content-standards/K/OA/A/3/tasks/175 https://www.illustrativemathematics.org/content-standards/1/OA/A/1/tasks/1152 https://www.illustrativemathematics.org/content-standards/1/OA/A/1/tasks/1317 http://www.insidemathematics.org/assets/problems-of-the-month/squirreling%20it%20away.pdf (Level A or B) https://www.illustrativemathematics.org/content-standards/2/OA/C/tasks/1304 http://www.insidemathematics.org/assets/problems-of-the-month/party%20time.pdf				

Performance Indicators Scoring Criteria for Competency 3

Performance Indicators Grades 3-5	Emerging	Progressing	Competent	Exemplary
a. The student models, evaluates, and explains problem solving situations involving all four operations, applies the properties of operations, and can explain the relationship between addition/subtraction and multiplication/division.	The student models a problem solving situation involving addition, subtraction, multiplication and division.	The student models a problem solving situation involving addition/subtraction and multiplication/division and applies the properties of operations.	The student models, evaluates, and explains problem solving situations involving all four operations, applies the properties of operations, and can explain the relationship between addition/subtraction and multiplication/division.	The competent student makes sense of and solves problems and defends a mathematical model in an authentic context and/or problems that exist across disciplines.
b. The student generates, analyzes, and explains numerical patterns and relationships.	The student generates numerical patterns.	The student generates and analyzes numerical patterns.	The student generates, analyzes, and explains numerical patterns and relationships.	The competent student makes sense of and solves problems and defends a mathematical model in an authentic context and/or problems that exist across disciplines.
c. The student solves problems involving measurement and estimation of intervals of time, liquid volumes, and masses of objects, and the conversion of measurements from a larger unit to a smaller unit.	The student solves problems involving measurement (intervals of time, liquid volume, masses of objects).	The student solves problems involving measurement and estimation of intervals of time, liquid volume, and masses of objects.	The student solves problems involving measurement and estimation of intervals of time, liquid volumes, and masses of objects, and the conversion of measurements from a larger unit to a smaller unit. .	The competent student makes sense of and solves problems and defends a mathematical model in an authentic context and/or problems that exist across disciplines.

Sample Tasks:
http://www.insidemathematics.org/assets/problems-of-the-month/diminishing%20return.pdf (Level A or B)
http://www.insidemathematics.org/assets/problems-of-the-month/digging%20dinosaurs.pdf (Level B)
https://www.illustrativemathematics.org/content-standards/4/OA/C/tasks/1484
https://www.illustrativemathematics.org/content-standards/5/MD/A/1/tasks/293
http://nrich.maths.org/34/solution

Graduation Competency #3: The student creates, interprets, uses, and analyzes patterns of algebraic structures to make sense of problems. *Pattern sense gives students a lens with which to understand trends and commonalities. Students recognize and represent mathematical relationships and analyze change. Students learn that the structures of algebra allow complex ideas to be expressed succinctly.*

Competency #3. Performance Indicators Middle School (6-8)

Expressions and Equations
a. Apply and extend previous understandings of arithmetic to algebraic expressions.
b. Reason about and solve one-variable equations and inequalities.
c. Represent and analyze quantitative relationships between dependent and independent variables.
d. Use properties of operations to generate equivalent expressions.
e. Solve real-life and mathematical problems using numerical and algebraic expressions and equations.
f. Work with radicals and integer exponents.
g. Understand the connections between proportional relationships, lines, and linear equations.
h. Analyze and solve linear equations and pairs of simultaneous linear equations.

Ratios and Proportional Relationships
i. Analyze proportional relationships and use them to solve real-world and mathematical problems.

Performance Indicators Scoring Criteria for Competency 3

Performance Indicators Grades 6-8 (MP 2,4,5,6,7)	Emerging	Progressing	Competent	Exemplary
a. Apply and extend previous understandings of arithmetic to algebraic expressions. MGSE6.EE.2a-b, MGSE7.EE.1, MGSE7.EE.2, MGSE7.EE.4a	The student can define algebraic expression.	The student can identify and interpret patterns.	The student can apply and extend previous understandings of arithmetic to explain patterns by writing algebraic expressions.	The student can use algebraic patterns, structures, and proportional relationships to defend a mathematical model and/or problem that exists across disciplines.
b. Reason about and solve one-variable equations and inequalities. MGSE6.EE.5, MGSE7.EE.4, MGSE8.EE.7	The student can use rote procedures to solve one-variable equations or inequalities with limited understanding.	The student can explain solutions to routine problems involving one-variable equations and inequalities.	The student can analyze similarities/differences between procedures or solutions and solve one-variable equations and inequalities in an authentic context.	The student can use algebraic patterns, structures, and proportional relationships to defend a mathematical model and/or problem that exists across disciplines.
c. Represent and analyze quantitative relationships between dependent and independent variables. MGSE6.EE.6, MGSE6.EE.9a-b, MGSE7.EE.4, MGSE8.EE.5, MGSE8.EE.6	The student can use rote procedures to solve algebraic problems with limited understanding.	The student can explain solutions to routine problems involving dependent and independent variables.	The student can represent and analyze quantitative relationships between dependent and independent variables in an authentic context.	The student can use algebraic patterns, structures, and proportional relationships to defend a mathematical model and/or problem that exists across disciplines.
d. Use properties of operations to generate equivalent expressions. MGSE6.EE.3, MGSE6.EE.4, MGSE7.EE.3, MGSE8.EE.1	The student can define equivalent expressions.	The student can identify equivalent expressions.	The student can use properties of operations to generate equivalent expressions.	The student can use properties of operations to defend a mathematical model and/or problem that exists across disciplines.

e. Solve real-life and mathematical problems using numerical and algebraic expressions and equations. MGSE6.EE.2c, MGSE7.EE.4a & c, MGSE8.EE.8	The student can use rote procedures to solve algebraic problems with limited understanding.	The student can use appropriate strategies to solve algebraic expressions and equations.	The student can solve real-life and mathematical problems involving numerical and algebraic expressions and equations.	The student can use algebraic patterns, structures, and proportional relationships to defend a mathematical model and/or problem that exists across disciplines.
f. Solve problems with radicals and/or integer exponents. MGSE6.EE.1, MGSE8.EE.1, MGSE8.EE.2, MGSE8.EE.3, MGSE8.EE.4	The student uses rote procedures to solve algebraic problems involving radicals and integer exponents with limited understanding.	The student can use appropriate strategies to solve algebraic problems involving radicals and integer exponents.	The student can solve problems with radicals and integer exponents in real world problem situations.	The student can use algebraic patterns, structures, and proportional relationships to defend a mathematical model and/or problem that exists across disciplines.
g. Understand the connections between proportional relationships, lines, and linear equations. MGSE7.RP.2, MGSE7.RP.2a, MGSE8.EE.7	The student can identify proportional relationships, lines, or linear equations.	The student can identify proportional relationships, lines, and linear equations.	The student can explain the connections between proportional relationships, lines, and linear equations using multiple representations.	The student can use algebraic patterns, structures, and proportional relationships to defend a mathematical model and/or problem that exists across disciplines.
h. Analyze and solve linear equations and pairs of simultaneous linear equations. MGSE7.RP.2c, MGSE8.EE.8	The student can use rote procedures to solve linear equations with limited understanding.	The student can solve linear equations and pairs of simultaneous linear equations.	The student can analyze and solve linear equations and pairs of simultaneous linear equations using multiple strategies.	The competent student can use algebraic patterns, structures, and proportional relationships to defend a mathematical model and/or problem that exists across disciplines.
i.Analyze proportional relationships and use them to solve real-world and mathematical problems. MGSE6.RP.3, MGSE7.RP.2a, MGSE8.EE.8c	The student can recognize mathematical patterns and proportional relationships.	The student can identify patterns as proportional relationships.	The student can analyze proportional relationships and use them to solve real-world and mathematical problems.	The competent student can use algebraic patterns, structures, and proportional relationships to defend a mathematical model and/or problem that exists across disciplines.

Sample Tasks:
Expressions and Equations
http://www.insidemathematics.org/assets/problems-of-the-month/growing%20staircases.pdf
https://www.illustrativemathematics.org/content-standards/8/EE/B/5/tasks/129
https://www.illustrativemathematics.org/content-standards/8/EE/C/8/tasks/554
https://www.illustrativemathematics.org/content-standards/8/EE/A/3/tasks/476

Graduation Competency #3: The student creates, interprets, uses, and analyzes patterns of algebraic structures to make sense of problems. *Pattern sense gives students a lens with which to understand trends and commonalities. Students recognize and represent mathematical relationships and analyze change. Students learn that the structures of algebra allow complex ideas to be expressed succinctly.*

Competency #3. Performance Indicators High School (9-12)

Seeing Structure in Expressions
a. The student interprets the structure of expressions and writes expressions in equivalent forms to solve problems.

Arithmetic with Polynomials and Rational Expressions
b. The student performs arithmetic operations on polynomials, understands the relationship between zeros and factors of polynomials, uses polynomial identities to solve problems and rewrites rational expressions.

Creating Equations
c. The student creates equations that describe numbers or relationships.

Reasoning with Equations and Inequalities
d. The student understands, represents and solves equations and inequalities in one variable both algebraically and graphically.
e. The student understands, represents and solves systems of equations and inequalities both algebraically and graphically.
f. Solve problems with radicals and integer exponents.

Performance Indicators Scoring Criteria for Competency 3

Performance Indicators Grades 9-12 (MP 1,2,4,5,6,7)	Emerging	Progressing	Competent	Exemplary
a. The student interprets the structure of expressions and writes expressions in equivalent forms to solve problems. MGSE9-12. A.SSE.1,1a,1b,2,3,3a,3b,3c,4	The student defines and identifies parts of an expression.	The student explains the meanings of the different parts of an expression according to the context of the problem.	The student interprets the structure of expressions and writes expressions in equivalent forms to solve problems.	The student creates an expression to model a given context.
b. The student performs arithmetic operations on polynomials, understands the relationship between zeros and factors of polynomials, uses polynomial identities to solve problems and rewrites rational expressions. MGSE9-12. A.APR.1,2,3,4,5,6,7	The student identifies polynomials and rational expressions.	The student recognizes polynomial identities and identifies zeros and factors of polynomials, and defines rational expressions.	The student performs arithmetic operations on polynomials, understands the relationship between zeros and factors of polynomials, uses polynomial identities to solve problems and rewrites rational expressions.	The student models a given situation using polynomials and/or rational expressions and analyzes and defends their solution in context.
c. The student creates equations that describe numbers or relationships. MGSE9-12.A.CED.2,4	The student chooses a variable to represent a number.	The student describes a relationship between numbers.	The student creates equations that describe numbers or relationships.	The student creates an equation in order to predict an outcome in a given context.
d. The student understands, represents and solves equations and inequalities in one variable both algebraically and graphically. MGSE9-12.A.REI.1, 3, 10, 12 MGSE9-12.A.CED.1, MGSE9-12.A.REI.2,4,4a,4b,11	The student identifies an equation or inequality, and builds a table of values.	The student identifies the independent and dependent variables in equations and inequalities and labels the axes, and solves basic equations and inequalities in one variable.	The student understands, represents and solves equations and inequalities in one variable both algebraically and graphically.	The student draws conclusions about problems using the graphs of equations and inequalities and justifies their reasoning.

e. The student understands, represents and solves systems of equations and inequalities both algebraically and graphically. MGSE9-12.A.REI.5, 6 MGSE9-12.A.CED.3	The student lists the methods of solving systems of equations.	The student explains the difference in the methods of solving systems and can solve using one of the methods.	The student understands, represents and solves systems of equations and inequalities both algebraically and graphically.	The student distinguishes the most efficient way to solve a system of equations and justifies their reasoning.
f. Solve problems with radicals and integer exponents. MGSE9-12.N.RN.2, 3	The student uses rote procedures to solve algebraic problems involving radicals and integer exponents with limited understanding.	The student can use appropriate strategies to solve algebraic problems involving radicals and integer exponent.	The student can solve problems with radicals and integer exponents in real world problem situations.	The student can use algebraic patterns, structures, and proportional relationships to defend a mathematical model and/or problem that exists across disciplines.

Graduation Competency #4: The student uses functions to interpret and analyze a variety of contexts.
Functions describe situations where one quantity determines another. Functions describe situations where one quantity determines another. *In school mathematics, functions usually have numerical inputs and outputs and are often defined by an algebraic expression. Functions presented as expressions can model many important phenomena.*

Competency #4. Performance Indicators Elementary School (K-2)
Operations and Algebraic Thinking
a. The student organizes information in contexts using two column tables and analyzes data in the table by looking for and explaining patterns.

Competency #4. Performance Indicators Elementary School (3-5)
Operations and Algebraic Thinking
a. The student organizes information in contexts using two column tables and analyzes data in the table by looking for and explaining patterns.

Performance Indicators Scoring Criteria for Competency 3

Performance Indicators Grades K-2	Emerging	Progressing	Competent	Exemplary
a. The student organizes information in contexts using two column tables and analyzes data in the table by looking for and explaining patterns.	With limited understanding, the student constructs charts from a context.	The student constructs two-column charts or tables of data from a context.	The student organizes information in contexts using two column tables and analyzes data in the table by looking for and explaining patterns.	The competent student can organize information from an authentic context and/or problems that exist across disciplines.
Sample Tasks: http://nrich.maths.org/88 http://nrich.maths.org/137 http://nrich.maths.org/166&part=				

Performance Indicators Scoring Criteria for Competency 3

Performance Indicators Grades 3-5	Emerging	Progressing	Competent	Exemplary
a. The student organizes information in contexts using two column tables and analyzes data in the table by looking for and explaining patterns.	With limited understanding, the student constructs charts from a context.	The student constructs two-column charts or tables of data from a context.	The student organizes information in contexts using two column tables and analyzes data in the table by looking for and explaining patterns.	The competent student can organize information from an authentic context and/or problems that exist across disciplines.
Sample Tasks: http://www.insidemathematics.org/assets/common-core-math-tasks/houses%20in%20a%20row.pdf http://www.insidemathematics.org/assets/problems-of-the-month/digging%20dinosaurs.pdf (Level D) http://www.insidemathematics.org/assets/problems-of-the-month/first%20rate.pdf (Level A)				

Graduation Competency #4: The student uses functions to interpret and analyze a variety of contexts.
Functions describe situations where one quantity determines another. Functions describe situations where one quantity determines another. *In school mathematics, functions usually have numerical inputs and outputs and are often defined by an algebraic expression. Functions presented as expressions can model many important phenomena*

Competency # 4. Performance Indicators Middle School (6-8)
Functions a. The student can define, evaluate, and compare functions. b. The student can use functions to model relationships between quantities.

Performance Indicators Scoring Criteria for Competency 4

Performance Indicators Grades 6-8	Emerging	Progressing	Competent	Exemplary
a,The student can define, evaluate, and compare functions. MGSE8.F.1, MGSE8.F.2, MGSE8.F.3	The student can define functions.	The student can define and evaluate functions.	The student can define, evaluate, and compare functions.	The student can defend a mathematical model in an authentic context and apply existing knowledge to a situation involving functions and relationships between functions that solves a problem in the community or across multiple disciplines.
b. The student can use functions to model relationships between quantities. MGSE6.RP.3, MGSE7.RP.2, MGSE8.F.4, MGSE8.F.5	The student can identify inputs and outputs.	The student can use functions to model relationships between quantities, using a graph ***or*** equation.	The student can use functions to model relationships between quantities, using a graph ***and*** an equation.	The student can defend a mathematical model in an authentic context and apply existing knowledge to a situation involving functions and relationships between functions that solves a problem in the community or across multiple disciplines.

Sample Tasks:
https://www.illustrativemathematics.org/content-standards/8/F/A/3/tasks/813

Graduation Competency #4: The student uses functions to interpret and analyze a variety of contexts.
Functions describe situations where one quantity determines another. Functions describe situations where one quantity determines another. *In school mathematics, functions usually have numerical inputs and outputs and are often defined by an algebraic expression. Functions presented as expressions can model many important phenomena*

Competency #4. Performance Indicators High School (9-12)
Interpreting Functions a. The student understands and uses different representations to interpret and analyze functions by examining their key features, including function notation. **Building Functions** b. The student builds a function that models a relationship between two quantities and builds new functions from existing functions. **Linear, Quadratic, and Exponential Models** c. The student constructs and compares linear, quadratic and exponential models and solves problems and interprets expressions for functions in terms of the situation they model. **Trigonometric Functions** d. The student extends the domain of trigonometric functions using the unit circle, models periodic phenomena with trigonometric functions, and proves and applies trigonometric identities.

Performance Indicators Scoring Criteria for Competency 4

Performance Indicators Grades 9-12 (MP 1,2,4,5,6,7)	Emerging	Progressing	Competent	Exemplary
a. The student understands and uses different representations to interpret and analyze functions by examining their key features, including function notation and rate of change. MGSE9-12.F.IF.1,2,5,6 MGSE9-12.F.LE.1a,b,c, 5	The student defines a relation and a function, identifies dependent and independent variables, and recognizes different representations of a function.	The student identifies the domain and range, explains the different parts of a function, and compares multiple representations of functions.	The student understands and uses different representations to interpret and analyze functions by examining their key features, including function notation and rate of change.	The student creates a function rule to model a given situation or chooses which representation best models a problem and defends their choice.
b. The student builds a function that models a relationship between two quantities and builds new functions from existing functions. MGSE9-12.F.IF.3,4 MGSE9-12.F.BF.1b,1c,3, 4, 4a, 4b, 4c, 4d, 5	The student describes the relationship between two quantities.	The student models the relationship between two quantities with a function.	The student builds a function that models a relationship between two quantities and builds new functions from existing functions.	The student creates multiple functions to model a given situation, or composes two functions and uses that to determine if functions are inverses.
c. The student constructs and compares linear, quadratic and exponential models and solves problems and interprets expressions for functions, making conclusions about their meaning in terms of the	The student identifies the different forms of linear, quadratic, and exponential equations and their transformations.	The student distinguishes between situations that can be represented with linear, quadratic, and exponential functions and describes how a function changes when its parameters are changed.	The student constructs and compares linear, quadratic and exponential models and solves problems and interprets expressions for functions, making conclusions about their	The student constructs linear, quadratic, and exponential functions given a graph or description of the situation and defends their conclusions about the parameters of the function.

situation they model. MGSE9-12.F.IF.7,7a,7b,7c,7d,7e,8,8a,8b,9 MGSE9-12.F.BF.1,1a MGSE9-12.F.BF.2 MGSE9-12.F.LE.1,2,3, 4 ,			meaning in terms of the situation they model.	
d. The student extends the domain of trigonometric functions using the unit circle, models periodic phenomena with trigonometric functions, and proves and applies trigonometric identities. MGSE.9-12.F.TF.1,2,3,4,5,6,7,8	The student recalls the Pythagorean Theorem and trigonometric ratios and define periodic.	The student converts between radian and degree measures, matches a trigonometric equation to its graph, and uses the Pythagorean Theorem to complete the unit circle.	The student extends the domain of trigonometric functions using the unit circle, models periodic phenomena with trigonometric functions, and proves and applies trigonometric identities.	The student explains the graphs of trigonometric functions using the unit circle, solves trigonometric equations using inverse functions, and proves trigonometric identities to solve problems.

Graduation Competency #5: The student proves, understands, and models geometric concepts using appropriate tools, theorems and constructions to solve problems and apply logical reasoning. *Geometric sense allows students to comprehend space and shape. Students analyze the characteristics and relationships of shapes and structures, engage in logical reasoning, and use tools and techniques to determine measurement. Students learn that geometry and measurement are useful in representing and solving problems in the real world as well as in mathematics.*

Competency #5. Performance Indicators Elementary School (K-2)
Geometry a. The student creates, identifies, and distinguishes between shapes based on their properties and defining attributes. **Measurement and Data** b. The student describes and compares measurable attributes.

Competency #5. Performance Indicators Elementary School (3-5)
Geometry a. The student creates, identifies, and distinguishes between shapes, lines, and angles based on their properties and defining attributes. b. The student graphs points on the coordinate plane to solve real-world and mathematical problems. **Measurement and Data** c. The student understands and models concepts of geometric measurement (perimeter, area and volume) and relates these measurements to multiplication and to addition. d. The student demonstrates the understanding of the concepts of angle by measuring angles and explaining their measurements.

Performance Indicators Scoring Criteria for Competency 5

Performance Indicators Grades K-2	Emerging	Progressing	Competent	Exemplary
a. The student identifies, creates, and distinguishes between shapes based on their properties and defining attributes.	The student identifies shapes based on their properties and defining attributes.	The student identifies and creates shapes based on their properties and defining attributes.	The student identifies, creates, and distinguishes between shapes based on their properties and defining attributes.	The competent student makes sense of and solves problems and defends a mathematical model in an authentic context and/or problems that exist across disciplines.
b. The student describes and compares, and estimates measurable attributes (ie. length, weight).	The student describes an object based on a measurable attribute.	The student describes and compares objects to one another.	The student describes, compares, and estimates measurable attributes.	The competent student makes sense of and solves problems and defends a mathematical model in an authentic context and/or problems that exist across disciplines.
Sample Tasks: http://nrich.maths.org/7009 http://www.insidemathematics.org/assets/problems-of-the-month/piece%20it%20together.pdf (Level A & B) http://www.insidemathematics.org/assets/problems-of-the-month/surrounded%20and%20covered.pdf (Level A) http://www.insidemathematics.org/assets/problems-of-the-month/on%20balance.pdf (Level A) http://www.insidemathematics.org/assets/problems-of-the-month/rod%20trains.pdf (Level A - this one requires Cuisenaire Rods) http://nrich.maths.org/6886				

Performance Indicators Scoring criteria for Competency 5

Performance Indicators Grades 3-5	Emerging	Progressing	Competent	Exemplary
a. The student identifies, creates, and distinguishes between shapes, lines, and angles based on their properties and defining attributes.	The student identifies shapes, lines, and angles based on their properties and defining attributes.	The student identifies and creates shapes, lines, and angles based on their properties and defining attributes.	The student identifies, creates, and distinguishes between shapes, lines, and angles based on their properties and defining attributes.	The competent student makes sense of and solves problems and defends a mathematical model in an authentic context and/or problems that exist across disciplines.
b. The student describes compares, and estimates measurable attributes.	The student describes an object based on a measurable attribute.	The student describes an object based on a measurable attribute and compares objects to one another.	The student describes, compares, and estimates measurable attributes.	The competent student makes sense of and solves problems and defends a mathematical model in an authentic context and/or problems that exist across disciplines.
c. The student understands and models concepts of geometric measurement (perimeter, area and volume) and relates these measurements to multiplication and to addition.	The student builds models of geometric measurement (perimeter, area and volume) problems.	The student develops understanding of geometric measurement (perimeter, area and volume) through model building and sense making.	The student understands and models concepts of geometric measurement (perimeter, area and volume) and relates these measurements to multiplication and addition.	The competent student makes sense of and solves problems and defends a mathematical model in an authentic context and/or problems that exist across disciplines.
d. The student demonstrates the understanding of the concepts of angle by measuring angles and explaining their measurements in reference to a circle.	The student identifies angles as right, acute, obtuse, or straight.	The student measures angles using tools such as pattern blocks & circles, angle rulers, and protractors.	The student demonstrates the understanding of the concepts of angle by measuring angles and explaining their measurements in reference to a circle.	The competent student makes sense of and solves problems and defends a mathematical model in an authentic context and/or problems that exist across disciplines.

Sample Tasks:
http://www.insidemathematics.org/assets/common-core-math-tasks/granny's%20balloon%20trip.pdf
http://www.insidemathematics.org/assets/problems-of-the-month/surrounded%20and%20covered.pdf (Level C)
http://nrich.maths.org/6886
http://nrich.maths.org/1235
http://www.insidemathematics.org/assets/problems-of-the-month/polly%20gone.pdf (Level A)
http://www.insidemathematics.org/assets/problems-of-the-month/between%20the%20lines.pdf (Level A & B)

Graduation Competency #5: The student proves, understands, and models geometric concepts using appropriate tools, theorems and constructions to solve problems and apply logical reasoning. *Geometric sense allows students to comprehend space and shape. Students analyze the characteristics and relationships of shapes and structures, engage in logical reasoning, and use tools and techniques to determine measurement. Students learn that geometry and measurement are useful in representing and solving problems in the real world as well as in mathematics.*

Competency # 5. Performance Indicators Middle School (6-8)
Geometry a. The student can solve real-world and mathematical problems involving angle measure, area, surface area, and volume. b. The student can draw, construct and describe geometrical figures and describe the relationships between them. c. The students can understand congruence and similarity using physical models, transparencies, or geometry software. d. The student can understand and apply the Pythagorean Theorem. e. The student can solve real-world and mathematical problems involving volume of cylinders, cones and spheres.

Performance Indicators Scoring Criteria for Competency 5

Performance Indicators Grades 6-8 (MP 2,4,5,6,7)	Emerging	Progressing	Competent	Exemplary
a, The student can solve real-world and mathematical problems involving angle measure, area, surface area, and volume. MGSE6.G.1, MGSE6.G.2, MGSE6.G.3, MGSE6.G.4, MGSE7.G.2, MGSE7.G.4, MGSE7.G.5, MGSE7.G.6, MGSE8.G.5	The student can identify the dimensions of geometric figures.	The student can solve mathematical problems using a formula or equation for angle measure, area, surface area, and volume.	The student can solve real-world and mathematical problems involving angle measure, area, surface area, and volume.	The student can justify or defend mathematical problems involving area, surface area, and volume.
b. The students can draw, construct and describe geometrical figures and describe the relationships between them. MGSE6.G.3, MGSE6.G.4, MGSE7.G.1, MGSE7.G.2, MGSE7.G.3, MGSE8.G.3	The student can draw and describe geometric figures.	The student can draw, construct and describe geometrical figures.	The student can draw, construct and describe geometrical figures and describe the relationships between them.	The student can defend a mathematical model by drawing, constructing and describing geometric figures in an authentic context that exists across disciplines.
c. Understand congruence and similarity using physical models, transparencies, or geometry software. MGSE8.G.1, MGSE8.G.2, MGSE8.G.3, MGSE8.G.4	The student can identify congruent ***or*** similar figures.	The student can identify congruent ***and*** similar figures.	The student can understand congruence and similarity using physical models, transparencies, or geometry software.	The student can prove congruence and similarity using physical models, transparencies, or geometry software.
d. Understand and apply the Pythagorean Theorem. MGSE8.G.6, MGSE8.G.7, MGSE8.G.8	The student can identify the Pythagorean Theorem.	The student solves problems using the Pythagorean Theorem.	The student can understand and apply the Pythagorean Theorem to solve problems involving right triangles.	The student can create or justify a mathematical model to prove the Pythagorean Theorem.

e. Solve real-world and mathematical problems involving volume of cylinders, cones and spheres. MGSE8.G.9	Students can identify the formulas for the volume of cylinders, cones, and spheres.	The student can solve mathematical problems involving volume of cylinders, cones or spheres, using a formula.	The student can solve real-world and mathematical problems involving volume of cylinders, cones and spheres.	The student can design real-world problems involving volume of cylinders, cones and spheres that exist across disciplines.
Sample Tasks: https://www.illustrativemathematics.org/content-standards/8/G/C/9/tasks/520 https://www.illustrativemathematics.org/content-standards/8/G/A/4/tasks/1946 http://www.insidemathematics.org/assets/problems-of-the-month/what's%20your%20angle.pdf				

Graduation Competency #5: The student proves, understands, and models geometric concepts using appropriate tools, theorems and constructions to solve problems and apply logical reasoning. *Geometric sense allows students to comprehend space and shape. Students analyze the characteristics and relationships of shapes and structures, engage in logical reasoning, and use tools and techniques to determine measurement. Students learn that geometry and measurement are useful in representing and solving problems in the real world as well as in mathematics.*

Competency #5. Performance Indicators High School (9-12)

Congruence
a. The student defines and understands congruence in terms of transformations and rigid motions and uses these transformations and geometric constructions to prove geometric theorems.

Similarity, Right Triangles and Trigonometry
b. The student understands similarity in terms of transformations and proves theorems involving similarity.
c. The student defines trigonometric ratios and solves problems involving right triangles and applies trigonometry to general triangles.

Circles
d. The student understands and applies theorems about circles and finds arc lengths and areas of sectors of circles.

Expressing Geometric Properties with Equations
e. The student translates between the geometric description and the equation for a conic section and uses coordinates to prove simple geometric theorems algebraically.

Geometric Measurement and Dimension
f. The student visualizes relationships between two-dimensional and three-dimensional objects and explains volume formulas and uses them to solve problems.

Modeling with Geometry
g. The student applies geometric concepts such as properties of figures, distance and midpoint formulas, and slope, to prove geometric shapes.

Performance Indicators Scoring Criteria for Competency 5

Performance Indicators Grades 9-12 (MP 1,2,4,5,6,7)	Emerging	Progressing	Competent	Exemplary
a. The student defines and understands congruence in terms of transformations and rigid motions and uses these transformations and geometric constructions to prove geometric theorems. MGSE9-12.G.CO.6 , 7, 8, 9, 10 , MGSE9-12.G.CO.1, 2,3,4,5	The student defines congruence and identifies geometric transformations.	The student classifies geometric figures as being congruent, understands the difference between rigid motion and dilations, and knows essential theorems and properties needed for geometric proofs.	The student defines and understands congruence in terms of transformations and rigid motions and uses these transformations and geometric constructions to prove geometric theorems.	The student creates and justifies a congruence statement using geometric constructions and proofs.
b. The student understands similarity in terms of transformations and proves theorems involving similarity. MGSE9-12.G.SRT.1,2,3,4,5	The student defines similarity.	The student classifies geometric figures as being similar using the appropriate theorem.	The student understands similarity in terms of transformations and proves theorems involving similarity.	The student creates and justifies a similarity statement.

c. The student defines trigonometric ratios and solves problems involving right triangles and applies trigonometry to general triangles MGSE9-12.G.SRT.6, 7, 8, 9, 10, 11 MGSE9-12.F.TF.9	The student lists the trigonometric ratios.	The student solves problems involving right triangles when given the appropriate trigonometric ratio to use.	The student defines trigonometric ratios and solves problems involving right triangles and applies trigonometry to general triangles.	The student applies multiple trigonometric ratios in order to solve a problem in context.
d. The student understands and applies theorems about circles and finds arc lengths and areas of sectors of circles. MGSE9-12.G.C.1, 2, 3, 4, 5	The student recognizes theorems about circles and identifies arc length and area of a sector.	The student distinguishes between the various theorems about circles and uses given formulas to solve for arc length and area of a sector.	The student understands and applies theorems about circles and finds arc lengths and areas of sectors of circles.	The student applies theorems about circles, arc length, and area of a sector in order to solve problems in context.
e. The student translates between the geometric description and the equation for a conic section and uses coordinates to prove simple geometric theorems algebraically. MGSE9-12.G.GPE.1,2,3	The student identifies the graphs of conic sections.	The student recognizes the equations of conic sections and can match them to the graphs.	The student translates between the geometric description and the equation for a conic section and uses coordinates to prove simple geometric theorems algebraically.	The student connects the geometric description, equation, and graph of conic sections to a given situation.
f. The student visualizes relationships between two-dimensional and three-dimensional objects and explains volume formulas and uses them to solve problems. MGSE9-12.G.GMD.1, 2, 3, 4	The student recalls the parts of a formula for different shapes in two- and three-dimensions.	The student labels the parts of a formula for different shapes in two- and three-dimensions and explain the relationship between the two- and three-dimensional objects.	The student visualizes relationships between two-dimensional and three-dimensional objects and explains volume formulas and uses them to solve problems.	The student develops a formula for different shapes in two- and three-dimensions and modifies it to solve problems.
g. The student applies geometric concepts such as properties of figures, distance and midpoint formulas, and slope, to prove geometric shapes. MGSE9-12.G.CO.11, 12,13 MGSE9-12.G.GPE.4,5,6,7	The student identifies quadrilaterals by their properties.	The student uses the formulas to find the distance and midpoint when given two points.	The student applies geometric concepts such as properties of figures, distance and midpoint formulas, and slope, to prove geometric shapes.	The student synthesizes information precisely in order to create figures which meet specific criteria.

h. The student applies geometric concepts such as density and volume to describe objects and solve design problems. MGSE9-12.G.MG.1, 2, 3	The student describes objects using geometric shapes.	The student applies geometric concepts such as density and volume to describe objects	The student applies geometric concepts such as density and volume to describe objects and solve design problems.	The student synthesizes information precisely in order to design an object which meet specific criteria.

Graduation Competency #6: The student uses a variety of data analysis and statistics strategies to analyze, develop and evaluate inferences based on data. *The use of data and probability provide students with tools to understand information and uncertainty. Students ask questions and gather and use data to answer them. Probability provides the foundation for collecting, describing, and interpreting data.*

Competency #6. Performance Indicators Elementary School (K-2)
Data
a. The student collects, represents, and interprets data.

Competency #6. Performance Indicators Elementary School (3-5)
Data
b. The student collects, represents, and interprets data.

Performance Indicators Scoring Criteria for Competency 6

Performance Indicator Grades K-2	Emerging	Progressing	Competent	Exemplary
a. The student collects, represents, and interprets data with up to three categories.	With limited understanding, the student asks questions, gathers information, attempts to represent data.	The student can ask a variety of questions, gather information, and represent data.	The student collects, represents, and interprets data with up to three categories.	The competent student collects, represents and interprets data in a variety of contexts and in problems that exist across disciplines.
Sample Tasks: http://www.insidemathematics.org/assets/problems-of-the-month/pick%20a%20pocket.pdf (Level A) http://nrich.maths.org/2341				

Performance Indicator Grades 3-5	Emerging	Progressing	Competent	Exemplary
b.The student collects, represents, and interprets data with multiple categories.	With limited understanding, the student asks questions, gathers information, attempts to represent data.	The student can ask a variety of questions, gather information, and represent data.	The student collects, represents, and interprets data with multiple categories.	The competent student collects, represents and interprets data in a variety of contexts and in problems that exist across disciplines.
Sample Tasks: http://www.insidemathematics.org/assets/problems-of-the-month/through%20the%20grapevine.pdf (Level A) http://nrich.maths.org/7725				

Graduation Competency #6: The student uses a variety of data analysis and statistics strategies to analyze, develop and evaluate inferences based on data. *The use of data and probability provide students with tools to understand information and uncertainty. Students ask questions and gather and use data to answer them. Probability provides the foundation for collecting, describing, and interpreting data.*

Competency #6. Performance Indicators Middle School (6-8)
Statistics and Probability a. The students can develop understanding of statistical variability. b. The student can summarize and describe distributions. c. The student can use random sampling to draw inferences about a population. d. The students can draw informal comparative inferences about two populations. e. The student can investigate chance processes and develop, use, and evaluate probability models. f. The student can investigate patterns of association in bivariate data. .

Performance Indicators Scoring Criteria for Competency 6

Performance Indicator Grades 6-8	Emerging	Progressing	Competent	Exemplary
alThe students can develop understanding of statistical variability. MGSE6.SP.1, MGSE6.SP.3, MGSE6.SP.4	The student can define variability.	The student can calculate statistical variability.	The student develops an understanding of statistical variability.	The student applies the concept of statistical variability to make inferences.
b. The student can summarize and describe distributions. MGSE6.SP.2, MGSE6.SP.3, MGSE6.SP.4, MGSE6.SP.5	The student can recognize distributions.	The student can summarize ***or*** describe distributions.	The student can summarize ***and*** describe distributions.	The student can analyze and synthesize distributions from multiple sources.

c. The student can use random sampling to draw inferences about a population. MGSE7.SP.1, MGSE7.SP.2	The student can conduct a random sample of a population.	The student can organize data from a random sample of a population.	The student can use random sampling to draw inferences about a population.	The student can analyze and synthesize information from multiple random samplings of a population.
d. The students can draw informal comparative inferences about two populations. MGSE7.SP.3, MGSE7.SP.4)	The student can compare information about two populations.	The student can interpret comparative inferences about two populations.	The student can draw informal comparative inferences about two populations.	The student can design a situation in which they can draw informal comparative inferences about two populations.
e. The student can investigate chance processes and develop, use, and evaluate probability models. MGSE7.SP.5, MGSE7.SP.6, MGSE7.SP.7 a-b, MGSE7.SP.8	The student can identify situations involving chance.	The student can evaluate situations involving chance using probability models.	The student can investigate chance processes and develop, use, and evaluate probability models.	The student can analyze and synthesize information from multiple sources involving chance processes.
f. The student can investigate patterns of association in bivariate data. MGSE8.SP.1, MGSE8.SP.2, MGSE8.SP.3, MGSE8.SP.4	The student can define bivariate data.	The student can collect and display patterns of association in	The student can investigate patterns of association in bivariate data.	The student can analyze patterns of association in bivariate data.
Sample Tasks: https://www.illustrativemathematics.org/content-standards/7/SP/A/2/tasks/1339 https://www.illustrativemathematics.org/content-standards/8/SP/A/1/tasks/1097				

Graduation Competency #6: The student uses a variety of data analysis and statistics strategies to analyze, develop and evaluate inferences based on data. *The use of data and probability provide students with tools to understand information and uncertainty. Students ask questions and gather and use data to answer them. Probability provides the foundation for collecting, describing, and interpreting data.*

Competency #6. Performance Indicators High School (9-12)
Interpreting Categorical and Quantitative Data a. The student summarizes, represents, and interprets data in a single variable or two variables and interprets linear models. **Making Inferences and Justifying Conclusions** b. The student understands and evaluates random processes underlying statistical experiments and makes inferences and justifies conclusions from sample surveys, experiments and observational studies. **Conditional Probability and the Rules of Probability** c. The student understands independence and conditional probability, using them to interpret data, and uses the rules of probability to compute probabilities of compound events in a uniform probability model. **Using Probability to Make Decision** d. The student calculates expected values and uses them to solve problems, and uses probability to evaluate outcomes of decisions.

Performance Indicators Scoring Criteria for Competency 6

Performance Indicators Grades 9-12 (MP 1,2,4,5,6,7)	Emerging	Progressing	Competent	Exemplary
a. The student summarizes, represents, and interprets data in a single variable or two variables and interprets linear models. MGSE9-12.S.ID.1,3,5,6,6a,c,7,8,9	The student identifies a box plot, histogram, number line, or dot plot for a given data set in one variable. Further, the student recognizes when two variables have a constant rate of change in a linear model.	The student represents data with an appropriate model. Further, the student identifies slope and y-intercept of a linear model.	The student summarizes, represents, and interprets data in a single variable or two variables and interprets linear models.	The student draws conclusions from a linear model, making contextual conclusions about trends in the data. The student relates the correlation coefficient to causation in a contextual model.

b. The student understands and evaluates random processes underlying statistical experiments and makes inferences and justifies conclusions from sample surveys, experiments and observational studies. MGSE9-12.S.IC.1,2,3,4,5,6	The student defines random process, sample, survey, experiment, and observational study.	The student explains the effect bias has on a sample and describes and compares sample surveys, experiments, and observations.	The student understands and evaluates random processes underlying statistical experiments and makes inferences and justifies conclusions from sample surveys, experiments and observational studies.	The student designs an experiment that minimizes bias and makes predictions from sample surveys, experiments, and observational studies.
c. The student understands independence and conditional probability, using them to interpret data, and uses the rules of probability to compute probabilities of compound events in a uniform probability model. MGSE9-12.S.CP.1,2,3,4,5,6,7,8,9	The student describes events as subsets of a sample space and states the addition rule for compound events.	The student explains what makes events independent and identifies the probability of an event occurring.	The student understands independence and conditional probability, using them to interpret data, and uses the rules of probability to compute probabilities of compound events in a uniform probability model.	The student justifies their reasoning for why two events are independent and evaluates the probability of compound events in a non-uniform probability model.
d. The student calculates expected values and uses them to solve problems, and uses probability to evaluate outcomes of decisions. MGSE9-12.S.MD.1,2,3,4,5,5a,5b,6,7	The student defines expected value.	The student calculates expected value given the formula.	The student calculates expected values and uses them to solve problems, and uses probability to evaluate outcomes of decisions.	The student designs a situation and makes predictions based on probability and expected value.
e. The student uses the center and spread of two or more different data sets to fit it to a model and estimate population based on that model. MGSE9-12.S.ID.2, 4	The student defines the center and spread of data.	The student calculates the center and spread of data.	The student uses the center and spread of two or more different data sets to fit it to a model and estimate population based on that model.	The student uses contextual data from two or more data sets and draws conclusions based on the distribution and spread.