

Grade 9-10 Math Performance Level Descriptors

9th–10th Grade Mathematics

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Cluster: N.RN.A

(N.RN.1 only)

Use properties of rational numbers and irrational numbers.

Standards:

HS.N.RN.1 - Know and apply the properties of integer exponents to generate equivalent numerical and algebraic expressions.

Evidence Statement			
1. The student generates equivalent numerical expressions by applying the properties of integer exponents.			
Performance Level Descriptors (PLDs)			
Level 1	Level 2	Level 3	Level 4
Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:	Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:	Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:	Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:
<ul style="list-style-type: none">Students should be able to apply one property of whole-number exponents with one base or variable to generate equivalent expressions.	<ul style="list-style-type: none">Students should be able to apply one property of integer exponents with one or two bases or variables to generate equivalent expressions.	<ul style="list-style-type: none">Students should be able to use exponent notation to apply two properties of integer exponents to generate equivalent expressions.	<ul style="list-style-type: none">Students should be able to use exponent notation to apply properties of integer exponents to generate equivalent expressions and explain why their solution is correct.

Cluster: N.Q.A

Reason quantitatively and use units to solve problems.

Standards:

N.Q.1 - Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

N.Q.2 - Define appropriate quantities for the purpose of descriptive modeling.

N.Q.3 - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Evidence Statements			
<ol style="list-style-type: none">1. The student uses units as a way to understand problems and to guide the solution of multistep problems, including choosing and interpreting units consistently in formulas.2. The student defines appropriate quantities for the purpose of descriptive modeling.3. The student chooses a level of accuracy appropriate to limitations on measurement when reporting quantities.			
Performance Level Descriptors (PLDs)			
Level 1 Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:	Level 2 Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:	Level 3 Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:	Level 4 Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:
<ul style="list-style-type: none">• Students should be able to solve two-step real-world problems involving units (no unit conversions) and equations (no inequalities).	<ul style="list-style-type: none">• Students should be able to model and solve two-step real-world problems with units using equations and inequalities.• Students should be able to choose and interpret appropriate scales and origins for data displays.	<ul style="list-style-type: none">• Students should be able to model and solve multistep real-world problems with units using equations and inequalities, including converting units as appropriate to suit the problem.• Students should be able to choose and interpret appropriate scales and origins for graphs and data displays.	<ul style="list-style-type: none">• Students should be able to compare, justify, and critique unit, scale, and accuracy choices in problem-solving situations.

		<ul style="list-style-type: none">• Students should be able to use values and contexts to make appropriate decisions about which unit(s) to use and which place(s) to round to when solving real-world problems.	
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Cluster: A.SSE.A

Interpret the structure of expressions.

Standards:

A.SSE.1 - Interpret expressions that represent a quantity in terms of its context.

A.SSE.1a - Interpret parts of an expression, such as terms, factors, and coefficients.

A.SSE.1b - Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret $P(1 + r)^n$ as the product of P and $(1 + r)^n$.*

A.SSE.2 - Use the structure of an expression to identify ways to rewrite it.

Evidence Statements			
<ol style="list-style-type: none"> 1. The student interprets parts of an expression (including, but not limited to, terms, factors, and coefficients) that models a quantity in terms of the real-world context. 2. The student interprets multiple parts of an expression as a single entity. 3. The students uses the structure of an expression to identify ways to rewrite it. 			
Performance Level Descriptors (PLDs)			
Level 1	Level 2	Level 3	Level 4
<p>Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to identify the meaning of any individual part of a two-term expression that models a context. • Students should be able to recognize two equivalent expressions that are written in two different ways. 	<p>Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to identify the meaning of any individual part of an expression that models a context. • Students should be able to view multiple parts of a two-term expression as both individual parts and as a single entity. • Students should be able to recognize equivalent expressions that are written in 	<p>Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to identify and explain the meaning of any individual part of an expression that models a context. • Students should be able to view multiple parts of an expression as both individual parts and as a single entity. • Students should be able to rewrite expressions in different ways and explain how each 	<p>Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to recognize ways in which individual or combined parts of a given expression could model a context, e.g., given that $y = 100(1.05)^x$ represents an amount of money, identify that 100 makes sense as a starting bank balance and $(1.05)^x$ represents a change that increases the

	different ways and describe what is emphasized when written in each way.	way emphasizes a quantity or relationship of interest.	balance based on increments of x .
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Cluster: A.SSE.B

(A.SSE.3a only)

Write expressions in equivalent forms to solve problems.

Standards:

A.SSE.3 - Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

A.SSE.3a - (9/10) Factor a quadratic expression to reveal the zeros of the function it defines.

Evidence Statement			
1. The student writes equivalent forms of quadratic expressions to reveal and explain different properties of the quantity represented by the expression.			
Performance Level Descriptors (PLDs)			
Level 1 Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:	Level 2 Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:	Level 3 Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:	Level 4 Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:
<ul style="list-style-type: none">Students should be able to factor quadratic expressions with integer coefficients and a leading coefficient of 1.Students should be able to find the zeros of a factored quadratic expression.	<ul style="list-style-type: none">Students should be able to factor quadratic expressions with integer coefficients and a leading integer coefficient other than 1 to reveal the zeros of the function it defines.	<ul style="list-style-type: none">Students should be able to factor quadratic expressions with rational coefficients to reveal the zeros of the function it defines.	<ul style="list-style-type: none">Students should be able to identify appropriate equivalent forms of expressions to reveal and explain different properties of a quantity represented by the expression (e.g., understand that a quadratic expression can be displayed in multiple ways).

Cluster: A.APR.A

(A.APR.1 only)

Perform arithmetic operations on polynomials.

Standards:

A.APR.1 - Add, subtract, and multiply polynomials.

Evidence Statements			
1. The student adds and subtracts polynomials. 2. The student multiplies polynomials.			
Performance Level Descriptors (PLDs)			
Level 1	Level 2	Level 3	Level 4
Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as: <ul style="list-style-type: none">• Students should be able to add and subtract polynomials with one variable, where each term has an exponent of 2 or less.• Students should be able to multiply a one-variable monomial and a one-variable binomial of degree 2 or less.	Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as: <ul style="list-style-type: none">• Students should be able to add and subtract multi-variable polynomials, where each variable has an exponent of 2 or less.• Students should be able to multiply two one-variable binomials of degree 2 or less.	Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as: <ul style="list-style-type: none">• Students should be able to add and subtract multi-variable polynomials.• Students should be able to multiply a binomial and a trinomial.	Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as: <ul style="list-style-type: none">• Students should be able to add, subtract, and multiply two trinomials.• Students should be able to multiply three binomials.

Cluster: A.APR.B

(A.APR.4 only)

Use polynomial identities to solve problems.

Standards:

A.APR.4 - (9/10/11) Generate polynomial identities from a pattern. For example, difference of squares, perfect square trinomials, (emphasize sum and difference of cubes in grade 11).

Evidence Statement			
1. The student uses patterns to generate and identify polynomial identities.			
Performance Level Descriptors (PLDs)			
Level 1	Level 2	Level 3	Level 4
Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:	Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:	Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:	Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:
<ul style="list-style-type: none">• Students should be able to recognize patterns in the difference of two squares, expressed numerically.	<ul style="list-style-type: none">• Students should be able to identify patterns of difference of squares and perfect square trinomials in relationships expressed algebraically.	<ul style="list-style-type: none">• Students should be able to apply patterns of difference of squares and perfect square trinomials to solve problems using polynomial identities.	<ul style="list-style-type: none">• Students should be able to identify errors in sample student work that solves problems using patterns of polynomial identities, correct the error, and justify the correction.

Cluster: A.CED.A

Create equations that describe numbers or relationships.

Standards:

A.CED.1 - Apply and extend previous understanding to create equations and inequalities in one variable and use them to solve problems.

A.CED.2 - Apply and extend previous understanding to create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

A.CED.3 - Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*

A.CED.4 - Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm’s law $V = IR$ to highlight resistance R.

Evidence Statements			
<ol style="list-style-type: none"> 1. Solve problems by creating equations and inequalities in one variable. 2. Create and graph equations in two or more variables to represent relationships between quantities. 3. Represent constraints by equations, inequalities, and systems of equations and inequalities. 4. Manipulate formulas to highlight different variables of interest. 			
Performance Level Descriptors (PLDs)			
Level 1	Level 2	Level 3	Level 4
<p>Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to create equations in one variable and use them to solve problems. • Students should be able to identify equations in two variables that represent relationships 	<p>Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to create equations and inequalities in one variable and use them to solve problems. • Students should be able to create equations in two variables to represent 	<p>Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to create and graph equations in two or more variables to represent relationships between quantities. • Students should be able to represent constraints by 	<p>Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to explain when and why solutions to systems of equations or inequalities are not viable in a modeling context and alter the equations or inequalities to

<p>between quantities.</p>	<p>relationships between quantities.</p> <ul style="list-style-type: none"> • Students should be able to represent constraints by equations and interpret solutions as viable or non-viable options in a modeling context. 	<p>equations or inequalities, and by systems of equations and/or inequalities, and identify solutions as viable or non-viable options in a modeling context.</p> <ul style="list-style-type: none"> • Students should be able to manipulate formulas to highlight a quantity of interest, using the same reasoning as in solving equations. 	<p>generate viable solutions.</p>
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Cluster: A.REI.A

Understand solving equations as a process of reasoning and explain the reasoning.

Standards:

A.REI.1 - Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

Evidence Statement			
1. Use mathematical and descriptive language to explain the reasoning for each step in the process of solving equations.			
Performance Level Descriptors (PLDs)			
Level 1	Level 2	Level 3	Level 4
Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:	Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:	Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:	Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:
<ul style="list-style-type: none">• Students should be able to order each step in solving a linear equation, starting from the assumption that the original equation has a solution.	<ul style="list-style-type: none">• Students should be able to explain each step in solving a linear or quadratic equation when given the steps of the solution, starting from the assumption that the original equation has a solution.	<ul style="list-style-type: none">• Students should be able to explain each step in solving a linear, quadratic, absolute value, or rational equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution.	<ul style="list-style-type: none">• Students should be able to identify mathematical or reasoning errors in the steps of a solution in given sample student work, correct the error, and justify the correction.

Cluster: A.REI.B

Solve equations and inequalities in one variable.

Standards:

A.REI.2 - (all) Apply and extend previous understanding to solve equations, inequalities, and compound inequalities in one variable, including literal equations and inequalities.

A.REI.3 - Solve equations in one variable and give examples showing how extraneous solutions may arise.

A.REI.3a - (9/10/11) - Solve rational, absolute value and square root equations. (9/10) Limited to simple equations such as, $2\sqrt{x-3} + 8 = 16$, $\frac{x+3}{2x-1} = 5$, $x \neq \frac{1}{2}$.

A.REI.5 - Solve quadratic equations and inequalities

A.REI.5a - (9/10) Solve quadratic equations by inspection (e.g. for $x^2 = 49$), taking square roots, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives no real solutions.

Evidence Statements
<ol style="list-style-type: none">1. The student solves linear equations and inequalities in one variable.2. The student solves compound inequalities in one variable.3. The student solves literal equations and inequalities.4. The student solves simple rational equations in one variable, including identifying the number and type of real solutions that might exist for the equation and recognizing where extraneous solution(s) might arise.5. The student solves absolute value equations in one variable, including identifying the number and type of real solutions that might exist for the equation and recognizing where extraneous solution(s) might arise.6. The student solves square root equations in one variable, including identifying the number and type of real solutions that might exist for the equation and recognizing where extraneous solution(s) might arise.7. The student solves quadratic equations in one variable by inspection, taking square roots, using the quadratic formula, or factoring.8. The student recognizes when the quadratic formula gives complex solutions (no real solutions).

Performance Level Descriptors (PLDs)			
<p>Level 1 Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to solve linear equations in one variable, including literal equations. • Students should be able to solve rational equations in one variable. • Students should be able to solve quadratic equations by inspection or taking square roots. 	<p>Level 2 Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to solve equations and inequalities in one variable. • Students should be able to solve absolute value and square root equations in one variable, including identifying the types of solutions that might exist for the equation. • Students should be able to solve quadratic equations by inspection, taking square roots, and factoring. 	<p>Level 3 Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to solve equations, inequalities, and compound inequalities in one variable. • Students should be able to solve rational, absolute value, and square root equations in one variable, including identifying the number and type of real solutions that might exist for the equation. • Students should be able to solve quadratic equations using the quadratic formula and recognize when the quadratic formula gives no real solutions. 	<p>Level 4 Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to solve literal equations and inequalities. • Students should be able to identify the number and type of real solutions that might exist for simple rational and square root equations, and explain cases where extraneous solutions might arise.

Cluster: A.REI.C

(A.REI.6 only)

Solve systems of equations.

Standards:

A.REI.6 - Analyze and solve pairs of simultaneous linear equations.

A.REI.6a - Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.

A.REI.6b - Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. *For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6.*

A.REI.6c - Solve real-world and mathematical problems leading to two linear equations in two variables. For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.

Evidence Statements			
<ol style="list-style-type: none"> 1. The student estimates solutions by graphing systems of two linear equations in two variables. 2. The student recognizes when a system of two linear equations in two variables has one solution, no solution, or infinitely many solutions. 3. The student solves a system of two linear equations in two variables in real-world and mathematical problems. 			
Performance Level Descriptors (PLDs)			
Level 1	Level 2	Level 3	Level 4
<p>Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to recognize that the graph of a system of two linear equations in two variables has one solution at the intersection of the lines. 	<p>Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to recognize when a system of two linear equations in two variables has one solution or no solution. • Students should be able to model real-world situations 	<p>Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to recognize when a system of two linear equations in two variables has one solution, no solution, or infinitely many solutions by analyzing graphs or 	<p>Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to generate scenarios for a system of two linear equations that would result in one solution, no solution, and infinitely many solutions.

	<p>with a system of two linear equations.</p> <ul style="list-style-type: none">• Students should be able to estimate solutions by graphing systems of two linear equations in two variables.	<p>algebraic equations.</p> <ul style="list-style-type: none">• Students should be able to solve systems of two linear equations in two variables in real-world and mathematical problems.• Students should be able to explain the meaning of a solution to a system of two linear equations in a real-world context.	
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Cluster: A.REI.D

Represent and solve equations and inequalities graphically.

Standards:

A.REI.8 - (all) Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

A.REI.9 - (9/10/11) Solve an equation $f(x) = g(x)$ by graphing $y = f(x)$ and $y = g(x)$ and finding the x -value of the intersection point. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions. For (9/10) focus on linear, quadratic, and absolute value.

A.REI.10 - (9/10) Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

Evidence Statements			
<ol style="list-style-type: none"> 1. The student recognizes points on a graph as solutions to an equation in two variables. 2. The student represents and solves the equation $f(x) = g(x)$ by graphing $y = f(x)$ and $y = g(x)$ and finding the x-value of the intersection point. 3. The student graphs the solutions to a linear inequality in two variables as a half plane. 4. The student graphs the solutions to a system of linear inequalities in two variables as the intersection of the corresponding half-planes. 			
Performance Level Descriptors (PLDs)			
Level 1	Level 2	Level 3	Level 4
<p>Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to recognize points on a graph of a linear equation in two variables as the solutions to that equation. • Students should be able to represent the equation $f(x) = g(x)$ by graphing $y = f(x)$ and $y = g(x)$, where both $f(x)$ and $g(x)$ are linear. 	<p>Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to explain that the graph of an equation in two variables is the set of all its solutions plotted on the coordinate plane. • Students should be able to represent and solve the equation $f(x) = g(x)$ by graphing $y = f(x)$ and $y = g(x)$ and 	<p>Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to explain that the graph of an equation in two variables is the set of all its solutions plotted on the coordinate plane, often forming a curve (which could be a line). • Students should be able to represent and solve the 	<p>Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to explain why the x-coordinates of the points where $f(x)$ and $g(x)$ intersect create the solution to $f(x) = g(x)$. • Students should be able to recognize and solve systems of equations where the two equations do not intersect on

	<p>finding the x-value of the intersection point(s), where $f(x)$ and $g(x)$ are linear or quadratic.</p> <ul style="list-style-type: none"> • Students should be able to graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality). 	<p>equation $f(x) = g(x)$ by graphing $y = f(x)$ and $y = g(x)$ and finding the x-value of the intersection point(s), where $f(x)$ and $g(x)$ are linear, quadratic, or absolute value functions.</p> <ul style="list-style-type: none"> • Students should be able to graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes. 	<p>the given view of the coordinate plane, but intersect outside of the given view of the coordinate plane, or where the two equations are partially collinear.</p>
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Cluster: F.IF.A

Understand the concept of a function and use function notation.

Standards:

F.IF.1 - Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x . The graph of f is the graph of the equation $y = f(x)$.

F.IF.2 - Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

F.IF.3 - (9/10/11) Recognize patterns in order to write functions whose domain is a subset of the integers. (9/10) Limited to linear and quadratic. For example, find the function given $\{(-1,4), (0,7), (1,10), (2,13)\}$.

Evidence Statements			
<ol style="list-style-type: none"> 1. The student distinguishes between functions and non-functions represented in a variety of ways (algebraically, graphically, numerically in tables, or by verbal descriptions). 2. The student identifies the domain and range of linear, quadratic, and absolute value functions represented in a variety of ways (algebraically, graphically, numerically in tables, or by verbal descriptions). 3. The student recognizes that the graph of f is the graph of the equation $y = f(x)$. 4. The student evaluates linear, quadratic, and absolute value functions for inputs in their domains or outputs in their ranges. 5. The student interprets statements that use function notation in terms of a context. 6. The student recognizes patterns and uses function notation to write a linear or quadratic function whose domain is a subset of the integers. 			
Performance Level Descriptors (PLDs)			
Level 1	Level 2	Level 3	Level 4
<p>Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to distinguish between functions and non-functions represented graphically. • Students should be able to identify the domain and range 	<p>Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to distinguish between functions and non-functions represented algebraically, numerically in tables, or by verbal descriptions. 	<p>Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to evaluate linear, quadratic, and absolute value functions for inputs in their domains or outputs in their ranges. 	<p>Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to recognize and explain restrictions that need to be placed on the domain for an equation to represent a function.

<p>of a function represented graphically.</p> <ul style="list-style-type: none"> • Students should be able to evaluate linear functions for inputs in their domains or outputs in their ranges. 	<ul style="list-style-type: none"> • Students should be able to identify the domain and range of a function represented algebraically, numerically in a table, or by a verbal description. • Students should be able to interpret function notation. • Students should be able to evaluate linear functions for inputs in their domains or outputs in their ranges. 	<ul style="list-style-type: none"> • Students should be able to interpret statements that use function notation in terms of a context and use function notation to write a linear function whose domain is a subset of the integers. • Students should be able to recognize patterns to write a linear function or a quadratic function whose domain is a subset of the integers. 	<ul style="list-style-type: none"> • Students should be able to recognize patterns and use function notation to write an absolute value function whose domain is a subset of the integers.
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Cluster: F.IF.B

Interpret functions that arise in applications in terms of the context.

Standards:

F.IF.4 - For a function that models a relationship between two quantities, interpret key features of expressions, graphs and tables in terms of the quantities, and sketch graphs showing key features given a description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.

F.IF.5 - Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function $h(n)$ gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*

F.IF.6 - (9/10/11) Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. (9/10) limited to linear functions.

Evidence Statements			
1. The student interprets key features of a function that models a relationship between two quantities represented in a variety of ways.			
2. The student sketches graphs of functions showing key features, given a description of a relationship between two quantities.			
3. The student relates the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.			
4. The student calculates and interprets the average rate of change of a linear function (presented symbolically or as a table) over a specified interval and estimates the rate of change of a linear function from a graph.			
Performance Level Descriptors (PLDs)			
Level 1	Level 2	Level 3	Level 4
Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:	Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:	Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:	Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:
<ul style="list-style-type: none">Students should be able to interpret key features (intercepts) of linear functions that model relationships	<ul style="list-style-type: none">Students should be able to interpret key features (intercepts; relative maxima and minima; and intervals where the function is	<ul style="list-style-type: none">Students should be able to interpret key features (intercepts; relative maxima and minima; intervals where the function is increasing,	<ul style="list-style-type: none">Students should be able to interpret key features of advanced functions that model nonlinear situations.

<p>between two quantities.</p> <ul style="list-style-type: none"> • Students should be able to relate the domain of a linear function to its graph. 	<p>increasing, decreasing, positive, or negative) of quadratic functions that model relationships between two quantities.</p> <ul style="list-style-type: none"> • Students should be able to relate the domain of a quadratic or absolute value function to its graph. • Students should be able to estimate the average rate of change of a linear function from a graph presented symbolically. 	<p>decreasing, positive, or negative; symmetries; end behavior; and periodicity) of quadratic and absolute value functions that model relationships between two quantities.</p> <ul style="list-style-type: none"> • Students should be able to relate the domain of a function to its graph and to the quantitative relationship it describes. • Students should be able to calculate and interpret the average rate of change of a linear function over a specified interval and estimate the rate of change from a graph. 	<ul style="list-style-type: none"> • Students should be able to relate the domain of an advanced function that models a nonlinear situation to its graph and the quantitative relationship it describes.
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Cluster: F.IF.C

Analyze functions using different representations.

Standards:

F.IF.7 - Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

F.IF.7a - (9/10) Graph linear, quadratic and absolute value functions and show intercepts, maxima, minima and end behavior.

F.IF.8 - Write a function in different but equivalent forms to reveal and explain different properties of the function.

F.IF.8a - (9/10) Use different forms of linear functions, such as slope-intercept, standard, and point-slope form to show rate of change and intercepts.

F.IF.9 - (all) Compare properties of two functions using a variety of representations (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, a quantity increasing exponentially eventually exceeds a quantity increasing linearly.*

Evidence Statements			
<ol style="list-style-type: none"> 1. The student graphs linear, quadratic, and absolute value functions expressed symbolically and shows key features of the graph (intercepts, maxima, minima, and end behavior). 2. The student writes linear functions in different but equivalent forms (slope-intercept, standard, and point-slope) to reveal and explain different properties of the function. 3. The student compares properties of two linear or quadratic functions using a variety of representations (algebraic, graphical, numerical in tables, verbal descriptions). 			
Performance Level Descriptors (PLDs)			
Level 1	Level 2	Level 3	Level 4
<p>Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to graph linear functions expressed symbolically and identify their intercepts. • Students should be able to write linear functions in slope-intercept form. 	<p>Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to graph linear and quadratic functions expressed symbolically and identify their intercepts, maxima, minima, and end behavior. 	<p>Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to graph linear, quadratic, and absolute value functions expressed symbolically and identify their intercepts, maxima, minima, and end behavior. 	<p>Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to compare the features of three functions— one linear, one quadratic, and one absolute value— represented in different forms (algebraically, graphically,

<ul style="list-style-type: none"> • Students should be able to compare the features of two linear functions represented in the same way. 	<ul style="list-style-type: none"> • Students should be able to write linear functions in slope-intercept and standard form. • Students should be able to compare the features of two linear functions represented in different forms (algebraically, graphically, numerically in tables, and by verbal descriptions) or two quadratic functions represented in the same way. 	<ul style="list-style-type: none"> • Students should be able to write linear functions in slope-intercept, standard, and point-slope form, and explain the properties of the function revealed by the resulting form. • Students should be able to compare the features of two linear, quadratic, and/or absolute value functions represented in different forms (algebraically, graphically, numerically in tables, and by verbal descriptions). 	<p>numerically in tables, and by verbal descriptions).</p>
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Cluster: F.BF.A

(F.BF.A.1a only)

Build a function that models a relationship between two quantities.

Standards:

F.BF.1 - Use functions to model real-world relationships.

F.BF.1a - (9/10) Combine multiple functions to model complex relationships. For example, $p(x) = r(x) - c(x)$; (*profit = revenue - cost*).

Evidence Statements			
<ol style="list-style-type: none"> 1. The student uses functions to model real-world linear, quadratic, and absolute value relationships. 2. The student combines multiple functions to model complex relationships. 			
Performance Level Descriptors (PLDs)			
Level 1	Level 2	Level 3	Level 4
<p>Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to model real-world linear functions. • Students should be able to combine linear functions to model a real-world problem. 	<p>Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to model real-world linear and quadratic functions. • Students should be able to combine different types of functions (linear and quadratic) to model a real-world problem. 	<p>Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to model real-world linear, quadratic, and absolute value functions. • Students should be able to combine different types of functions (linear, quadratic, and/or absolute value) to model a real-world problem. 	<p>Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to analyze and interpret a real-world problem by combining any number of functions, including linear, quadratic, and absolute value.

Cluster: F.BF.B

(F.BF.3 only)

Build new functions from existing functions.

Standards:

F.BF.3 - (9/10/11) Transform parent functions $f(x)$ by replacing $f(x)$ with $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them. For (9/10) focus on linear, quadratic, and absolute value functions.

Evidence Statements			
<ol style="list-style-type: none"> 1. The student identifies transformations of parent linear, quadratic, and absolute value functions from equations and graphs. 2. The student writes linear, quadratic, and absolute value functions formed by transformations of parent functions. 3. The student graphs and explains the changes made to a parent function. 			
Performance Level Descriptors (PLDs)			
Level 1	Level 2	Level 3	Level 4
<p>Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to identify, write, and graph transformations of linear parent functions, limited to $f(x) + k$ and $kf(x)$. 	<p>Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to identify, write, and graph transformations of linear, quadratic, and absolute value parent functions, limited to $f(x) + k$, $kf(x)$, and $f(x + k)$. 	<p>Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to identify, write, and graph transformations of linear, quadratic, and absolute value parent functions, limited to $f(x) + k$, $kf(x)$, $f(x + k)$, and $f(kx)$. • Students should be able to use technology to experiment with cases and illustrate an explanation of transformation effects on a graph. 	<p>Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to identify, write, and graph compound transformations of linear functions that apply two or more types of transformations from among $f(x) + k$, $kf(x)$, $f(x + k)$, and $f(kx)$.

		<ul style="list-style-type: none">• Students should be able to recognize even and odd functions from their graphs and algebraic expressions.	
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Cluster: G.CO.A

Experiment with transformations in the plane.

Standards:

G.CO.1 - (9/10) Verify experimentally (for example, using patty paper or geometry software) the properties of rotations, reflections, translations, and symmetry:

G.CO.1a - (9/10) Lines are taken to lines, and line segments to line segments of the same length.

G.CO.1b - (9/10) Angles are taken to angles of the same measure.

G.CO.1c - (9/10) Parallel lines are taken to parallel lines.

G.CO.1d - (9/10) Identify any line of reflection and/or rotational symmetry within a figure.

G.CO.2 - (9/10) Recognize transformations as functions that take points in the plane as inputs and give other points as outputs and describe the effect of translations, rotations, and reflections on two-dimensional figures. *For example, (x, y) maps to $(x + 3, y - 5)$; reflecting triangle ABC (input) across the line of reflection maps the triangle to exactly one location, $A'B'C'$ (output).*

Evidence Statements			
<ol style="list-style-type: none"> 1. The student describes the effects of sequences of rotations, reflections, and translations on lines and angles in the plane, and verifies that lines and angles are congruent. 2. The student identifies any line and/or rotational symmetry within a figure. 3. The student recognizes transformations (rotations, reflections, and translations) as functions and uses points in the plane as inputs to give other points as outputs. 			
Performance Level Descriptors (PLDs)			
Level 1	Level 2	Level 3	Level 4
<p>Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to identify a single rotation, reflection, or translation on a line segment, line, or angle in the plane. 	<p>Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to identify a sequence of rotations, reflections, and translations on line segments, lines, and angles in the plane. • Students should be able to identify 90° and 180° rotational 	<p>Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to describe the effects of sequences of rotations, reflections, and translations on line segments, lines, and angles in the plane, and verify that lines, line segments, and 	<p>Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to use starting and ending points for figures in the plane to generate a sequence of transformations. • Students should be able to recognize transformations (rotations, reflections, and

	<p>symmetry within a figure.</p> <ul style="list-style-type: none">• Students should be able to recognize transformations (rotations, reflections, and translations) as functions.	<p>angles are congruent after these rigid transformations.</p> <ul style="list-style-type: none">• Students should be able to identify any line of reflection and/or rotational symmetry within a figure.• Students should be able to recognize transformations (rotations, reflections, and translations) as functions and use points in the plane as inputs to give other points as outputs.	<p>translations) as functions and use points in the plane as outputs to find the inputs.</p>
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Cluster: G.CO.B

Understand congruence in terms of rigid motions.

Standards:

G.CO.3 - (9/10) Given two congruent figures, describe a **sequence** of rigid motions that exhibits the congruence (**isometry**) between them using coordinates and the non-coordinate plane.

G.CO.4 - (9/10) Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.

Evidence Statements			
<ol style="list-style-type: none"> 1. The student describes a sequence of rotations, reflections, and translations between two congruent figures using the coordinate and non-coordinate planes. 2. The student constructs a new figure after the original figure is rotated, reflected, or translated. 3. The student uses rotations, reflections, and translations to show that two triangles are congruent if corresponding sides and angles are congruent. 			
Performance Level Descriptors (PLDs)			
Level 1	Level 2	Level 3	Level 4
<p>Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to identify a single rigid transformation between two congruent figures in the coordinate plane. 	<p>Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to identify a sequence of two rigid transformations between two congruent figures in the coordinate and non-coordinate planes. 	<p>Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to describe a sequence of rigid transformations between two congruent figures on the coordinate and non-coordinate planes. • Students should be able to show that two triangles are congruent if corresponding sides and angles are congruent. • Students should be able to use a sequence of rigid 	<p>Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to explain why two figures are congruent in relation to a sequence of rotations, reflections, and translations. • Students should be able to generate a series of transformations between two figures in the coordinate and non-coordinate planes, given starting points,

		motions to construct a new figure in the plane and demonstrate that the two figures are congruent.	ending points, and a set of constraints.
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Cluster: G.CO.C

Construct arguments about geometric theorems using rigid transformations and/or logic.

Standards:

G.CO.7 - (9/10) Construct arguments about lines and angles using theorems. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment’s endpoints. (Building upon standard in 8th grade Geometry.)

G.CO.8 - (9/10) Construct arguments about the relationships within one triangle using theorems. Theorems include: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point; angle sum and exterior angle of triangles.

G.CO.9 - (9/10) Construct arguments about the relationships between two triangles using theorems. Theorems include: SSS, SAS, ASA, AAS, and HL.

G.CO.10 - (9/10) Construct arguments about parallelograms using theorems. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals. (Building upon prior knowledge in elementary and middle school.)

Evidence Statements			
<ol style="list-style-type: none"> 1. The student constructs arguments related to theorems about the congruency of lines and angles. 2. The student constructs arguments related to theorems about the relationships within one triangle. 3. The student constructs arguments related to theorems about the congruency of two triangles or relationships between two triangles. 4. The student constructs arguments related to theorems about the congruency of parallelograms. 			
Performance Level Descriptors (PLDs)			
Level 1	Level 2	Level 3	Level 4
<p>Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to identify arguments in proofs involving lines and angles 	<p>Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to complete arguments and order the steps in proofs involving 	<p>Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to construct arguments and complete proofs involving lines and 	<p>Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to identify, correct, and justify corrections for errors in arguments

<p>using theorems about vertical angles, transversals, and alternate interior angles.</p> <ul style="list-style-type: none"> • Students should be able to identify arguments in proofs involving the relationships between triangles using SSS and SAS. 	<p>lines and angles using theorems about vertical angles, transversals, and alternate interior angles.</p> <ul style="list-style-type: none"> • Students should be able to complete arguments and order the steps in proofs involving measures of interior angles of a triangle, base angles of isosceles triangles, and the segment joining midpoints of two sides of a triangle. • Students should be able to complete arguments and order the steps in proofs involving the relationships between triangles using SSS, SAS, and ASA. 	<p>angles using theorems about vertical angles, transversals, alternate interior angles, corresponding angles, and perpendicular bisectors.</p> <ul style="list-style-type: none"> • Students should be able to complete arguments and order the steps in proofs involving measures of interior angles of a triangle, base angles of isosceles triangles, the segment joining midpoints of two sides of a triangle, the medians of a triangle, and angle sum and exterior angles of triangles. • Students should be able to construct arguments and complete proofs involving the relationships between triangles using SSS, SAS, ASA, AAS, and HL. • Students should be able to construct arguments and complete proofs involving parallelograms using theorems about opposite 	<p>and proofs involving lines, angles, triangles, and parallelograms, and explain the reasoning.</p> <ul style="list-style-type: none"> • Students should be able to apply their knowledge of congruence criteria to solve contextual problems.
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		sides, opposite angles, and diagonals of a parallelogram.	
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Cluster: G.CO.D

(G.CO.11 only)

Make geometric constructions.

Standards:

G.CO.11 - (9/10) Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.

Evidence Statement			
1. The student makes formal geometric constructions with a variety of tools and methods, including copying and bisecting a segment, copying and bisecting an angle, constructing perpendicular lines and perpendicular bisectors, and constructing parallel lines.			
Performance Level Descriptors (PLDs)			
Level 1 Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:	Level 2 Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:	Level 3 Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:	Level 4 Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:
<ul style="list-style-type: none"> Students should be able to recognize the steps involved in copying a segment, copying an angle, bisecting a segment, and bisecting an angle. 	<ul style="list-style-type: none"> Students should be able to copy a segment, copy an angle, bisect a segment, bisect an angle, and construct geometric figures based on the relationships between the objects using a compass and straightedge, string, reflective devices, or paper folding. 	<ul style="list-style-type: none"> Students should be able to copy a segment; copy an angle; bisect a segment; bisect an angle; construct perpendicular lines, including the perpendicular bisector of a line segment; construct a line parallel to a given line through a point not on the line; and construct geometric figures based on the relationships between the objects, using a variety of method, 	<ul style="list-style-type: none"> Students should be able to identify the best method for constructing a given geometric figure, justify why the method is best for the given figure, and verify that the constructions are accurate.

		including dynamic geometric software.	
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Cluster: G.SRT.A

Understand similarity in terms of similarity transformations.

Standards:

G.SRT.1 - Use geometric constructions to verify the properties of dilations given by a center and a scale factor:

G.SRT.1a - A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.

G.SRT.1b - The dilation of a line segment is longer or shorter in the ratio given by the scale factor.

G.SRT.2 - Recognize transformations as functions that take points in the plane as inputs and give other points as outputs and describe the effect of dilations on two-dimensional figures.

G.SRT.3 - Given two similar figures, describe a **sequence** of transformations that exhibits the similarity between them using coordinates and the non-coordinate plane.

G.SRT.4 - Understand the meaning of similarity for two-dimensional figures as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.

Evidence Statements			
<ol style="list-style-type: none"> 1. The student recognizes transformations (dilations, rotations, reflections, and translations) as functions and uses points in the plane as inputs to give other points as outputs. 2. The student describes the effects of dilations on two-dimensional figures. 3. The student constructs a new figure after a sequence of transformations to the original figure. 4. The student describes a sequence of transformations between two similar figures using the coordinate and non-coordinate planes. 5. The student determines whether two-dimensional figures are similar and explains why they are similar using the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides. 			
Performance Level Descriptors (PLDs)			
Level 1	Level 2	Level 3	Level 4
<p>Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to identify a dilation as a transformation that relates two similar figures in the non-coordinate 	<p>Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to identify dilations and rotations of two-dimensional figures as functions that take points in the 	<p>Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to construct a new figure after a sequence of transformations. • Students should be able to recognize 	<p>Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to explain why two figures are similar in relation to a sequence of transformations.

<p>plane, limited to dilations with a scale factor of 2 or 3.</p> <ul style="list-style-type: none"> • Students should be able to identify a dilation, translation, rotation, or reflection. 	<p>plane as inputs and give other points as outputs.</p> <ul style="list-style-type: none"> • Students should be able to determine whether two two-dimensional figures are similar. • Students should be able to identify that similar two-dimensional figures have equivalent corresponding pairs of angles and proportionality of all corresponding pairs of sides. 	<p>transformations (dilations, rotations, reflections, and translations) as functions and use points in the plane as inputs to give other points as outputs.</p> <ul style="list-style-type: none"> • Students should be able to describe a sequence of transformations that include dilations that relate two similar figures, using the coordinate and non-coordinate planes. • Students should be able to explain how similar two-dimensional figures have equivalent corresponding pairs of angles and proportionality of all corresponding pairs of sides. 	<ul style="list-style-type: none"> • Students should be able to describe the effect of multiple transformations, including a dilation, on two-dimensional figures using coordinates and coordinate notation.
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Cluster: G.SRT.B

Construct arguments about theorems involving similarity.

Standards:

G.SRT.5 - Construct arguments about triangles using theorems. Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity, and AA.

G.SRT.6 - Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

Evidence Statements			
<ol style="list-style-type: none"> 1. The student constructs arguments related to theorems about the similarity of triangles. 2. The student uses congruence and similarity criteria for triangles to solve problems and prove relationships in geometric figures. 			
Performance Level Descriptors (PLDs)			
Level 1	Level 2	Level 3	Level 4
<p>Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to identify lines, angles, and necessary components of triangles to construct arguments related to a line parallel to one side of a triangle dividing the other two sides proportionally. • Students should be able to find measures of sides of congruent and similar figures. 	<p>Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to complete proofs related to a line parallel to one side of a triangle dividing the other two sides proportionally. • Students should be able to construct arguments about the similarity of triangles and identify the properties that support them. • Students should be able to solve problems involving triangles using congruence and similarity criteria. 	<p>Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to construct arguments and complete proofs related to one side of a triangle dividing the other two sides proportionally, the Pythagorean Theorem proven using triangle similarity, and AA. • Students should be able to use congruence and similarity criteria for triangles to solve mathematical problems and to prove relationships 	<p>Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to identify errors in arguments or proofs about the similarity and congruence of triangles, and explain the reasoning. • Students should be able to use congruence and similarity criteria for triangles to solve real-world problems.

		in geometric figures.	
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Cluster: G.SRT.C

Define trigonometric ratios and solve problems involving right triangles.

Standards:

G.SRT.7 - Show that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.

G.SRT.8 - Explain and use the relationship between the sine and cosine of complementary angles.

G.SRT.9 - Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

Evidence Statements			
<ol style="list-style-type: none"> 1. The student uses the definitions of trigonometric ratios for acute angles in a right triangle. 2. The student uses similar triangles to define and determine trigonometric ratios in right triangles. 3. The student explains and uses the relationship between the sine and cosine of complementary angles. 4. The student uses trigonometric ratios and the Pythagorean Theorem to solve problems involving right triangles in mathematical or real-world context. 			
Performance Level Descriptors (PLDs)			
Level 1	Level 2	Level 3	Level 4
<p>Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to identify trigonometric ratios. • Students should be able to use the Pythagorean Theorem to solve for the missing side length in a right triangle in mathematical contexts, with scaffolding. • Students should be able to understand that the acute angles of a right 	<p>Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to define trigonometric ratios and know the relationship between the sine and cosine of complementary angles. • Students should be able to use the Pythagorean Theorem and trigonometric ratios to solve for the missing side length in a right triangle in 	<p>Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to use the Pythagorean Theorem, trigonometric ratios, and the sine and cosine of complementary angles to solve mathematical and real-world problems involving finding the missing side length or missing angle measure of a right triangle. 	<p>Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to solve complex or multistep problems involving right triangles.

triangle are complementary.	mathematical problems, with some scaffolding.		
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Cluster: G.C.A

Understand and apply theorems about circles.

Standards:

G.C.1 - Construct arguments that all circles are similar.

G.C.2 - Identify and describe relationships among **inscribed** angles, radii, and chords. Include the relationship between central, inscribed, and **circumscribed** angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.

G.C.3 - Construct arguments using properties of polygons inscribed and circumscribed about circles.

Evidence Statements			
<ol style="list-style-type: none"> 1. The student constructs arguments that all circles are similar. 2. The student identifies and describes relationships among inscribed angles, radii, and chords. (Include the relationship among central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; and the radius of a circle is perpendicular to the tangent where the radius intersects the circle.) 3. The student constructs arguments using properties of polygons inscribed in and circumscribed about circles. 			
Performance Level Descriptors (PLDs)			
Level 1	Level 2	Level 3	Level 4
<p>Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to identify angles, radii, diameters, and chords of a circle, given a diagram of the circle. 	<p>Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to order the steps in an argument about the similarity of circles. • Students should be able to identify the center of a circle and determine the scale factor of a dilation of a circle. • Students should be able to describe relationships 	<p>Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to construct arguments and complete proofs about the similarity of circles. • Students should be able to construct arguments and complete proofs using properties of polygons inscribed in and circumscribed about circles. 	<p>Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to identify errors in arguments and proofs about the similarity of circles and explain the reasoning. • Students should be able to identify errors in arguments and proofs using properties of polygons inscribed in and circumscribed about circles.

	<p>among the parts of a circle.</p> <ul style="list-style-type: none">• Students should be able to identify relationships among inscribed angles, radii, and chords, and the relationship among central, inscribed, and circumscribed angles of a circle.	<ul style="list-style-type: none">• Students should be able to identify and describe relationships among inscribed angles, radii, and chords, and the relationship among central, inscribed, and circumscribed angles of a circle.• Students should be able to recognize that inscribed angles on a diameter are right angles, and a circle's radius is perpendicular to the tangent line that intersects the circle at that radius.	
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Cluster: G.GPE.A

Translate between the geometric description and the equation for a conic section.

Standards:

G.GPE.1 - Write the equation of a circle given the center and radius or a graph of the circle; use the center and radius to graph the circle in the coordinate plane.

Evidence Statements			
1. The student writes the equation of a circle, given the center and radius or a graph of the circle.			
2. The student uses the center and the radius to graph a circle in the coordinate plane.			
Performance Level Descriptors (PLDs)			
Level 1	Level 2	Level 3	Level 4
Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:	Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:	Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:	Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:
<ul style="list-style-type: none">• Students should be able to identify the center, radius, and diameter of a circle, given a graph of the circle.	<ul style="list-style-type: none">• Students should be able to write an equation for a circle, given the radius and center.• Students should be able to write an equation for a circle with a center at the origin, given a graph of the circle.	<ul style="list-style-type: none">• Students should be able to write an equation for a circle, given the radius and center or a graph of the circle.• Students should be able to graph a circle, given the center and radius.	<ul style="list-style-type: none">• Students should be able to compare features of circles by analyzing their graphs and equations.

Cluster: G.GPE.B

Use coordinates to prove simple geometric theorems algebraically.

Standards:

G.GPE.6 - Use coordinates to prove simple geometric theorems algebraically, including the use of slope, distance, and midpoint formulas *For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle.*

G.GPE.7 - Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (*e.g. find the equation of a line parallel or perpendicular to a given line that passes through a given point*).

G.GPE.8 - Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, including the use of the distance and midpoint formulas.

Evidence Statements			
<ol style="list-style-type: none"> 1. The student uses coordinates to prove simple geometric theorems algebraically, including the use of slope, distance, and midpoint formulas to solve real-world and mathematical problems. 2. The student determines whether lines or sides of a figure are parallel, intersecting, or perpendicular. 3. The student writes equations of parallel and perpendicular lines. 4. The student uses and proves the slope criteria for parallel and perpendicular lines. 5. The student uses coordinates to compute perimeters of polygons and areas of triangles and rectangles, including the use of the distance and midpoint formulas. 			
Performance Level Descriptors (PLDs)			
Level 1	Level 2	Level 3	Level 4
<p>Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to identify the slopes of parallel and perpendicular lines. • Students should be able to determine whether lines are parallel, intersecting, or perpendicular, given graphs 	<p>Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to use coordinates to prove simple geometric theorems involving slope. • Students should be able to determine whether sides of a figure are parallel, intersecting, or perpendicular. 	<p>Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to prove or disprove a claim about a figure using geometric theorems involving the slope, distance, and midpoint formulas. • Students should be able to use and prove the slope criteria for 	<p>Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to prove or disprove a geometric claim, given a real-world problem, and explain their reasoning using logic. • Students should be able to compute the perimeter and area of a variety of

<p>and/or slopes of the lines.</p> <ul style="list-style-type: none"> • Students should be able to write equations of parallel lines, given a graph. • Students should be able to use coordinates to find slopes, midpoints, and/or distances algebraically. 	<ul style="list-style-type: none"> • Students should be able to write equations of parallel and perpendicular lines, given a graph. • Students should be able to compute the area and perimeter of a polygon with four or fewer sides, using coordinates from a given graph. • Students should be able to create the equation of a line that passes through a specific point, given its slope. 	<p>problems involving parallel and perpendicular lines.</p> <ul style="list-style-type: none"> • Students should be able to graph a polygon, given coordinates, and find its perimeter. • Students should be able to find the area of triangles and rectangles, given coordinates. • Students should be able to create the equation of a line parallel or perpendicular to a given line that passes through a given point. 	<p>polygons, including convex, concave, and irregularly shaped polygons.</p>
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Cluster: G.MG.A

Apply geometric concepts in modeling situations.

Standards:

G.MG.1 - Use geometric shapes, their measures, and their properties to describe objects (*e.g. modeling a tree trunk or a human torso as a cylinder*).

G.MG.2 - Apply concepts of density and displacement based on area and volume in modeling situations (*e.g. persons per square mile, BTUs per cubic foot*).

G.MG.3 - Apply geometric methods to solve design problems (*e.g. designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios*).

Evidence Statements			
<ol style="list-style-type: none"> 1. The student uses geometric shapes, measurements, and properties to describe objects. 2. The student applies concepts of density and displacement based on area and volume in modeling situations. 3. The student applies geometric methods to solve design problems. 			
Performance Level Descriptors (PLDs)			
Level 1	Level 2	Level 3	Level 4
<p>Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to recognize that geometric shapes can be used to describe two- and three-dimensional real-world objects. • Students should be able to identify when a visual representation models a design problem. 	<p>Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to identify geometric shapes that can describe two- and three-dimensional real-world objects. • Students should be able to solve design problems using a geometric model. • Students should be able to understand the meaning of density and displacement. 	<p>Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to describe two- and three-dimensional real-world objects using geometric shapes, measurements, and properties. • Students should be able to solve design problems using a geometric model and interpret the solutions in the context of the problem. 	<p>Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to explain and describe the geometric shapes that compose real-world objects and use the measurements and properties to solve design problems. • Students should be able to explain and justify geometric methods used to solve design problems.

		<ul style="list-style-type: none">• Students should be able to apply concepts of density and displacement based on area and volume in modeling situations.	
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Cluster: S.ID.A

Summarize, represent, and interpret data on a single count or measurement variable.

Standards:

S.ID.1 - Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (**interquartile range**, standard deviation) of two or more different data sets.

S.ID.2 - Interpret differences in shape, center, and spread in the context of the data sets using dot plots, histograms, and box plots, accounting for possible effects of extreme data points (**outliers**).

Evidence Statements			
<ol style="list-style-type: none"> 1. The student uses statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets. 2. The student interprets the differences in shape, center, and spread in the context of data sets represented by dot plots, histograms, and box plots. 3. The student interprets the effects of outliers on the shape, center, and spread of a data set. 			
Performance Level Descriptors (PLDs)			
Level 1	Level 2	Level 3	Level 4
<p>Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to describe a data set represented by a dot plot, histogram, or box plot in terms of center and spread. • Students should be able to describe the center of a single set of data or graph using mean and median. 	<p>Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to compare the similarities or differences in shape, center, or spread between two data displays. • Students should be able to identify outliers and the center of the data for data sets represented by dot plots, histograms, or box plots. 	<p>Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to use appropriate statistics to generate data displays to interpret, explain, and summarize differences in shape, center, and spread of two or more different data sets. • Students should be able to interpret the effects of outliers. • Students should be able to identify the appropriate 	<p>Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to decide how and when to include outliers when finding the center for data sets. • Students should be able to identify the appropriate choice of spread as interquartile range or standard deviation, based on the choice of measure of center.

		measure for representing the center of the data for data sets represented by dot plots, histograms, or box plots.	
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Cluster: S.ID.B

Summarize, represent, and interpret data on two categorical and quantitative variables.

Standards:

S.ID.4 - Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.

S.ID.5 - Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.

S.ID.5a - Use a given linear function to solve problems in the context of data.

S.ID.5b - Fit a linear function to data and use it to solve problems in the context of the data.

Evidence Statements			
<ol style="list-style-type: none"> 1. The student summarizes categorical data for two categories in a two-way frequency table. 2. The student uses two-way frequency tables to interpret relative frequencies in the context of the data and identify possible associations and trends in the data. 3. The student represents data on a scatter plot and describes how the two quantitative variables are related. 4. The student solves problems in the context of data represented on a scatter plot, given a linear function or by writing a linear function to fit the data. 			
Performance Level Descriptors (PLDs)			
Level 1	Level 2	Level 3	Level 4
<p>Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to identify and describe two-way frequency tables that present data sets with four total categories. • Students should be able to describe the data represented on a scatter plot, given a linear function to fit the data. 	<p>Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to solve problems and make simple observations given a two-way frequency table. (e.g., find the total number of people represented in the two-way frequency table about movie theater patrons). 	<p>Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to summarize categorical data for two categories in two-way frequency tables, interpret relative frequencies in the context of the data, and produce relative frequency tables from two-way tables. 	<p>Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:</p> <ul style="list-style-type: none"> • Students should be able to interpret and use relative frequencies from a two-way table to explain possible associations and trends in the data to make predictions in real-world situations.

	<ul style="list-style-type: none"> • Students should be able to calculate frequencies from categorical data in a two-way frequency table. • Students should be able to represent data on two quantitative variables on a scatter plot. • Students should be able to solve problems in the context of data represented on a scatter plot, given a linear function to fit the data. 	<ul style="list-style-type: none"> • Students should be able to identify possible associations and trends in a data distribution. • Students should be able to describe if and how two quantitative variables are related. • Students should be able to use a given linear function to solve problems and fit a linear function to data on a scatter plot to solve problems in the context of data. 	
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Cluster: S.ID.C

(S.ID.6 only)

Interpret linear models.

Standards:

S.ID.6 - Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

Evidence Statement			
1. The student interprets the slope and the intercept of a linear model in the context of the data.			
Performance Level Descriptors (PLDs)			
Level 1	Level 2	Level 3	Level 4
Students at level 1 show a <i>limited</i> ability to demonstrate their knowledge and skills such as:	Students at level 2 show a <i>basic</i> ability to demonstrate their knowledge and skills such as:	Students at level 3 show a <i>proficient</i> ability to demonstrate their knowledge and skills such as:	Students at level 4 show an <i>advanced</i> ability to demonstrate their knowledge and skills such as:
<ul style="list-style-type: none">• Students should be able to identify the slope and the y-intercept of a linear model.	<ul style="list-style-type: none">• Students should be able to identify and describe the slope and the y-intercept of a linear model of data.	<ul style="list-style-type: none">• Students should be able to interpret the slope and y-intercept of a linear model in the context of the data.	<ul style="list-style-type: none">• Students should be able to interpret and explain unreliable extrapolations and limitations of predictions made from linear models.