



National Center and State Collaborative

Core Content Connectors: Patterns, Relations, and Functions 2

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National Center and State Collaborative

The National Center and State Collaborative (NCSC) is applying the lessons learned from the past decade of research on alternate assessments based on alternate achievement standards (AA-AAS) to develop a multi-state comprehensive assessment system for students with significant cognitive disabilities. The project draws on a strong research base to develop an AA-AAS that is built from the ground up on powerful validity arguments linked to clear learning outcomes and defensible assessment results, to complement the work of the Race to the Top Common State Assessment Program (RTTA) consortia.

Our long-term goal is to ensure that students with significant cognitive disabilities achieve increasingly higher academic outcomes and leave high school ready for post-secondary options. A well-designed summative assessment alone is insufficient to achieve that goal. Thus, NCSC is developing a full system intended to support educators, which includes formative assessment tools and strategies, professional development on appropriate interim uses of data for progress monitoring, and management systems to ease the burdens of administration and documentation. All partners share a commitment to the research-to-practice focus of the project and the development of a comprehensive model of curriculum, instruction, assessment, and supportive professional development. These supports will improve the alignment of the entire system and strengthen the validity of inferences of the system of assessments.



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This document is available in alternative formats upon request.

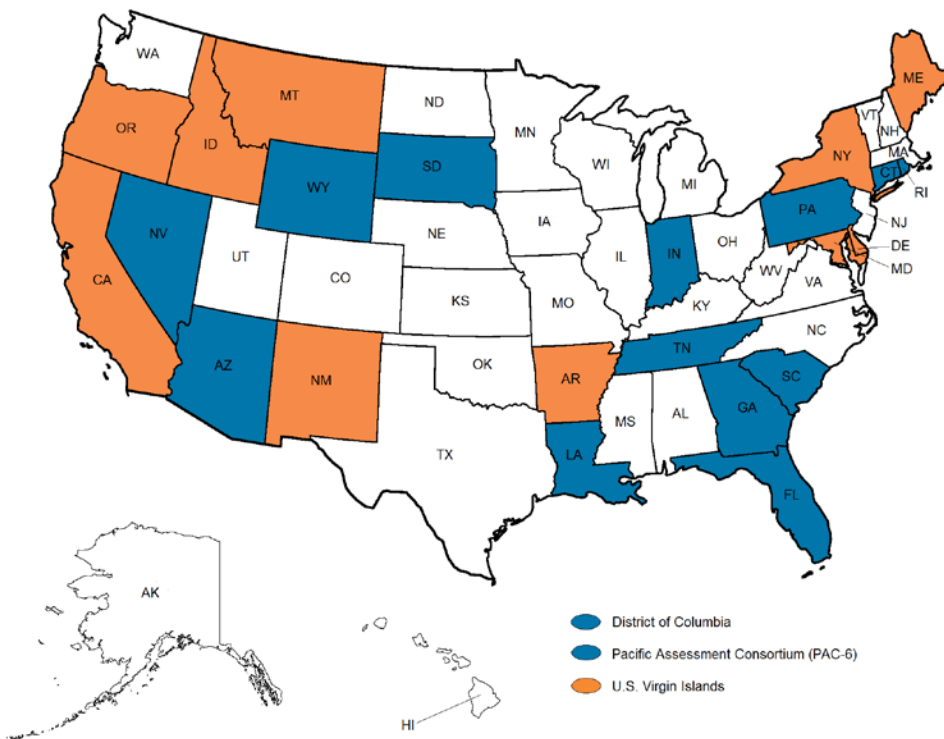


National Center and State Collaborative

NCSC is a collaborative of 15 states and five organizations.

The states include (shown in blue on map): Arizona, Connecticut, District of Columbia, Florida, Georgia, Indiana, Louisiana, Nevada, Pacific Assessment Consortium (PAC-6)¹, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, and Wyoming.

Tier II states are partners in curriculum, instruction, and professional development implementation but are not part of the assessment development work. They are (shown in orange on map): Arkansas, California, Delaware, Idaho, Maine, Maryland, Montana, New Mexico, New York, Oregon, and U.S. Virgin Islands.



*Core partner states are blue in color and Tier II states are orange in color.

¹ The Pacific Assessment Consortium (including the entities of American Samoa, Commonwealth of the Northern Mariana Islands, Federated States of Micronesia, Guam, Republic of Palau, and Republic of the Marshall Islands) partner with NCSC as one state, led by the University of Guam Center for Excellence in Developmental Disabilities Education, Research, and Service (CEDDERS).



National Center and State Collaborative

The five partner organizations include: The National Center on Educational Outcomes (NCEO) at the University of Minnesota, The National Center for the Improvement of Educational Assessment (Center for Assessment), The University of North Carolina at Charlotte, The University of Kentucky, and edCount, LLC.



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Identifying the Core Content of the Learning Progressions Framework for the Common Core State Standards for Students Who Participate in AA-AAS

Introduction

The purpose of this paper is to describe the development and prioritization of the academic content for students with significant cognitive disabilities. This prioritized academic content is referred to as Core Content Connectors (CCCs). This work is part of the NCSC GSEG and provides the foundation for the development of curriculum resources, professional development, instructional resources, and alternate assessment based on alternate achievement standards (AA-AAS). A unique feature of the development and prioritization of academic content is the use of learning progressions framework (LPF), which is built to include relationships with the Common Core State Standards (CCSSs). The LPF does not provide details of grade-specific curriculum, but describes a path for student learning as an ongoing developmental progression and is a starting point for thinking about how students develop competency in an academic domain (Hess, 2010). The following sections describe the use of LPFs for identifying specific grade-level Common Core State Standards (CCSS), and the development of the CCCs for providing more specificity for teachers.

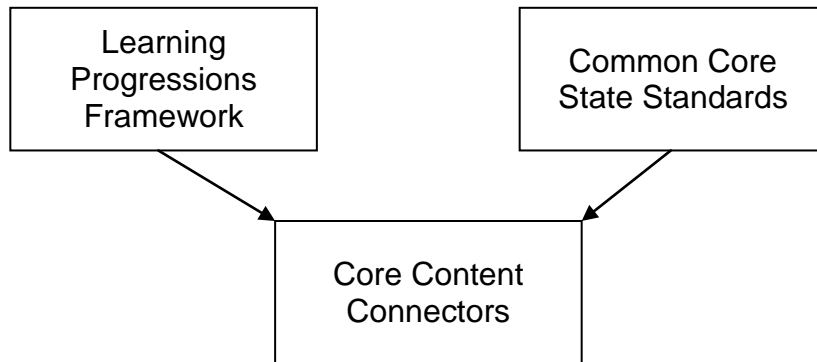
Learning Progression Framework

The National Alternate Assessment Center, under the leadership of Karin Hess, developed LPFs. Hess's (2008) definition of LPs is based on four interrelated guiding principles: (a) LPs are developed and refined using available research and evidence, (b) LPs have clear binding threads that articulate the essential core concepts and processes of a discipline sometimes referred to as the "big ideas" of the discipline, (c) LPs articulate movement towards increased understanding, and (d) LPs go hand-in-hand with well-designed and aligned assessments.

The grade span learning targets of the LPF were identified by national content experts and are a broad description of the essential content and general sequencing for student learning and skill development. The LPF does not provide details of grade-specific curriculum, but describes a path for student learning as an ongoing developmental progression. The LPF is currently available at http://www.nciea.org/publications/Math_LP_F_KH11.pdf

Core Content Connectors

The Core Content Connectors (CCCs) are the prioritized academic content designed to frame the instruction and assessment of students with significant cognitive disabilities. The CCCs create a connection between the Learning Progressions Framework (LPF) and Common Core State Standards (CCSS) for these students.



The purpose of the CCCs is to identify the most salient core academic content in ELA and math found in both the CCSS and the LPF Progress Indicators (LPF PIs) (i.e., observable learning along the learning continuum for each strand in the LPFs). The CCCs illustrate the necessary knowledge and skills students with significant cognitive disabilities need to reach the learning targets or critical big ideas within the Learning Progression Frameworks (LPF, Hess et al., 2010) and the Common Core State Standard. This identified core content serves as a connection or stage between the LPF (designed for typically developing students) and the CCSS (which define grade level content and achievement). The CCCs are intentionally dually aligned with both the LPFs and the CCSSs. The CCCs identify priorities for the instruction for students in this population, and the alternate assessment. CCCs are designed to contribute to a fully aligned system of content, instruction, and assessment.

Progress Indicator: M.NO.1e describing, representing, and comparing absolute value relationships		
Core Content Connectors: 6	CCSS Domain/Cluster	Common Core State Standard
6.NO.1e1 Determine the meaning of absolute value	Expressions and Equations 6 NS Apply and extend previous understandings of numbers to the system of rational numbers.	6.NS.7c Understand ordering and absolute value of rational numbers. a) Understand the absolute value of a rational number as its distance from 0 on the number line; interpret absolute value as magnitude for a positive or negative quantity in a real-world situation. For example, for an account balance of -30 dollars write $ -30 = 30$ to describe the size of the debt in dollars.
Progress Indicator: M.NO.1f recognizing equivalence of representations using fractions, decimals, and percents and using them solve ratio problems		
Core Content Connectors: 6	CCSS Domain/Cluster	Common Core State Standard
6.NO.1f1 Find a percent of a quantity as rate per 100	Ratios and Proportional Relationships 6 RP Understand ratio concepts and use ratio reasoning to solve problems.	6.RP.3c Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations. c) Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent.
6.NO.1f2 Write or select a ratio to match a given statement and representation	Ratios and Proportional Relationships 6 RP Understand ratio concepts and use ratio reasoning to solve problems.	6.RP.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. For example, "The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak." "For every vote candidate A received, candidate C received nearly three votes."
6.NO.1f3 Select or make a statement to interpret a given ratio	Ratios and Proportional Relationships 6 RP Understand ratio concepts and use ratio reasoning to solve problems.	6.RP.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. For example, "The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak." "For every vote candidate A received, candidate C received nearly three votes."

The CCCs preserve the sequence of learning outlined in the LPFs to the extent possible while disaggregating the progress indicators (which describe concepts and skills along the learning continuum for each grade span in the learning progression) into teachable and assessable segments of content. The connectors and corresponding curriculum resource guides were written to help promote how students can engage in the CCSS while following the learning progression.

The CCCs have the following characteristics:

- Sequenced according to the LPFs to help guide meaningful instruction for students and lead to enduring skills in successive grades
- Written as outcome based, which provides a description of what students should know and do
- Written at high levels of expectations for students to eliminate potential ceiling effect for student learning
- Aligned to the grade-level CCSSs to provide access to the general curriculum
- Organized by the six major LPF strands (Symbolic Expression; Nature of Numbers & Operations; Measurement; Patterns, Relations, & Functions; Geometry; and Data Analysis, Probability, & Statistics)

In some grades, CCCs were developed that were considered important for student learning but were not aligned to the LPF. CCCs for some prerequisite skills were included in some of the grades, but these CCCs are for instructional purposes and not intended as a target for assessment. At the high school level, where only one AA-AAS will be administered to students but many CCSSs and LPFs are provided, some subsets of LPF Progress Indicators were selected for developing CCCs.

All CCCs will be provided by the curriculum and instruction work group in NCSC. While states may add additional content standards as they deem necessary that is specific to the needs, states and teachers will NOT have to develop any further CCCs. The complete set will be disseminated upon completion and validation. It is anticipated that states who have adopted the Common Core State Standards can use the CCCs as the priorities for students who take AA-AAS and will not need to create other forms of translations or create extensions of the Common Core unless they choose to do so. Teachers will be able to use these, along with the various curriculum resources, to plan instruction.

Uses of the document

There are several potential uses for this document. The first is to demonstrate how the identified core content builds critical big ideas across the grades. The format is intended to show how students can grow within the linked content across the grades and the connections between the related content to help guide sequential and meaningful instructional efforts. The second potential use is to provide clarity and specificity of the content within each grade level. In the process of identifying the CCC within each of the PI, it was evident that some considerations were necessary related to the content. First, it is necessary to disaggregate the content within some of the PI to a finer grain size. As students with significant cognitive disabilities may require instruction on single concepts, PIs that include multiple concepts may need to be separated in the unpacked content. Additionally, identifying core content requires focusing on the critical big ideas within the content and the need for considering meaningful instructional context within the instruction of students who participate in the alternate assessment. The third use for this document is to demonstrate how the CCCs have direct links to the CCSS. The CCSS that are identified as having the closest match are listed beside the corresponding CCC. As these direct links indicate, the CCC are not weakly linked or “watered down” translations, but instead pinpoint the most salient content in the standard. The potential users of this document ranges from assessment designers to teachers. While the document is not intended to be a standalone instructional resource, it is intended to support teachers in their understanding of the content.

References

- Hess, K. (2010, December). *Learning progressions frameworks designed for use with the Common Core State Standards in mathematics K-12*. National Alternate Assessment Center at the University of Kentucky and the National Center for the Improvement of Educational Assessment, Dover, N.H.
- Hess, K. (2008). Developing and using learning progressions as a schema for measuring progress [online]. Retrieved from http://www.nciea.org/publications/CCSSO2_KH08.pdf

	(K-4) Elementary School Learning Targets		(5-8) Middle School Learning Targets		(9-12) High School Learning Targets
	<i>E.PRF-2 Give examples, interpret, and analyze repeating and growing patterns and functions involving the four basic operations.</i>		<i>M.PRF-2 Give examples, interpret, and analyze a variety of mathematical patterns, relations, and explicit and recursive functions.</i>		<i>H.PRF-2 Use trends and analyze a variety of mathematical patterns, relations, and explicit and recursive functions.</i>
	Grades K-2	Grades 3-4	Grades 5-6	Grades 7-8	HS
Arithmetic Patterns	K.PRF.2a1 Describe or select the repeating pattern using objects or pictures (AB or ABC)	3.PRF.2d1 Identify multiplication patterns in a real world setting	5.PRF.2a1 Generate a pattern that follows the provided rule	8.PRF.2c1 Given two graphs, describe the function as linear and not linear	H.PRF. 2c1 Make predictions based on a given model (for example, a weather model, data for athletes over years)
	K.PRF.2a2 Extend a repeating pattern using objects or pictures (AB or ABC)	3.PRF.2d2 Apply properties of operations as strategies to multiply and divide	5.PRF.2b1 Generate or select a comparison between two graphs from a similar situation	8.PRF.2e1 Distinguish between functions and non-functions, using equations, graphs or tables	
	K.PRF.2a3 Extend a repeating numerical AB pattern	4.PRF.2d3 Generate a pattern when given a rule and word problem (I run 3 miles every day, how many miles have I run in 3 days)	6.PRF.2b2 Using provided table with numerical patterns, form ordered pairs	8.PRF.2e2 Identify the rate of change (slope) and initial value (y-intercept) from graphs	
	K.PRF.2b1 Create a repeating pattern using objects, pictures, or numbers	4.PRF.2e1 Extend a numerical pattern when the rule is provided		8.PRF.2e3 Given a verbal description of a situation, create or identify a graph to model the situation	
				8.PRF.2e4 Given a graph of a situation, generate a description of the situation	
	1.PRF.2a4 Use a number line to extend the numerical patterns that grow at a constant rate (2,4,6,8)				

	(K-4) Elementary School Learning Targets		(5-8) Middle School Learning Targets		(9-12) High School Learning Targets
	<i>E.PRF-2 Give examples, interpret, and analyze repeating and growing patterns and functions involving the four basic operations.</i>		<i>M.PRF-2 Give examples, interpret, and analyze a variety of mathematical patterns, relations, and explicit and recursive functions.</i>		<i>H.PRF-2 Use trends and analyze a variety of mathematical patterns, relations, and explicit and recursive functions.</i>
	Grades K-2	Grades 3-4	Grades 5-6	Grades 7-8	HS
	1.PRF.2b2 Create a growing pattern using numbers or objects				
	1.PRF.2c1 Identify the rule of a given arithmetic pattern				
	2.PRF.2a6 Use a number line to extend the numerical patterns that grow at a constant rate (2,4,6,8)				
	2.PRF.2b3 Use a number line to extend arithmetic patterns that are decreasing				
	2.PRF.2c2 Identify the rule of arithmetic patterns that are increasing				
	2.PRF.2c3 Identify the rule of arithmetic patterns that are decreasing				
Expressions and Equations			6.PRF.2a2 Use variables to represent numbers and write expressions when solving real-world problems	7.PRF.2a5 Use variables to represent two quantities in a real-world problem that change in relationship to one another	H.PRF.2a1 Translate an algebraic expression into a word problem

	(K-4) Elementary School Learning Targets		(5-8) Middle School Learning Targets		(9-12) High School Learning Targets
	<i>E.PRF-2 Give examples, interpret, and analyze repeating and growing patterns and functions involving the four basic operations.</i>		<i>M.PRF-2 Give examples, interpret, and analyze a variety of mathematical patterns, relations, and explicit and recursive functions.</i>		<i>H.PRF-2 Use trends and analyze a variety of mathematical patterns, relations, and explicit and recursive functions.</i>
	Grades K-2	Grades 3-4	Grades 5-6	Grades 7-8	HS
			6.PRF.2a3 Use variables to represent two quantities in a real-world problem that change in relationship to one another	7.PRF.2d1 Solve word problems leading to inequalities of the form $px + q > r$ or $px + q < r$, where p , q , and r are specific rational numbers	H.PRF.2b1 Translate a real-world problem into a one variable equation
			6.PRF.2a4 Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation		H.PRF.2b2 Solve equations with one or two variables using equations or graphs
			6.PRF.2b3 Complete a statement that describes the ratio relationship between two quantities		
			6.PRF.2b4 Determine the unit rate in a variety of contextual situations		

	(K-4) Elementary School Learning Targets		(5-8) Middle School Learning Targets		(9-12) High School Learning Targets
	<i>E.PRF-2 Give examples, interpret, and analyze repeating and growing patterns and functions involving the four basic operations.</i>		<i>M.PRF-2 Give examples, interpret, and analyze a variety of mathematical patterns, relations, and explicit and recursive functions.</i>		<i>H.PRF-2 Use trends and analyze a variety of mathematical patterns, relations, and explicit and recursive functions.</i>
	Grades K-2	Grades 3-4	Grades 5-6	Grades 7-8	HS
			6.PRF.2b5 Use ratios and reasoning to solve real-world mathematical problems (e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations)		

Progress Indicator: E.PRF.2a recognizing, describing, and extending simple repeating (ABAB) and growing (A+1, A+2, A+3) patterns (e.g., colors, sounds, words, shapes, numeric – counting, odd, even)		
Core Content Connectors: K	CCSS Domain/Cluster	Common Core State Standard
K.PRF.2a1 Describe or select the repeating pattern using objects or pictures (AB or ABC)		No CCSS linked
K.PRF.2a2 Extend a repeating pattern using objects or pictures (AB or ABC)		No CCSS linked
K.PRF.2a3 Extend a repeating numerical AB pattern		No CCSS linked
Progress Indicator: E.PRF.2b creating and explaining repeating and growing patterns using objects or numbers		
Core Content Connectors: K	CCSS Domain/Cluster	Common Core State Standard
K.PRF.2b1 Create a repeating pattern using objects, pictures, or numbers		No CCSS linked

Progress Indicator: E.PRF.2a recognizing, describing, and extending simple repeating (ABAB) and growing (A+1, A+2, A+3) patterns (e.g., colors, sounds, words, shapes, numeric – counting, odd, even)		
Core Content Connectors: 1	CCSS Domain/Cluster	Common Core State Standard
1.PRF.2a4 Use a number line to extend the numerical patterns that grow at a constant rate (2,4,6,8)		No CCSS linked
Progress Indicator: E.PRF.2b creating and explaining repeating and growing patterns using objects or numbers		
Core Content Connectors: 1	CCSS Domain/Cluster	Common Core State Standard
1.PRF.2b2 Create a growing pattern using numbers or objects		No CCSS linked

Progress Indicator: E.PRF.2c extending and analyzing simple numeric patterns with rules that involve addition and subtraction		
Core Content Connectors: 1	CCSS Domain/Cluster	Common Core State Standard
1.PRF.2c1 Identify the rule of a given arithmetic pattern		No CCSS linked

Progress Indicator: E.PRF.2a recognizing, describing, and extending simple repeating (ABAB) and growing (A+1, A+2, A+3) patterns (e.g., colors, sounds, words, shapes, numeric – counting, odd, even)		
Core Content Connectors: 2	CCSS Domain/Cluster	Common Core State Standard
2.PRF.2a6 Use a number line to extend the numerical patterns that grow at a constant rate (2,4,6,8)		No CCSS linked

Progress Indicator: E.PRF.2b creating and explaining repeating and growing patterns using objects or numbers		
Core Content Connectors: 2	CCSS Domain/Cluster	Common Core State Standard
2.PRF.2b3 Use a number line to extend arithmetic patterns that are decreasing		No CCSS linked

Progress Indicator: E.PRF.2c extending and analyzing simple numeric patterns with rules that involve addition and subtraction		
Core Content Connectors: 2	CCSS Domain/Cluster	Common Core State Standard
2.PRF.2c2 Identify the rule of arithmetic patterns that are increasing		No CCSS linked
2.PRF.2c3 Identify the rule of arithmetic patterns that are decreasing		No CCSS linked

Progress Indicator: E.PRF.2d representing and analyzing patterns and rules (e.g., doubling, adding 3) using words, tables, graphs, and models		
Core Content Connectors: 3	CCSS Domain/Cluster	Common Core State Standard
3.PRF.2d1 Identify multiplication patterns in a real world setting	Operations and Algebraic Thinking 3 OA Solve problems involving the four operations, and identify and explain patterns in arithmetic.	3.OA.9 Identify arithmetic patterns (including patterns in the addition table or multiplication table), and explain them using properties of operations. <i>For example, observe that 4 times a number is always even, and explain why 4 times a number can be decomposed into two equal addends.</i>
3.PRF.2d2 Apply properties of operations as strategies to multiply and divide	Operations and Algebraic Thinking 3 OA Understand properties of multiplication and the relationship between multiplication and division.	3.OA.5 Apply properties of operations as strategies to multiply and divide. <i>Examples: If $6 \times 4 = 24$ is known, then $4 \times 6 = 24$ is also known. (Commutative property of multiplication.) $3 \times 5 \times 2$ can be found by $3 \times 5 = 15$, then $15 \times 2 = 30$, or by $5 \times 2 = 10$, then $3 \times 10 = 30$. (Associative property of multiplication.) Knowing that $8 \times 5 = 40$ and $8 \times 2 = 16$, one can find 8×7 as $8 \times (5 + 2) = (8 \times 5) + (8 \times 2) = 40 + 16 = 56$. (Distributive property.)</i>

Progress Indicator: E.PRF.2d representing and analyzing patterns and rules (e.g., doubling, adding 3) using words, tables, graphs, and models		
Core Content Connectors: 4	CCSS Domain/Cluster	Common Core State Standard
4.PRF.2d3 Generate a pattern when given a rule and word problem (I run 3 miles every day, how many miles have I run in 3 days)	Operations and Algebraic Thinking 4 OA Generate and analyze patterns.	4.OA.5 Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself. <i>For example, given the rule "Add 3" and the starting number 1, generate terms in the resulting sequence and observe that the terms appear to alternate between odd and even numbers. Explain informally why the numbers will continue to alternate in this way.</i>
Progress Indicator: E.PRF.2e extending, translating, and analyzing numeric patterns and their rules using addition, subtraction, multiplication, and division		
Core Content Connectors: 4	CCSS Domain/Cluster	Common Core State Standard
4.PRF.2e1 Extend a numerical pattern when the rule is provided	Operations and Algebraic Thinking 4 OA Generate and analyze patterns.	4.OA.5 Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself. <i>For example, given the rule "Add 3" and the starting number 1, generate terms in the resulting sequence</i>

		<i>and observe that the terms appear to alternate between odd and even numbers. Explain informally why the numbers will continue to alternate in this way.</i>
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Progress Indicator: M.PRF.2a representing, analyzing, extending, and generalizing a variety of patterns using tables, graphs, words, and symbolic rules

Core Content Connectors: 5	CCSS Domain/Cluster	Common Core State Standard
5.PRF.2a1 Generate a pattern that follows the provided rule	Operations and Algebraic Thinking 4 OA Generate and analyze patterns.	4.OA.5 Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself. <i>For example, given the rule “Add 3” and the starting number 1, generate terms in the resulting sequence and observe that the terms appear to alternate between odd and even numbers. Explain informally why the numbers will continue to alternate in this way.</i>

Progress Indicator: M.PRF.2b relating and comparing different forms of representation and identifying functions as linear or nonlinear

Core Content Connectors: 5	CCSS Domain/Cluster	Common Core State Standard
5.PRF.2b1 Generate or select a comparison between two graphs from a similar situation	Operations and Algebraic Thinking 5 OA Analyze patterns and relationships.	5.OA.3 Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns, and graph the ordered pairs on a coordinate plane. <i>For example, given the rule “Add 3” and the starting number 0, and given the rule “Add 6” and the starting number 0, generate terms in the resulting sequences, and observe that the terms in one sequence are twice the corresponding terms in the other sequence. Explain informally why this is so.</i>

Progress Indicator: M.PRF.2a representing, analyzing, extending, and generalizing a variety of patterns using tables, graphs, words, and symbolic rules		
Core Content Connectors: 6	CCSS Domain/Cluster	Common Core State Standard
6.PRF.2a2 Use variables to represent numbers and write expressions when solving real-world problems	Expressions and Equations 6 EE Reason about and solve one-variable equations and inequalities.	6.EE.6 Use variables to represent numbers and write expressions when solving real-world or mathematical problems; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.
6.PRF.2a3 Use variables to represent two quantities in a real-world problem that change in relationship to one another	Expressions and Equations 6 EE Represent and analyze quantitative relationships between dependent and independent variables.	6.EE.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. <i>Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. For example, in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation $d = 65t$ to represent the relationship between distance and time.</i>
6.PRF.2a4 Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation	Expressions and Equations 6 EE Represent and analyze quantitative relationships between dependent and independent variables.	6.EE.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. <i>Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. For example, in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation $d = 65t$ to represent the relationship between distance and time.</i>

Progress Indicator: M.PRF.2b relating and comparing different forms of representation and identifying functions as linear or nonlinear		
Core Content Connectors: 6	CCSS Domain/Cluster	Common Core State Standard
6.PRF.2b2 Using provided table with numerical patterns, form ordered pairs	<p>Operations and Algebraic Thinking</p> <p>5 OA Analyze patterns and relationships.</p>	5.OA.3 Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns, and graph the ordered pairs on a coordinate plane. <i>For example, given the rule “Add 3” and the starting number 0, and given the rule “Add 6” and the starting number 0, generate terms in the resulting sequences, and observe that the terms in one sequence are twice the corresponding terms in the other sequence. Explain informally why this is so.</i>
Progress Indicator: M.PRF.2b relating and comparing different forms of representation and identifying functions as linear or nonlinear		
Core Content Connectors: 6	CCSS Domain/Cluster	Common Core State Standard
6.PRF.2b3 Complete a statement that describes the ratio relationship between two quantities	<p>Ratios and Proportional Relationships</p> <p>6 RP Understand ratio concepts and use ratio reasoning to solve problems.</p>	6.RP.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. <i>For example, “The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak.” “For every vote candidate A received, candidate C received nearly three votes.”</i>
6.PRF.2b4 Determine the unit rate in a variety of contextual situations	<p>Ratios and Proportional Relationships</p> <p>6 RP Understand ratio concepts and use ratio reasoning to solve problems.</p>	6.RP.2 Understand the concept of a unit rate a/b associated with a ratio $a:b$ with $b \neq 0$, and use rate language in the context of a ratio relationship. <i>For example, “this recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is $\frac{3}{4}$ cup of flour for each cup of sugar.” “We paid \$75 for 15 hamburgers, which is a rate of \$5 per hamburger.”</i>
6.PRF.2b5 Use ratios and reasoning to solve real-world mathematical problems (e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations)	<p>Ratios and Proportional Relationships</p> <p>6 RP Understand ratio concepts and use ratio reasoning to solve problems.</p>	6.RP.3 Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations. <ul style="list-style-type: none"> a) Make tables of equivalent ratios relating quantities with whole-number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios. b) Solve unit rate problems including those involving unit

		<p>pricing and constant speed. <i>For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?</i></p> <p>c) Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent.</p> <p>d) Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.</p>
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Progress Indicator: M.PRF.2a representing, analyzing, extending, and generalizing a variety of patterns using tables, graphs, words, and symbolic rules		
Core Content Connectors: 7	CCSS Domain/Cluster	Common Core State Standard
7.PRF.2a5 Use variables to represent two quantities in a real-world problem that change in relationship to one another	Expressions and Equations 6 EE Represent and analyze quantitative relationships between dependent and independent variables.	6.EE.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. <i>Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. For example, in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation $d = 65t$ to represent the relationship between distance and time.</i>
Progress Indicator: M.PRF.2d solving linear equations and formulating and explaining reasoning about expressions and equations		
Core Content Connectors: 7	CCSS Domain/Cluster	Common Core State Standard
7.PRF.2d1 Solve word problems leading to inequalities of the form $px + q > r$ or $px + q < r$, where p, q, and r are specific rational numbers	Expressions and Equations 7 EE Solve real-life and mathematical problems using numerical and algebraic expressions and equations.	7.EE.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. <p>b) Solve word problems leading to inequalities of the form $px + q > r$ or $px + q < r$, where p, q, and r are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem. <i>For</i></p>

		<i>example: As a salesperson, you are paid \$50 per week plus \$3 per sale. This week you want your pay to be at least \$100. Write an inequality for the number of sales you need to make, and describe the solutions.</i>
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Progress Indicator: M.PRF.2c relating and comparing different forms of representation and identifying functions as linear or nonlinear

Core Content Connectors: 8	CCSS Domain/Cluster	Common Core State Standard
8.PRF.2c1 Given two graphs, describe the function as linear and not linear	<p>Functions</p> <p>8 F Define, evaluate, and compare functions.</p> <p>8 F Use functions to model relationships between quantities.</p>	<p>8.F.3 Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. <i>For example, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.</i></p> <p>8.F.5 Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.</p>

Progress Indicator: M.PRF.2e using functions to describe quantitative relationships

Core Content Connectors: 8	CCSS Domain/Cluster	Common Core State Standard
8.PRF.2e1 Distinguish between functions and non-functions, using equations, graphs or tables		No CCSS linked
8.PRF.2e2 Identify the rate of change (slope) and initial value (y-intercept) from graphs	<p>Functions</p> <p>8 F Use functions to model relationships between quantities.</p>	8.F.4 Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.

8.PRF.2e3 Given a verbal description of a situation, create or identify a graph to model the situation	Functions 8 F Use functions to model relationships between quantities.	8.F.5 Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.
8.PRF.2e4 Given a graph of a situation, generate a description of the situation	Functions 8 F Use functions to model relationships between quantities.	8.F.5 Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

Progress Indicator: H.PRF.2a interpreting and rewriting a variety of expressions or functions to solve problems		
Core Content Connectors: 9-12	CCSS Domain/Cluster	Common Core State Standard
H.PRF.2a1 Translate an algebraic expression into a word problem	Seeing Structure in Expressions A SSE Interpret the structure of expressions.	A.SSE.1 Interpret expressions that represent a quantity in terms of its context. a) Interpret parts of an expression, such as terms, factors, and coefficients. b) Interpret complicated expressions by viewing one or more of their parts as a single entity. <i>For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P.</i>
Progress Indicator: H.PRF.2b creating equations and inequalities (in one or two variables) and use them to solve problems and graph solutions		
Core Content Connectors: 9-12	CCSS Domain/Cluster	Common Core State Standard
H.PRF.2b1 Translate a real-world problem into a one variable equation	Creating Equations A CED Create equations that describe numbers or relationships.	A.CED.1 Create equations and inequalities in one variable and use them to solve problems. <i>Include equations arising from linear and quadratic functions, and simple rational and exponential functions.</i>
H.PRF.2b2 Solve equations with one or two variables using equations or graphs	Reasoning with Equations and Inequalities A REI Understand solving equations as a process of reasoning and explain the reasoning.	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. A.REI.3 Solve linear equations and inequalities in one variable,

	<p>A REI Solve equations and inequalities in one variable.</p> <p style="text-align: center;">Creating Equations</p> <p>A CED Create equations that describe numbers and relationships.</p>	<p>including equations with coefficients represented by letters.</p> <p>A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p>
Progress Indicator: H.PRF. 2c using trends that follow a pattern and are described mathematically to make generalizations or predictions		
Core Content Connectors: 9-12	CCSS Domain/Cluster	Common Core State Standard
H.PRF. 2c1 Make predictions based on a given model (for example, a weather model, data for athletes over years)	<p style="text-align: center;">Linear, Quadratic, and Exponential Models</p> <p>F LE Construct and compare linear, quadratic, and exponential models and solve problems.</p>	F.LE.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.
Explanations and clarifications:		