Achieve

**A Side-by-Side Analysis of the Oklahoma Academic Standards for Mathematics (Third Draft, March, 2016) with the Common Core State Standards for Mathematics**

This chart uses the Common Core State Standards as the organizing structure in the left column. Each Oklahoma benchmark is used in the alignment chart, at least once, in the column directly to the right of the CCSS. When multiple OAS benchmarks are needed for a full alignment to a particular CCSS, the cells are merged to indicate their grouping. Color-coding is used to help users of this analysis navigate the report quickly and efficiently:

Gaps in either the CCSS or the OAS columns are indicated by an empty cell, which is highlighted in yellow for an easy visual reference.

When an OAS benchmark, or group of benchmarks, partially meets the expectations of a CCSS, but not the whole of its expectations, the cell with the OAS benchmark is highlighted in grey. In addition the word(s) that particularly relate to the alignment in either the CCCS or the OAS are underlined.

Within the text of either or both of the CCSS and the OAS, the specific word or phrase indicating the partial gap can be identified in red font.

Commentary on the partial or weak alignments is found in the third column and is in red to connect to that particular part of the text.

If there are words or phrases that are unclear or incorrect in an OAS benchmark, they can be identified in blue font.

Commentary on the clarity issues is found in the fourth column of the chart and is in blue to connect to that particular part of the text. In some cases there are clarity issues with an entire benchmark and blue font is not used in the benchmark, itself.

In some cases an OAS benchmark from earlier grades provides the best alignment with a particular CCSS. In those cases we have highlighted the cells in shades of green for OAS that are addressed earlier than in the CCSS.

Varying shades of green (for OAS that is addressed earlier than in the CCSS) indicate the number of years. The palest color of shading indicates one year of difference, the second level of shading indicates two years of difference, and the darkest indicates more than two years of difference.

In some cases an OAS benchmark from later grades provides the best alignment with a particular CCSS. In those cases we have highlighted the cells in shades of pink for OAS that are addressed earlier than in the CCSS.

Varying shades of pink (for OAS that is addressed later than in the CCSS) indicate the number of years. The palest color of shading indicates one year of difference, the second level of shading indicates two years of difference, and the darkest indicates more than two years of difference.

*Note: Since Pre-Kindergarten standards are not included in the CCSS and for the purposes of this review, the Oklahoma standards for Kindergarten through Grade 12 were used.*

| The CCSS Standards for Mathematical Practice | The OAS Mathematical Actions and Processes | |
|---|---|---|
| **CCSS** | **OAS** | **Comments** |
| **Mathematically proficient students...** | Mathematically literate students will... | |
| **MP.1 Make sense of problems and persevere in solving them.** | Develop Strategies for *Problem Solving* | Both these process/practice standards require analysis of complex tasks that are related to real world or mathematical applications, with an emphasis on entry points for a solution, flexibility in selecting strategies for solving, reasoning about the solution, and using multiple representations. MP.1 goes beyond this in that it also asks that students persevere in solving challenging problems, to monitor their progress and change course if necessary, to consider analogous problems in their plan, to explain correspondences between representations for a problem, to search for regularity or trends, and to strategically use technology to assist them. |
| | Develop Mathematical *Reasoning* | Mathematical Reasoning also has a connection to MP.1: Make sense of problems and persevere in solving them, in its requirement to explore a variety of problem solving strategies. |
| **MP.2 Reason abstractly and quantitatively.** | Develop a Deep and Flexible *Conceptual* Understanding | When considering the expectations of these two actions and processes, we see that together they encourage a strong sense of numbers; a deep understanding of concepts, operations, and relationships between those numbers; and both mathematical and real world applications. Similar practices are also addressed in the CCSS, MP.2. However MP.2 places the emphasis on "quantities and their relationships in problem situations" rather than "a strong sense of numbers," in that it asks student to create a coherent representation of a problem while considering the relationships between those quantities and operations. It also expects consideration of the units involved, and the ability to de-contextualize when manipulating the symbols and then to re-contextualize when considering the reasonableness of the solution. |
| | Develop Accurate and Appropriate *Procedural* Fluency | |

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| **MP.3 Construct viable arguments and critique the reasoning of others.** | Develop Mathematical *Reasoning*<br><br>Develop the Ability to *Communicate* Mathematically | These two OAS processes require that students use reasoning strategies to think through problems, develop and present reasoned arguments, make connections to other contexts, learn and use mathematical definitions, and translate and critique the ideas and reasoning of others. The CCSS counterpart shares those same requirements but also asks that students recognize and use previously stated assumptions and results and counterexamples in constructing their arguments. They need to make conjectures and build a logical progression of statements to explore the truth of those conjectures. In addition MP.3 specifically addresses reasoning with data, comparing the effectiveness of arguments, taking the context of a problem into account, justifying conclusions and communicating them to others, and responding to the arguments of others |
| **MP.4 Model with mathematics.** | | MP.4 is not addressed in the OAS actions and processes, and is particularly weak in the Oklahoma benchmarks. For example in the K-7 Oklahoma standards and benchmarks there are twenty-five instances where variations of the term "model" is used. However in none of these examples is a student required to create and use a mathematical model, as described in MP.4. This area particularly needs improvement in the OAS. |
| **MP.5 Use appropriate tools strategically.** | | While there are multiple specific references to the use of tools addressed in the content standards and benchmarks of the K-12 OAS, there is no specific call in the process standards to be strategic about the use of tools. Nearly all references in the content standards are found in geometry and measurement or data, making the need for a general call for being strategic in the use of tools especially strong for the studies of algebra and number concepts. |

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| **MP.6 Attend to precision.** | Develop Accurate and Appropriate *Procedural* Fluency | This OAS process addresses a sophisticated understanding and efficiency with computational procedures, based on a strong sense of numbers. Precision in the CCSS also requires computational and procedural accuracy in its definition, but goes beyond this procedural accuracy in that it adds precise use of language and symbols, units of measure, and scales and labels for axes. It also addresses and understanding of the degree of precision appropriate for the context for problem solutions. |
| **MP.7 Look for and make use of structure.** | Develop the Ability to Make Conjectures, *Model* , and Generalize | Because the term "model" is used, and italicized, in the title for this OAS process, the closest connection might be assumed to be MP.4. However this is not evident in the descriptor. The descriptor actually relates best to **MP.7: Look for and make use of structure,** and **MP.8: Look for and express regularity in repeated reasoning**, in that it asks that students draw conclusions based on patterns and repeated structures. However MP.7 goes beyond these OAS processes by requiring that students shift their perspective and see complicated things as being composed of several simpler parts ... |
| **MP.8 Look for and express regularity in repeated reasoning.** | | ...and MP.8 asks that students can look for general methods and shortcuts based on regularity in repeated reasoning and that they maintain oversight of the process while attending to details. While generalization is part of the title for this process, and might strengthen the connection to MP.8, it is not clearly addressed, described, or defined in the descriptor. |
| | Develop a Productive Mathematical *Disposition* | The primary requirement in this OAS process is to hold the belief that mathematics is "sensible, useful, and worthwhile." There is no match in the CCSS for this OAS process standard. In fact a mathematical disposition, while very important to the successful study of mathematics, is truly neither an action nor a process. |

| CCSS | OAS Final V2 Jan 2016 | Comments OAS Final V2 Jan 2016<br>Clarity Comments are in blue font |
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| **GRADE K** | . | . |
| K.CC.1. Count to 100 by ones and by tens. | **K.N.1.1** Count aloud forward in sequence to 100 by 1's and 10's. | The CCSS does not specify that the counting must be aloud. |
| K.CC.2. Count forward beginning from a given number within the known sequence (instead of having to begin at 1). | **K.N.1.5** Count forward, with and without objects, from any given number up to 10. | The OAS objective includes a limitation of starting with a number less than 10. Since counting aloud is required to 100, it is not clear why this limitation should be made. |
| | **K.N.1.7** Find a number that is 1 more or 1 less than a given number up to 10. | This OAS objective also requires counting one backward so goes beyond the CCSS requirement for this grade level. |
| K.CC.3. Write numbers from 0 to 20. Represent a number of objects with a written numeral 0-20 (with 0 representing a count of no objects). | **K.N.1.6** Read, write, discuss, and represent whole numbers from 0 to at least 10. Representations may include numerals, pictures, real objects and picture graphs, spoken words, and manipulatives. | While "to at least 10" might be interpreted to mean that the requirement could go as high as 20, this is not completely clear. |
| K.CC.4. Understand the relationship between numbers and quantities; connect counting to cardinality. | **K.N.1.2** Recognize that a number can be used to represent how many objects are in a set up to 10. | The OAS objective asks for recognition that a number represents a quantity rather than an understanding of the concept of quantity. It also includes the limitation of quantities that are less than 10 even though counting aloud to 100 is required at this grade level. |
| K.CC.4a When counting objects, say the number names in the standard order, pairing each object with one and only one number name and each number name with one and only one object. | **K.N.1.3** Use ordinal numbers to represent the position of an object in a sequence up to 10. | The OAS objective includes a limitation of representing a number that is less than 10, even though counting aloud to 100 is required at this grade level. |
| K.CC.4b Understand that the last number name said tells the number of objects counted. The number of objects is the same regardless of their arrangement or the order in which they were counted. | . | There is no counterpart in the OAS for this CCSS grade level expectation. |
| K.CC.4c Understand that each successive number name refers to a quantity that is one larger. | . | There is no counterpart in the OAS for this CCSS grade level expectation. |

| CCSS | OAS Final V2 Jan 2016 | Comments OAS Final V2 Jan 2016<br>Clarity Comments are in blue font |
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| K.CC.5. Count to answer "how many?" questions about as many as 20 things arranged in a line, a rectangular array, or a circle, or as many as 10 things in a scattered configuration; given a number from 1–20, count out that many objects. | . | There is no counterpart in the OAS for this CCSS grade level expectation. |
| K.CC.6. Identify whether the number of objects in one group is greater than, less than, or equal to the number of objects in another group, e.g., by using matching and counting strategies. | **K.N.1.8** Using the words more than, less than or equal to compare and order whole numbers, with and without objects, from 0 to 10. | The OAS objective includes a limitation of comparing quantities less than 10, even though counting to 100 is required at this grade level. |
| K.CC.7. Compare two numbers between 1 and 10 presented as written numerals. | **K.N.1.8** Using the words more than, less than or equal to compare and order whole numbers, with and without objects, from 0 to 10. | |
| | **K.N.1.4** Recognize without counting (subitize) the quantity of a small group of objects in organized and random arrangements up to 10. | Even though it may be intended in the Counting and Cardinality progressions and the foundational understandings are present, the CCSS does not specifically address subitizing. |
| K.OA.1. Represent addition and subtraction with objects, fingers, mental images, drawings, sounds (e.g., claps), acting out situations, verbal explanations, expressions, or equations. | **1.N.2.1** Represent and solve real-world and mathematical problems using addition and subtraction up to ten. | This Gr 1 OAS goes beyond in requiring problem solving. |
| | **2.A.2.1** Use objects and number lines to represent number sentences. | This OAS objective from Gr 2 addresses representation of equations with objects and number lines. This implies some operation would be present. However there is no expectation in OAS objective Gr K for addition or subtraction. |
| K.OA.2. Solve addition and subtraction word problems, and add and subtract within 10, e.g., by using objects or drawings to represent the problem. | **1.N.2.1** Represent and solve real-world and mathematical problems using addition and subtraction up to ten. | In OAS K.A.2.1 we see the foundation for addition and subtraction but there is no specific call for students to solve word problems using those operations in Gr K. This Gr 1 OAS objective meets that need. |

| CCSS | OAS Final V2 Jan 2016 | Comments OAS Final V2 Jan 2016<br>Clarity Comments are in blue font |
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| K.OA.3. Decompose numbers less than or equal to 10 into pairs in more than one way, e.g., by using objects or drawings, and record each decomposition by a drawing or equation (e.g., 5 = 2 + 3 and 5 = 4 + 1). | **K.N.2.1** Compose and decompose numbers up to 10 with objects and pictures. | It is not clear why addition and subtraction are not addressed in OAS Gr K. Especially in light of this requirement to compose and decompose numbers to 10. |
| K.OA.4. For any number from 1 to 9, find the number that makes 10 when added to the given number, e.g., by using objects or drawings, and record the answer with a drawing or equation. | **K.N.2.1** Compose and decompose numbers up to 10 with objects and pictures. | |
| K.OA.5. Fluently add and subtract within 5. | . | There is no counterpart in the OAS for this CCSS Gr level expectation. Fluency for addition and subtraction to 10 is required in OAS Gr 1 and to 20 in Grade 2. This step in the progression is missing. This is even more puzzling since composition and decomposition of numbers to 10 is required in OAS Gr K. |
| | **K.N.3.1** Distribute equally a set of objects into at least two smaller equal sets. | This Gr K OAS objective addressing equal distributions is not matched in the CCSS. |
| | **K.A.1.2** Recognize, duplicate, complete, and extend repeating, shrinking and growing patterns involving shape, color, size, objects, sounds, movement, and other contexts. | This OAS objective addressing geometric patterns begins a progression for Grs K-2 that moves from geometric to numerical patterns. This progression and concept is not matched in the CCSS. |
| K.NBT.1. Compose and decompose numbers from 11 to 19 into ten ones and some further ones, e.g., by using objects or drawings, and record each composition or decomposition by a drawing or equation (e.g., 18 = 10 + 8); understand that these numbers are composed of ten ones and one, two, three, four, five, six, seven, eight, or nine ones. | . | There is no counterpart in the OAS for this CCSS grade level expectation. The OAS does not require composition or decomposition of numbers larger than 10. |

| CCSS | OAS Final V2 Jan 2016 | Comments OAS Final V2 Jan 2016<br>Clarity Comments are in blue font |
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| K.MD.1. Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object. | **K.GM.2.1** Use words to compare objects according to length, size, weight, position, and location. | |
| K.MD.2. Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference. *For example, directly compare the heights of two children and describe one child as taller/shorter.* | **K.GM.2.1** Use words to compare objects according to length, size, weight, position, and location. | |
| | **K.GM.2.2** Order up to 6 objects using measurable attributes, such as length and weight. | This OAS objective goes beyond the CCSS by setting the limitation at up to 6 objects rather than 2. |
| | **K.GM.2.4** Compare the number of objects needed to fill two different containers. | Only if the objects used to fill the containers are of the same size and/or weight can this be about a measurable attribute, such as volume or weight. If not, this is meaningless. |

| CCSS | OAS Final V2 Jan 2016 | Comments OAS Final V2 Jan 2016<br>Clarity Comments are in blue font |
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| K.MD.3. Classify objects into given categories; count the numbers of objects in each category and sort the categories by count. | **K.A.1.1** Sort and group up to 10 objects into a set based upon characteristics such as color, size, and shape. Explain verbally what the objects have in<br>common. | This collection of Gr K OAS objectives all basically say the same thing but none call for counting the elements in as set. |
| | **K.D.1.1** Collect and sort information about objects and events in the environment. | |
| | **K.GM.2.3** Sort objects into sets by more than one attribute. | |
| | **K.GM.1.2** Sort two-dimensional objects using characteristics such as shape, size, color, and thickness. | There is a mathematical error in this OAS objective, as 2-dimensional figures have no "thickness." |
| | **K.D.1.2** Use categorical data to create real-object and picture graphs. | There is no counterpart in the OAS for this CCSS grade level expectation. The CCSS introduces data graphs in Gr 2. |
| | **K.N.4.1** Identify pennies, nickels, dimes, and quarters by name. | There is no counterpart in the OAS for this CCSS grade level expectation. The CCSS introduces currency in Gr 2. |
| | **K.GM.3.1** Develop an awareness of simple time concepts using words such as yesterday, today, tomorrow, morning, afternoon, and night within his/her daily life. | This OAS objective appears to be an expectation of language rather than math, especially since rather than quantities, only the meanings of words related to the calendar are expected. |
| K.G.1. Describe objects in the environment using names of shapes, and describe the relative positions of these objects using terms such as *above* , *below* , *beside* , *in front of* , *behind* , and *next to* . | **K.GM.2.1** Use words to compare objects according to length, size, weight, position, and location. | . |

| CCSS | OAS Final V2 Jan 2016 | Comments OAS Final V2 Jan 2016<br>Clarity Comments are in blue font |
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| K.G.2. Correctly name shapes regardless of their orientations or overall size. | **K.GM.1.1** Recognize squares, circles, triangles, and rectangles. | The OAS objective requires "recognition" of these four 2-dimensional shapes and matches the CCSS requirement to correctly name two of the shapes in Gr 1. The OAS objective limits the 2-D shapes in their requirement and does not address the shapes' orientation or size. |
| | **1.GM.1.1** Identify trapezoids and hexagons by pointing to the shape when given the name. | It is not clear why this OAS objective should be limited to pointing to a trapezoid or hexagon, as opposed to correctly naming them without that limitation. This OAS objective is one grade level later than the CCSS and has a less rigorous expectation. |
| | **2.GM.1.1** Recognize trapezoids and hexagons. | This OAS objective repeats 1.GM.1.1 since "recognition" could mean nothing more than pointing to the shape. This Gr 2 OAS objective has no match in the CCSS beyond K.G.2. |
| | **1.GM.1.4** Recognize three-dimensional shapes such as cubes, cones, cylinders, and spheres. | The OAS objective requires "recognition" of 3-dimensional shapes but does not specifically require "correct names" for the shapes or their orientation or size. |
| K.G.3. Identify shapes as two-dimensional (lying in a plane, “flat”) or three- dimensional (“solid”). | . | The OAS asks only for recognition of basic 2-D figures. There is no requirement to understand the concept of the dimensions. |

| CCSS | OAS Final V2 Jan 2016 | Comments OAS Final V2 Jan 2016<br>Clarity Comments are in blue font |
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| K.G.4. Analyze and compare two- and three-dimensional shapes, in different sizes and orientations, using informal language to describe their similarities, differences, parts (e.g., number of sides and vertices/“corners”) and other attributes (e.g., having sides of equal length). | **K.GM.1.3** Identify attributes of two-dimensional shapes using informal and formal geometric language interchangeably. | This OAS objective is limited to 2-D shapes. Classification of 3-D shapes appears on OAS in Gr 5. The CCSS counterpart extends to analysis and comparison of 3-D shapes, as well. |
| | **K.GM.2.1** Use words to <u>compare</u> objects according to length, size, weight, position, and location. | This objective expects comparison only. |
| | **2.GM.1.2** Describe, compare, and classify two-dimensional figures according to their geometric attributes. | The Gr 2 OAS objective addresses comparison of measurable attributes of 2-dimensional figures. This concept is not revisited beyond Gr K in the CCSS. |
| | **3.GM.1.1** Sort three-dimensional shapes based on attributes. | The CCSS does not require analysis or classification of 3-dimensional shapes beyond Gr K. It is not clear whether conventional types of 3-D shapes would be required (prisms, cylinders, pyramids, cones, and spheres) in the OAS objective or if composite 3-D figures that do not fit any of those categories would be included. |
| | **4.GM.1.3** Given two three-dimensional shapes, identify similarities, and differences. | This OAS objective has no other match in the CCSS. The comma after similarities is grammatically incorrect. |
| | **5.GM.1.2** Describe and classify three-dimensional figures including cubes, rectangular prisms, and pyramids by the number of edges, faces or vertices as well as the shapes of faces. | This Gr 5 OAS has no other match in the CCSS. This concept appears four years later in the OAS than in the CCSS. |
| K.G.5. Model shapes in the world by building shapes from components (e.g., sticks and clay balls) and drawing shapes. | **K.GM.1.5** Compose free-form shapes with blocks. | The OAS objective expects only one type of "component" to be used. The example provided in the CCSS leaves room for other types of objects to be used in building the shapes. |

| CCSS | OAS Final V2 Jan 2016 | Comments OAS Final V2 Jan 2016<br>Clarity Comments are in blue font |
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| balls) and drawing shapes. | **K.GM.1.6** Use basic shapes and spatial reasoning to represent objects in the real world. | This OAS objective seems to repeat GM.1.5, but without the limitation of using "blocks." |
| K.G.6. Compose simple shapes to form larger shapes. *For example, "Can you join these two triangles with full sides touching to make a rectangle?"* | **K.GM.1.4** Use smaller shapes to form a larger shape when there is an outline to follow. | The limitation of "an outline to follow" is not required in the CCSS. |

| CCSS | OAS Final V2 Jan 2016 | Comments OAS Final V2 Jan 2016<br>Clarity Comments are in blue font |
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| GRADE 1 | . | . |
| 1.OA.1. Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem. | **1.N.2.1** Represent and solve real-world and mathematical problems using addition and subtraction up to ten. | This OAS objective requires solving add/subtract problems only to 10, which is a Gr K requirement in the CCSS. In addition there are no suggestions for the type of strategies 1st grade student should be expected to use. |
| | **2.A.2.1** Use objects and number lines to represent number sentences. | This OAS objective from Gr 2 addresses representation of equations with objects. |
| 1.OA.2. Solve word problems that call for addition of three whole numbers whose sum is less than or equal to 20, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem. | **1.N.2.1** Represent and solve real-world and mathematical problems using addition and subtraction up to ten. | This OAS objective requires solving add/subtract problems only to 10, which is a Gr K requirement in the CCSS. There is also no specific OAS requirement to use three numbers in the problems. |
| 1.OA.3. Apply properties of operations as strategies to add and subtract. *Examples: If 8 + 3 = 11 is known, then 3 + 8 = 11 is also known. (Commutative property of addition.) To add 2 + 6 + 4, the second two numbers can be added to make a ten, so 2 + 6 + 4 = 2 + 10 = 12. ( Associative property of addition .)* | **2.A.2.3** Apply commutative and identity properties and number sense to find values for unknowns that make number sentences involving addition and subtraction true or false. | This Gr 2 OAS objective addresses using the commutative and identity properties but not associative. It also comes one year later than in CCSS. |
| 1.OA.4. Understand subtraction as an unknown-addend problem. *For example, subtract 10 – 8 by finding the number that makes 10 when added to 8.* | **2.N.2.1** Use the relationship between addition and subtraction to generate basic facts up to 20. | |
| 1.OA.5. Relate counting to addition and subtraction (e.g., by counting on 2 to add 2). | . | There is no OAS expectation that addition and subtraction would be related to the counting requirements in Gr K. |
| 1.OA.6. Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting on; making ten (e.g., 8 + 6 = 8 + 2 + 4 = 10 + 4 = 14); decomposing a number leading to a ten (e.g., 13 – 4 = 13 – 3 – 1 = 10 – 1 = 9); using | **1.N.2.3** Demonstrate fluency with basic addition facts and related subtraction facts up to 10. | Both sets of standards require fluency to 10 at this level but the CCSS extends understanding of the operations to 20. |

| CCSS | OAS Final V2 Jan 2016 | Comments OAS Final V2 Jan 2016<br>Clarity Comments are in blue font |
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| 1.OA.7. Understand the meaning of the equal sign, and determine if equations involving addition and subtraction are true or false. *For example, which of the following equations are true and which are false? 6 = 6, 7 = 8 – 1, 5 + 2 = 2 + 5, 4 + 1 = 5 + 2.* | **1.N.2.2** Determine if equations involving addition and subtraction are true. | . |
| 1.OA.8. Determine the unknown whole number in an addition or subtraction equation relating three whole numbers. *For example, determine the unknown number that makes the equation true in each of the equations 8 + ? = 11, 5 = ▯ – 3, 6 + 6 = ▯.* | . | This CCSS expectation, which is a foundation for solving equations, has no counterpart in the OAS. |
| | **1.A.1.1** Identify, create, complete, and extend repeating, growing, and shrinking patterns with quantity, numbers, or shapes in a variety of real-world and mathematical contexts. | This OAS objective is a progression that is not matched in the CCSS. (See K.A.1.2) |
| | **1.N.1.1** Recognize numbers to 20 without counting (subitize) the quantity of structured arrangements. | This OAS requirement represents a progression from a similar requirement in Gr K for numbers to 20. (The CCSS introduces numbers patterns in operations Gr 3 and progresses through Gr 5.)<br><br>It is neither clear how a student would "recognize" a pattern of larger numbers of objects (for example, 15, 17, or 20) nor why it would be a desired skill. |

| CCSS | OAS Final V2 Jan 2016 | Comments OAS Final V2 Jan 2016<br>Clarity Comments are in blue font |
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| 1.NBT 1. Count to 120, starting at any number less than 120. In this range, read and write numerals and represent a number of objects with a written numeral. | **1.N.1.4** Count forward, with and without objects, from any given number up to 100 by 1s, 2s, 5s and 10s. | This OAS objective both falls short and goes beyond the requirements of the CCSS. The OAS objective limitation is to 100 rather than to 120, but counting is required by 2s, 5s, and 10s, in addition to 1s in OAS. Skip counting is addressed in CCSS in Gr 2.<br><br>The intention of this standards is not clear. For example would a first grade student be expected to count by 5's from, say, 7? |
| | **1.N.1.3** Read, write, discuss, and represent whole numbers up to 100. Representations may include numerals, addition and subtraction, pictures, tally<br>marks, number lines and manipulatives, such as bundles of sticks and base 10 blocks. | The OAS objective falls short of the CCSS requirement to read, write and represent numbers to 120. |
| 1.NBT 2. Understand that the two digits of a two-digit number represent amounts of tens and ones. Understand the following as special cases:<br>a 10 can be thought of as a bundle of ten ones — called a "ten."<br>b The numbers from 11 to 19 are composed of a ten and one, two, three, four, five, six, seven, eight, or nine ones.<br>c The numbers 10, 20, 30, 40, 50, 60, 70, 80, 90 refer to one, two, three, four, five, six, seven, eight, or nine tens (and 0 ones). | **1.N.1.2** Use concrete representations to describe whole numbers between 10 and 100 in terms of tens and ones. | |
| 1.NBT.3. Compare two two-digit numbers based on meanings of the tens and ones digits, recording the results of comparisons with the symbols >, =, and <. | **1.N.1.6** Compare and order whole numbers from 0 to 100. | |
| | **1.N.1.8** Use objects to represent and use words to describe the relative size of numbers, such as more than, less than, and equal to. | The OAS objective does not require the use of comparison based on place values and does not require the comparative symbols in Gr 1. |

| CCSS | OAS Final V2 Jan 2016 | Comments OAS Final V2 Jan 2016<br>Clarity Comments are in blue font |
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| 1.NBT.4. Add within 100, including adding a two-digit number and a one-digit number, and adding a two-digit number and a multiple of 10, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. Understand that in adding two-digit numbers, one adds tens and tens, ones and ones; and sometimes it is necessary to compose a ten. | . | The OAS requires that students count, compare, order, read, write, and represent numbers to 100 at this grade level. However there is no requirement to add within 100. This requirement comes in OAS objective 2.N.2.4, but there it includes subtraction, as well. |
| 1.NBT.5. Given a two-digit number, mentally find 10 more or 10 less than the number, without having to count; explain the reasoning used. | **1.N.1.5** Find a number that is 10 more or 10 less than a given number up to 100. | The OAS objective does not require that students can explain their reasoning for mental math. This neglects laying the conceptual foundation for understanding place value. |
| 1.NBT.6. Subtract multiples of 10 in the range 10-90 from multiples of 10 in the range 10-90 (positive or zero differences), using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. | . | The OAS requires finding 10 less but only to 100 and does not address subtraction of multiples of 10. |
| 1.MD.1. Order three objects by length; compare the lengths of two objects indirectly by using a third object. | . | The OAS does not require comparison of three objects based on their length. |

| CCSS | OAS Final V2 Jan 2016 | Comments OAS Final V2 Jan 2016<br>Clarity Comments are in blue font |
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| 1.MD.2. Express the length of an object as a whole number of length units, by laying multiple copies of a shorter object (the length unit) end to end; understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps. Limit to contexts where the object being measured is spanned by a whole number of length units with no gaps or overlaps. | **1.GM.2.1** Use nonstandard and standard measuring tools to measure the length of objects to reinforce the continuous nature of linear measurement. | |
| | **1.GM.2.2** Illustrate that the length of an object is the number of same-size units of length that, when laid end-to-end with no gaps or overlaps, reach from one end of the object to the other. | The wording of this objective needs revision for clarity. It is imprecise to say "Illustrate that the length of an object is the number of same-size units of length" since the length of an object is simply the length of that object. However, the measure of that length may be expressed in terms of the number of copies of some other length. |
| | **1.GM.2.4** Describe a length to the nearest whole unit using a number and a unit. | |
| | **2.GM.2.1** Explain the relationship between the size of the unit of measurement and the number of units needed to measure the length of an object. | This Gr 2 OAS objective has no match in CCSS Gr 2 but is important to this alignment with the CCSS Gr 1 requirement to relate the length of an object to the number of units required to span it. |
| 1.MD.3. Tell and write time in hours and half-hours using analog and digital clocks. | **1.GM.3.1** Tell time to the hour and half-hour (analog and digital). | |
| 1.MD.4. Organize, represent, and interpret data with up to three categories; ask and answer | **1.D.1.1** Collect, sort, and organize data in up to three categories using representations (e.g., tally marks, tables, Venn diagrams). | The CCSS does not provide specific examples of the types of displays that are required. |
| | **1.D.1.2** Use data to create picture and bar-type graphs to demonstrate one-to-one correspondence. | This OAS objective limits the types of data displays to picture and bar graphs. |

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| with up to three categories, ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another. | **1.D.1.3** Draw conclusions from picture and bar-type graphs. | The CCSS does not provide specific examples of the types of displays that are required. This OAS objective limits interpretation of only picture and bar graphs.<br><br>What would the "conclusions" drawn be? They may be answers to questions asked regarding counts of data points, but that is not clear. |
| | **1.N.4.1** Identifying pennies, nickels, dimes, and quarters by name and value. | The OAS places more emphasis on recognizing, using, and counting currency than the CCSS. |
| | **1.N.4.2** Write a number with the cent symbol to describe the value of a coin. | |
| | **1.N.4.3** Determine the value of a collection of pennies, nickels, or dimes up to one dollar counting by ones, fives, or tens. | |
| 1.G.1. Distinguish between defining attributes (e.g., triangles are closed and three-sided) versus non-defining attributes (e.g., color, orientation, overall size); build and draw shapes to possess defining attributes. | . | This CCSS has no match in the OAS. |
| 1.G.2. Compose two-dimensional shapes (rectangles, squares, trapezoids, triangles, half-circles, and quarter-circles) or three-dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape, and compose new | **1.GM.1.2** Compose and decompose larger shapes using smaller two-dimensional shapes. | The CCSS is more specific about the types of shapes that are addressed.<br>Without seeing 1.GM.1.3 in conjunction with this objective, it may not be completely clear that the "larger shapes" in this OAS objective are 2-dimensional. On its own, this OAS objective might be construed as an expectation to use 2-D nets to form 3-D figures. |
| | **1.GM.1.3** Compose structures with three-dimensional shapes. | The CCSS is more specific about the types of shapes that are addressed. |

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| shapes from the composite shape. | **2.GM.1.3** Compose two-dimensional shapes using triangles, squares, hexagons, trapezoids, and rhombi. | This Gr 2 OAS objective meets the need for using trapezoids in the compositions, which is not made clear in Gr 1 OAS. However the CCSS does not specifically include hexagons or rhombi. There is no match for this OAS objective in Gr 2 CCSS. |
| 1.G.3. Partition circles and rectangles into two and four equal shares, describe the shares using the words *halves* , *fourths* , and *quarters* , and use the phrases *half of* , *fourth of* , and *quarter of* . Describe the whole as two of, or four of the shares. Understand for these examples that | **1.N.3.1** Partition a regular polygon using physical models and recognize when those parts are equal. | The OAS objective does not designate the sizes of the partitions and does not include circles. |
| | **1.N.3.2** Partition (fair share) sets of objects into equal groupings. | This OAS objective, addressing fair shares, does not explicitly require partitioning circles but rather refers to sets of objects. |

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| **GRADE 2** | . | . |
| 2.OA.1. Use addition and subtraction within 100 to solve one- and two-step word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem. | **2.N.2.5** Solve real-world and mathematical addition and subtraction problems involving whole numbers up to 2 digits.<br>**2.N.2.4** Use strategies and algorithms based on knowledge of place value and equality to add and subtract two-digit numbers.<br>**3.N.2.5** Use addition and subtraction to solve real-world and mathematical problems involving whole numbers. Use various strategies, including the relationship between addition and subtraction, the use of technology, and the context of the problem to assess the reasonableness of results. | These OAS objectives address addition and subtraction to 100 but none of these Gr 2 and Gr 3 OAS objectives specify that the word problems to be solved are one-and two-step. It is also not clear in Gr 2 that a symbol for an unknown number would be required. 3.A.2.1 is included in this alignment to address the use of equations. |
| 2.OA.2. Fluently add and subtract within 20 using mental strategies. By end of Grade 2, know from memory all sums of two one-digit numbers. | **2.N.2.1** Use the relationship between addition and subtraction to generate basic facts up to 20.<br>**2.N.2.2** Demonstrate fluency with basic addition facts and related subtraction facts up to 20. | |
| 2.OA.3. Determine whether a group of objects (up to 20) has an odd or even number of members, e.g., by pairing objects or counting them by 2s; write an equation to express an even number as a sum of two equal addends. | . | The CCSS concept of odd or even numbers is not found in the OAS. |
| 2.OA.4. Use addition to find the total number of objects arranged in rectangular arrays with up to 5 rows and up to 5 columns; write an equation to express the total as a sum of equal addends. | **2.N.2.6** Use concrete models and structured arrangements, such as repeated addition, arrays and ten frames to develop understanding of multiplication. | The OAS objective does not expect students to use equations in Gr 2. |

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| | **2.N.2.3** Estimate sums and differences up to 100. | There is no match for this OAS objective in Gr 2. This OAS objective speaks to the CCSS requirement to use estimation to check results for add/subtract problems. The limitation of "up to 100" falls short of the Gr 3 requirements in 3.OA.8 and this OAS objective does not specifically expect estimation to be used for any sort of application. |

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| | **2.A.1.2** Represent and describe repeating patterns involving shapes in a variety of contexts. | These Gr 2 OAS objectives continue this progression from Gr K and Gr 1 addressing patterns of shapes. (See K.A.1.2, 1.A.1.1) However they overlap greatly, making It unclear why both are needed. |
| | **2.A.1.1** Represent, create, describe, complete, and extend growing and shrinking patterns with quantity and numbers in a variety of real-world and mathematical contexts. | |
| 2.NBT.1. Understand that the three digits of a three-digit number represent amounts of hundreds, tens, and ones; e.g., 706 equals 7 hundreds, 0 tens, and 6 ones. Understand the following as special cases:<br>a 100 can be thought of as a bundle of ten tens — called a “hundred.”<br>b The numbers 100, 200, 300, 400, 500, 600, 700, 800, 900 refer to one, two, three, four, five, six, seven, eight, or nine hundreds (and 0 tens and 0 ones). | **2.N.1.3** Use place value to describe whole numbers between 10 and 1,000 in terms of hundreds, tens and ones. Know that 100 is 10 tens, and 1,000 is 10 hundreds. | |
| 2.NBT.2. Count within 1000; skip-count by 5s, 10s, and 100s. | **1.N.1.4** Count forward, with and without objects, from any given number up to 100 by 1s, 2s, 5s and 10s. | Counting by 5s is addressed in Gr 1 of the OAS but only to 100. |
| | **2.N.1.1** Read, write, discuss, and represent whole numbers up to 1,000. Representations may include numerals, words, pictures, tally marks, number lines and manipulatives. | While the OAS for Gr 2 does not specifically address counting to 1000, this requirement to read, write, discuss, and represent numbers to 1000 may include counting. The CCSS does not require pictures, tally marks or manipulatives at this grade level. |
| | **2.N.1.4** Find 10 more or 10 less than a given three-digit number. Find 100 more or 100 less than a given three-digit number. | This OAS objective can be used to count by 10s or 100s but does not include counting by 5s. |

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| 2.NBT.3. Read and write numbers to 1000 using base-ten numerals, number names, and expanded form. | **2.N.1.1** Read, write, discuss, and represent whole numbers up to 1,000. Representations may include numerals, words, pictures, tally marks, number lines and manipulatives. | The OAS objective includes other representations than the CCSS. Expanded form is not required in the OAS. |
| 2.NBT.4. Compare two three-digit numbers based on meanings of the hundreds, tens, and ones digits, using >, =, and < symbols to record the results of comparisons. | **2.N.1.6** Use place value to compare and order whole numbers up to 1,000 using comparative language, numbers, and symbols (e.g., 425 > 276, 73 < 107, page 351 comes after page 350, 753 is between 700 and 800). | The CCSS does not specifically require using words in quantity comparisons. |
| 2.NBT.5. Fluently add and subtract within 100 using strategies based on place value, properties of operations, and/or the relationship between addition and subtraction. | **2.N.2.2** Demonstrate fluency with basic addition facts and related subtraction facts up to 20. | This OAS fluency requirement aligns with the CCSS for Gr 1. The Gr 2 CCSS includes properties of operations. |
| | **3.N.2.3** Use strategies and algorithms based on knowledge of place value and equality to fluently add and subtract multi-digit numbers. | This Gr 3 OAS objective goes beyond the CCSS at this grade by not including the limitation of within 100. |
| 2.NBT.6. Add up to four two-digit numbers using strategies based on place value and properties of operations. | **2.N.2.4** Use strategies and algorithms based on knowledge of place value and equality to add and subtract two-digit numbers. | The OAS objective does not specifically require adding up to four numbers. However it goes beyond the CCSS for this alignment in that it addresses subtraction. |
| | **3.A.2.2** Recognize, represent and apply the number properties (commutative, identity, and associative properties of addition and multiplication) using models and manipulatives to solve problems. | This Gr 3 OAS objective is needed to align with using the properties of operations. |
| 2.NBT.7. Add and subtract within 1000, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and | **2.N.2.4** Use strategies and algorithms based on knowledge of place value and equality to add and subtract two-digit numbers. | This Gr 2 OAS objective falls short by only requiring operations with numbers within 100. |

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| subtraction; relate the strategy to a written method. Understand that in adding or subtracting three-digit numbers, one adds or subtracts hundreds and hundreds, tens and tens, ones and ones; and sometimes it is necessary to compose or | **3.N.1.1** Read, write, discuss, and represent whole numbers up to 10,000. Representations may include numerals, expressions with operations, words, pictures, number lines, and manipulatives. | This Gr 3 OAS objective goes beyond the CCSS in that it addresses numbers up to 10,000. |
| 2.NBT.8. Mentally add 10 or 100 to a given number 100–900, and mentally subtract 10 or 100 from a given number 100–900. | **2.N.1.4** Find 10 more or 10 less than a given three-digit number. Find 100 more or 100 less than a given three-digit number. | The two standards have the same basic expectations. The CCSS includes the idea of mental math. |
| 2.NBT.9. Explain why addition and subtraction strategies work, using place value and the properties of operations. | . | |

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| 2.MD.1. Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes. | **2.GM.2.2** Explain the relationship between length and the numbers on a ruler by using a ruler to measure lengths to the nearest whole unit. | This OAS objective addresses the CCSS in part by requiring the use of a ruler. Since a ruler measures in centimeter, or inches/feet, it would be assumed that those would be the "whole unit" referenced in the OAS. |
| | **3.GM.2.3** Choose an appropriate measurement instrument and measure the length of objects to the nearest whole centimeter or meter. | |
| | **3.GM.2.4** Choose an appropriate measurement instrument and measure the length of objects to the nearest whole yard, whole foot, or half inch. | It is not clear why the choice of limits was made for this OAS. If the nearest whole yard and foot are required, why not a whole inch? |
| 2.MD.2. Measure the length of an object twice, using length units of different lengths for the two measurements; describe how the two measurements relate to the size of the unit chosen. | **1.GM.2.3** Measure the same object/distance with units of two different lengths and describe how and why the measurements differ. | Describing how the two measurements differ is not the same as describing how the two measurements relate to the size of the units. The first might simply elicit the response that "one needs more than the other" without conceptually relating the difference to the size of the units used.<br>It is possible that in answering the "why" question that the OAS objective might get at the question being asked by the Gr 2 CCSS. This is not completely clear, however.<br>In addition the use of "object/distance" is unclear. Is the intention to measure a distance on an object? Is there something else about the object that is intended here? |
| 2.MD.3. Estimate lengths using units of inches, feet, centimeters, and meters. | **2.GM.2.2** Explain the relationship between length and the numbers on a ruler by using a ruler to measure lengths to the nearest whole unit. | This Gr 2 OAS objective requires measurement to the nearest unit using a ruler, which would imply using centimeters or inches/feet. |
| | **3.GM.2.5** Using common benchmarks, estimate the lengths (customary and metric) of a variety of objects. | This Gr 3 OAS objective addresses the CCSS requirement to use metric, in addition to customary, units and estimation of length measurements. |

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| 2.MD.4. Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard length unit. | **2.GM.1.2** Describe, compare, and classify two-dimensional figures according to their geometric attributes. | The OAS objective addresses comparison of measurable attributes of 2-dimensional figures but does not specifically expect comparison of lengths or expressing the difference in terms of a standard length unit. |
| 2.MD.5. Use addition and subtraction within 100 to solve word problems involving lengths that are given in the same units, e.g., by using drawings (such as drawings of rulers) and equations with a symbol for the unknown number to represent the problem. | **2.A.2.1** Use objects and number lines to represent number sentences. | This OAS objective addresses the part of the corresponding CCSS in that it requires using number sentences.<br>Typically, in a "number sentence" there would an operation and an equality (or inequality). It is not clear how objects or number lines would be used in this mathematical context. 2.A.2.1 needs an example to clarify its purpose and goal. |
| | **2.N.2.5** Solve real-world and mathematical addition and subtraction problems involving whole numbers up to 2 digits. | |
| 2.MD.6. Represent whole numbers as lengths from 0 on a number line diagram with equally spaced points corresponding to the numbers 0, 1, 2, ..., and represent whole-number sums and differences within 100 on a number line diagram. | **1.N.1.7** Use knowledge of number relationships to locate the position of a given whole number on an open number line up to 20. | This Gr 1 OAS objective addresses the position of the number rather than its distance from 0 and includes the limitation of "up to 20," which is not part of this Gr 2 CCSS. This has no other alignment possibility. |
| | **2.N.1.2** Use knowledge of number relationships to locate the position of a given whole number on an open number line up to 100. | The CCSS introduces the number line in Grade 2 (2.MD.6), but in the context of addition and subtraction within 100 with the number line at that level. Together these two Gr 2 OAS objectives address locating numbers on the number line and using it to represent number sentences, which may imply sums and differences. |
| | **2.A.2.1** Use objects and number lines to represent number sentences. | |
| 2.MD.7. Tell and write time from analog and digital clocks to the nearest five minutes, using a.m. and p.m. | **2.GM.3.1** Read and write time to the quarter-hour on an analog and digital clock. Distinguish between a.m. and p.m. | This OAS objective limits time to the quarter-hour while the CCSS aims for the nearest five minutes. |
| | **3.GM.3.1** Read and write time to the nearest 5-minute (analog and digital). | This CCSS Gr 2 expectation appears one year later in the OAS. |

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| 2.MD.8. Solve word problems involving dollar bills, quarters, dimes, nickels, and pennies, using $ and ¢ symbols appropriately. *Example: If you have 2 dimes and 3 pennies, how many cents do you have?* | **2.N.4.1** Determine the value of a collection(s) of coins up to one dollar using the cent symbol.<br>**2.N.4.2** Use a combination of coins to represent a given amount of money up to one dollar. | The Gr 2 OAS objective does not require using dollar bills or solving word problems but rather expects counting the value of coins and using the cent symbol. |
| 2.MD.9. Generate measurement data by measuring lengths of several objects to the nearest whole unit, or by making repeated measurements of the same object. Show the measurements by making a line plot, where the horizontal scale is marked off in whole-number units. | **3.D.1.1** Summarize and construct a data set with multiple categories using a frequency table, line plot, pictograph, and/or bar graph with scaled intervals. | The Gr 3 OAS objective does not specifically require collecting data based on measurement. Representing data in a line plot is expected one year later in the OAS than in the CCSS. |
| | **2.GM.2.3** Explore how varying shapes and styles of containers can have the same capacity. | This OAS objective has no match in the CCSS. Volume is introduced in Gr 1 of the OAS objective and then reappears in Gr 4. Measures of liquid volume are introduced in the CCSS in Gr 3. (3.MD.2). It is not clear whether this OAS objective expects liquid or solid capacity measurement. |
| | **2.D.1.1** Explain that the length of a bar in a bar graph or the number of objects in a picture graph represents the number of data points for a given category. | While the CCSS does require using picture and bar graphs, there is no call to explain how the data is represented in the graph. |
| 2.MD.10. Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put- | **K.D.1.3** Draw conclusions from real-object and picture graphs. | In the Gr K OAS objective students draw conclusions based on graphs, which partially aligns with the CCSS requirement to solve problems related to a graph. This Gr K OAS objective has no other matches with the CCSS. |
| | **2.D.1.2** Organize a collection of data with up to four categories using pictographs and bar graphs with intervals of 1s, 2s, 5s or 10s. | This OAS objective requires up to four categories but also specifies intervals other than single-units. |

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| with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. | **2.D.1.4** Draw conclusions and make predictions from information in a graph. | The requirements in this OAS objective might be construed to address the expectation to solve problems using the information in a bar graph. |
| | **2.D.1.3** Write and solve one-step word problems involving addition or subtraction using data represented within pictographs and bar graphs with intervals of one. | This OAS objective more clearly addresses the expectation to solve problems based on data in a bar graph. |

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| 2.G.1. Recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces. Identify triangles, quadrilaterals, pentagons, hexagons, and cubes. | **2.GM.1.1** Recognize trapezoids and hexagons. | The OAS objective specifically limits this recognition to trapezoids and hexagons. Trapezoids are not included in this CCSS. |
| | **2.GM.1.2** Describe, compare, and classify two-dimensional figures according to their geometric attributes. | The OAS objective does not require drawing the shapes. |
| 2.G.2. Partition a rectangle into rows and columns of same-size squares and count to find the total number of them. | **2.N.3.2** Construct equal-sized portions through fair sharing including length, set, and area models for halves, thirds, and fourths. | This OAS objective limits the partitions to halves, thirds, and fourths and does not require finding the total number of squares. The CCSS does not specify a limitation on the number of rows and columns. |
| 2.G.3. Partition circles and rectangles into two, three, or four equal shares, describe the shares using the words *halves* , *thirds* , *half of* , *a third of* , etc., and describe the whole as two halves, three thirds, four fourths. Recognize that equal shares of identical wholes need not have the same shape. | **2.N.3.1** Identify the parts of a set and area that represent fractions for halves, thirds, and fourths. | These OAS objectives include sets and length in the partitioning, while the CCSS limits to areas of circles and rectangles. However the OAS does not address the relationship between shares of identical wholes. The Gr 3 OAS addresses only writing fractions with words |
| | **2.N.3.2** Construct equal-sized portions through fair sharing including length, set, and area models for halves, thirds, and fourths. | |
| | **3.N.3.1** Read and write fractions with words and symbols. | |

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| **GRADE 3** | . | . |
| 3.OA.1. Interpret products of whole numbers, e.g., interpret 5 x 7 as the total number of objects in 5 groups of 7 objects each. *For example, describe a context in which a total number of objects can be expressed as 5 × 7.* | **3.N.2.1** Represent multiplication facts by using a variety of approaches, such as repeated addition, equal-sized groups, arrays, area models, equal jumps on a number line and skip counting. | This Gr 3 OAS objective does not require interpretation of the product. |
| | **2.A.2.2** Generate real-world situations to represent number sentences and vice versa. | This OAS objective asks that students create a situation to match an equation, which addresses the interpretation required this CCSS. There is no other match for this Gr 2 OAS. The OAS objective does not specify multiplication. Including mathematical representations of real world situations as a "vice versa" in this OAS does not give that skill the weight it deserves. |
| 3.OA.2. Interpret whole-number quotients of whole numbers, e.g., interpret 56 ÷ 8 as the number of objects in each share when 56 objects are partitioned equally into 8 shares, or as a number of shares when 56 objects are partitioned into equal shares of 8 objects each. *For example, describe a context in which a number of shares or a number of groups can be expressed as 56 ÷ 8.* | **3.N.2.6** Represent division facts by using a variety of approaches, such as repeated subtraction, equal sharing and forming equal groups. | This Gr 3 OAS objective does not require interpretation of the quotient. |
| | **2.A.2.2** Generate real-world situations to represent number sentences and vice versa. | This OAS objective asks that students create a situation to match an equation, which addresses the interpretation required this CCSS. There is no other match for this Gr 2 OAS. The OAS objective does not specify division. Including mathematical representations of real world situations as a "vice versa" in this OAS does not give that skill the weight it deserves. |
| 3.OA.3. Use multiplication and division within 100 to solve word problems in situations involving | **3.N.2.7** Recognize the relationship between multiplication and division to represent and solve real-world problems. | Together this pair of OAS objectives meet the CCSS requirements to solve real world problems, using a |

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| equal groups, arrays, and measurement quantities, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem. | **3.N.2.1** Represent multiplication facts by using a variety of approaches, such as repeated addition, equal-sized groups, arrays, area models, equal jumps on a number line and skip counting. | requirements to solve real world problems, using a variety of approaches. There is no single OAS objectives that puts those two expectations together. |
| 3.OA.4. Determine the unknown whole number in a multiplication or division equation relating three whole numbers. *For example, determine the unknown number that makes the equation true in each of the equations 8 × ? = 48, 5 = ⍰ ÷ 3, 6 × 6 = ?.* | **3.A.2.1** Find unknowns represented by symbols in arithmetic problems by solving one-step open sentences (equations) and other problems involving addition, subtraction, and multiplication. Generate real-world situations to represent number sentences. | In addition to equations that require multiplication, this OAS objective includes addition and subtraction. However solving division equations is not included at this level. |
| 3.OA.5. Apply properties of operations as strategies to multiply and divide. *Examples: If 6 × 4 = 24 is known, then 4 × 6 = 24 is also known. (Commutative property of multiplication.) 3 × 5 × 2 can be found by 3 × 5 = 15, then 15 × 2 = 30, or by 5 × 2 = 10, then 3 × 10 = 30. (Associative property of multiplication.) Knowing that 8 × 5 = 40 and 8 × 2 = 16, one can find 8 × 7 as 8 × (5 + 2) = (8 × 5) + (8 × 2) = 40 + 16 = 56. ( Distributive property .)* | **3.A.2.2** Recognize, represent and apply the number properties (commutative, identity, and associative properties of addition and multiplication) using models and manipulatives to solve problems. | The OAS objective does not require division or the distributive property. The distributive property is first mentioned in Grade 4 of the OAS. |
| | **3.N.2.7** Recognize the relationship between multiplication and division to represent and solve real-world problems. | By emphasizing representing and solving problems, this OAS objective runs the risk of missing the conceptual understanding of division required in this CCSS. |

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| 3.OA.6. Understand division as an unknown-factor problem. *For example, find 32 ÷ 8 by finding the number that makes 32 when multiplied by 8.* | **4.N.1.7** Determine the unknown addend or factor in equivalent and non-equivalent expressions. (e.g., 5 + 6 = 4 + ☐ , 3 x 8 < 3 x ☐). | This Gr 4 OAS objective addresses the Gr 3 CCSS requirement to use the unknown factor as a way of understanding division. However the connection to division is not explicitly made here.<br>It is not clear how "the" unknown addend or factor can be determined in a "non-equivalent expression." Also the language used here is mathematically inaccurate, as these examples are not expressions, but rather an equation and an inequality. |

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| 3.OA.7. Fluently multiply and divide within 100, using strategies such as the relationship between multiplication and division (e.g., knowing that 8 X 5 = 40, one knows 40 ÷ 5 = 8) or properties of operations. By the end of Grade 3, know from memory all products of two one-digit numbers. | **3.N.2.2** Demonstrate fluency of multiplication facts with factors up to 10. | |
| | **3.N.2.7** Recognize the relationship between multiplication and division to represent and solve real-world problems. | |
| | **3.N.2.8** Use strategies and algorithms based on knowledge of place value, equality and properties of addition and multiplication to multiply a two-digit number by a one-digit number. | |
| | **4.N.1.1** Demonstrate fluency with multiplication and division facts with factors up to 12. | Fluency for division facts comes one year later in OAS than in CCSS. |
| 3.OA.8 Solve two-step word problems using the four operations. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation | **4.A.2.1** Use number sense, properties of multiplication and the relationship between multiplication and division to solve problems and find values for the unknowns represented by letters and symbols that make number sentences true. | These OAS objectives match the CCSS expectation to solve word problems using equations that involve all four operations. These fall one year later in the OAS but do not limit the problems to those requiring no more than two steps. |
| | **4.A.2.2** Solve for unknowns in problems by solving open sentences (equations) and other problems involving addition, subtraction, multiplication, or division with whole numbers. Use real-world situations to represent number sentences and vice versa. | |

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| strategies including rounding. | **4.N.1.5** Solve multi-step real-world and mathematical problems requiring the use of addition, subtraction, and multiplication of multi-digit whole numbers. Use various strategies, including the relationship between operations, the use of appropriate technology, and the context of the problem to assess the reasonableness of results. | |
| 3.OA.9. Identify arithmetic patterns (including patterns in the addition table or multiplication table), and explain them using properties of operations. *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.* | **3.A.1.1** Create, describe, and extend patterns involving addition, subtraction, or multiplication to solve problems in a variety of contexts.<br>**3.A.1.3** Explore and develop visual representations of growing geometric patterns and construct the next steps.<br>**3.A.2.2** Recognize, represent and apply the number properties (commutative, identity, and associative properties of addition and multiplication) using models and manipulatives to solve problems. | While properties of operations are required in OAS Gr 3, the requirement to use the properties to explain patters in ways similar to the CCSS example is not matched in the OAS objectives. |
| | **3.A.1.2** Describe the rule (single operation) for a pattern from an input/output table or function machine involving addition, subtraction, or multiplication. | NOTE: The concept of ordered pairs (inputs and outputs) are introduced in the CCSS in Gr 5, and students begin building tables of values in Gr 6. Functions are not formally introduced in either the CCSS or OAS until Gr 8, but "function machine" is defined in the glossary. |

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| 3.NBT.1. Use place value understanding to round whole numbers to the nearest 10 or 100. | **2.N.1.5** Recognize when to round numbers to the nearest 10 and 100. | The Gr 2 OAS objective does not expect students to actually round numbers in Grade 2 but includes this idea of knowing "when to round." This objective matches the limitations for Gr 3 in the CCSS counterpart.<br>It is not clear how teachers would interpret the requirement of knowing WHEN to round. It is assumed that this refers to a contextual situation but that is not made clear. Some examples may be needed for clarity. |
| | **3.N.2.4** Recognize when to round numbers and apply understanding to round numbers to the nearest ten thousand, thousand, hundred, and ten and use compatible numbers to estimate sums and differences. | This OAS objective goes beyond the limitation of the CCSS by including rounding to the nearest 10,000 and 1,000. The Gr 2 OAS objective is a better match for the Gr 3 limitation in the CCSS. Rounding to the ten thousands place seems to be at odds with the OAS limitation at this grade level to read, write, and discuss numbers to 10,000 (3.N.1.1). |
| 3.NBT.2. Fluently add and subtract within 1000 using strategies and algorithms based on place | **3.N.1.3** Find 1,000 more or 1,000 less than a given four- or five-digit number. Find 100 more or 100 less than a given four- or five-digit number. | While there is no direct match in the CCSS for this Gr 3 objective, CCSS students are already using place value understanding and fluently adding and subtracting within 1000. This objective has higher limits than the CCSS for Gr 3. |
| | **3.N.2.3** Use strategies and algorithms based on knowledge of place value and equality to fluently add and subtract multi-digit numbers. | This OAS is not limited to numbers within 1000. |

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| value, properties of operations, and/or the relationship between addition and subtraction. | **4.N.1.7** Determine the unknown addend or factor in equivalent and non-equivalent expressions. (e.g., 5 + 6 = 4 + ☐ , 3 x 8 < 3 x ☐). | This Gr 4 OAS objective addresses the Gr 3 CCSS requirement to use the unknown addend as a way of using the relationship between addition and subtraction.<br>It is not clear how "the" unknown addend or factor can be determined in a "non-equivalent expression." Also the language used here is mathematically inaccurate, as these examples are not expressions, but rather an equation and an inequality. |
| 3.NBT.3. Multiply one-digit whole numbers by multiples of 10 in the range 10–90 (e.g., 9 x 80, 5 x 60) using strategies based on place value and properties of operations. | **4.N.1.2** Use an understanding of place value to multiply or divide a number by 10, 100 and 1,000. | This is a partial match in that the CCSS requires multiplication of a 1-digit number by ANY multiple of 10 up to 90 (not restricted to 100 and 1000). |

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| 3.NF.1. Understand a fraction 1/*b* as the quantity formed by 1 part when a whole is partitioned into *b* equal parts; understand a fraction *a* /*b* as the quantity formed by *a* parts of size 1/*b* . | **3.N.3.2** Construct fractions using length, set, and area models. | In the CCSS for this grade level the concept of fraction is shifted from a shape to a number. This OAS objective keeps the focus on more concrete illustrations of fractions.<br>This OAS is imprecise. Students are not constructing fractions using these things, rather, they are recognizing a fractional quantity in these things. |
| | **3.N.3.3** Recognize unit fractions and use them to compose and decompose fractions related to the same whole. Use the numerator to describe the number of parts and the denominator to describe the number of partitions. | The OAS objective requires recognition, de/composing, and "describing" the number of parts and partitions (which amounts to counting) rather than understanding a fraction as a quantity.<br><br>The term, partitions, is used here in a way that conflicts with the OAS glossary ,where it is defined as a process of dividing an object into parts or subsets. |
| | **4.N.2.3** Decompose a fraction in more than one way into a sum of fractions with the same denominator using concrete and pictorial models and recording results with symbolic representations (e.g., 3/4 = 1/4 + 1/4 + 1/4). | This concept comes one year later in the OAS than in the CCSS. |
| 3.NF.2. Understand a fraction as a number on the number line; represent fractions on a number line diagram. | . | The very important conceptual understanding of fractions as numbers addressed in this Gr 3 CCSS is not matched in the OAS. |
| 3.NF.2a Represent a fraction 1/*b* on a number line diagram by defining the interval from 0 to 1 as the whole and partitioning it into *b* equal parts. | **3.N.3.3** Recognize unit fractions and use them to compose and decompose fractions related to the same whole. Use the numerator to describe the number of parts and the denominator to describe the number of partitions. | The Gr 3 OAS objective neglects to make the connection between the concept of fractions as parts of a whole and of fractions as numbers. |

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| Recognize that each part has size 1/*b* and that the endpoint of the part based at 0 locates the number 1/*b* on the number line. | **4.N.2.2** Use benchmark fractions (0, 1/4, 1/3, 1/2, 2/3, 3/4, 1) to locate additional fractions on a number line. Use models to order and compare whole numbers and fractions less than and greater than one using comparative language and symbols. | This Gr 4 OAS objective more clearly addresses the conceptual understanding of fractions as numbers in the CCSS at Gr 3. |
| 3.NF.2b Represent a fraction *a* /*b* on a number line diagram by marking off *a* lengths 1/*b* from 0. Recognize that the resulting interval has size *a* /*b* and that its endpoint locates the number *a* /*b* on the number line. | **3.N.3.3** Recognize unit fractions and use them to compose and decompose fractions related to the same whole. Use the numerator to describe the number of parts and the denominator to describe the number of partitions. | The Gr 3 OAS objective neglects to make the connection between the concept of fractions as parts of a whole and of fractions as numbers. |
| | **4.N.2.2** Use benchmark fractions (0, 1/4, 1/3, 1/2, 2/3, 3/4, 1) to locate additional fractions on a number line. Use models to order and compare whole numbers and fractions less than and greater than one using comparative language and symbols. | This Gr 4 OAS objective more clearly addresses the conceptual understanding of fractions as numbers in the CCSS at Gr 3. |
| 3.NF.3. Explain equivalence of fractions in special cases, and compare fractions by reasoning about their size. | **4.N.2.1** Represent and rename equivalent fractions using fraction models (e.g. parts of a set, area models, fraction strips, number lines). | These OAS objectives from Gr 3 and Gr 4 do not go far enough to match the expectation of the Gr 3 CCSS to explain equivalence or to reason about their size.<br>It is not clear why "represent and rename" is used here rather than the more mathematically precise notion of creating or generating equivalent fractions. |
| | **3.N.3.4** Use models and number lines to order and compare fractions that are related to the same whole. | |
| 3.NF.3a Understand two fractions as equivalent (equal) if they are the same size, or the same point on a number line. | **4.N.2.1** Represent and rename equivalent fractions using fraction models (e.g. parts of a set, area models, fraction strips, number lines). | The OAS Gr 4 objective requires representing and renaming but does not require understanding or reasoning about the equivalence, based on the fractions' size or position on the number line.<br>It is not clear why "represent and rename" is used here rather than the more mathematically precise notion of creating or generating equivalent fractions. |

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| 3.NF.3b Recognize and generate simple equivalent fractions, e.g., 1/2 = 2/4, 4/6 = 2/3). Explain why the fractions are equivalent, e.g., by using a visual fraction model. | **4.N.2.1** Represent and rename equivalent fractions using fraction models (e.g. parts of a set, area models, fraction strips, number lines). | This CCSS requirement appears one year later in the OAS. The CCSS has made a conceptual shift in Gr 3 to understanding of fractions as quantities. There is no requirement in the OAS objective to explain why two fractions are equivalent.<br>It is not clear why "represent and rename" is used here rather than the more mathematically precise notion of creating or generating equivalent fractions. |
| | **5.N.2.4** Recognize and generate equivalent decimals, fractions, mixed numbers, and fractions less than one in various contexts. | This OAS objective addresses this concept two years later than the CCSS counterpart. |
| 3.NF.3c Express whole numbers as fractions, and recognize fractions that are equivalent to whole numbers. *Examples: Express 3 in the form 3 = 3/1; recognize that 6/1 = 6; locate 4/4 and 1 at the same point of a number line diagram.* | . | This CCSS has no match in the OAS. |
| 3.NF.3d Compare two fractions with the same numerator or the same denominator by reasoning about their size. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with the symbols >, =, or <, and justify the conclusions, e.g., by using a visual fraction model. | **3.N.3.4** Use models and number lines to order and compare fractions that are related to the same whole. | The OAS objective does not specify that comparisons should be made with both like numerators and with like denominators. Additionally there is no call to use the comparison symbols when comparing fractions before OAS Gr 6. |
| 3.MD.1. Tell and write time to the nearest minute | **3.GM.3.1** Read and write time to the nearest 5-minute (analog and digital). | This OAS objective was also used in a Gr 2 alignment in order to match the limitation there. (See 2.MD.7) |

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| and measure time intervals in minutes. Solve word problems involving addition and subtraction of time intervals in minutes, e.g., by representing the problem on a number line diagram. | **3.GM.3.2** Determine the solutions to problems involving addition and subtraction of time in intervals of 5 minutes, up to one hour, using pictorial models, number line diagrams, or other tools. | The CCSS expectation is that time should be found to the nearest minute. |
| 3.MD.2. Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem. | **1.GM.2.5** Use standard and nonstandard tools to identify volume/capacity. Compare and sort containers that hold more, less, or the same amount. | Liquid volume is addressed in the OAS in Gr 1 objective. Measures of weight are not addressed in OAS. |
| | **4.GM.2.5** Solve problems that deal with measurements of length, when to use liquid volumes, when to use mass, temperatures above zero and money using addition, subtraction, multiplication, or division as appropriate (customary and metric). | This Gr 4 objective addresses solving problems related to mass and volume. |
| | **6.GM.3.1** Estimate weights, capacities and geometric measurements using benchmarks in customary and metric measurement systems with appropriate units. | Estimation of measurements using appropriate units is addressed in this Gr 6 objective. There is no other match for this objective in the CCSS. |
| 3.MD.3. Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs. *For example, draw a bar graph in which each square in the bar graph might represent 5 pets.* | **3.D.1.1** Summarize and construct a data set with multiple categories using a frequency table, line plot, pictograph, and/or bar graph with scaled intervals. | The OAS requires a frequency table while the CCSS does not require them at this level. |
| | **3.D.1.2** Solve one- and two-step problems using categorical data represented with a frequency table, pictograph, or bar graph with scaled intervals. | |
| 3.MD.4. Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a | **3.D.1.1** Summarize and construct a data set with multiple categories using a frequency table, line plot, pictograph, and/or bar graph with scaled intervals. | The CCSS waits to introduce frequency until Gr 7 and frequency tables in Gr 8. |

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| line plot, where the horizontal scale is marked off in appropriate units— whole numbers, halves, or quarters. | **4.GM.2.4** Choose an appropriate instrument and measure the length of an object to the nearest whole centimeter or quarter-inch. | This Gr 4 OAS objective addresses the level of precision of the measurement part of the CCSS counterpart. |
| 3.MD.5 Recognize area as an attribute of plane figures and understand concepts of area measurement.<br>a. A square with side length 1 unit, called "a unit square," is said to have "one square unit" of area, and can be used to measure area.<br>b. A plane figure which can be covered without gaps or overlaps by n unit squares is said to have an area of n square units. | **3.GM.2.8** Find the area of two-dimensional figures by counting total number of same size unit squares that fill the shape without gaps or overlaps. | This foundational/conceptual CCSS is not fully matched in the OAS objectives. This OAS objective aligns best with part b but in the more procedural way of counting squares. |
| 3.MD.6. Measure areas by counting unit squares (square cm, square m, square in, square ft, and improvised units). | **3.GM.2.8** Find the area of two-dimensional figures by counting total number of same size unit squares that fill the shape without gaps or overlaps. | |

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| 3.MD.7. Relate area to the operations of multiplication and addition. | **3.N.2.1** Represent multiplication facts by using a variety of approaches, such as repeated addition, equal-sized groups, arrays, area models, equal jumps on a number line and skip counting. | This OAS objective addressing number concepts lays the foundation for relating multiplication and addition to area. |
| | **3.GM.2.2** Develop and use formulas to determine the area of rectangles. Justify why length and width are multiplied to find the area of a rectangle by<br>breaking the rectangle into one unit by one unit squares and viewing these as grouped into rows and columns. | |
| 3.MD.7a Find the area of a rectangle with whole-number side lengths by tiling it, and show that the area is the same as would be found by multiplying the side lengths. | **3.GM.2.2** Develop and use formulas to determine the area of rectangles. Justify why length and width are multiplied to find the area of a rectangle by breaking the rectangle into one unit by one unit squares and viewing these as grouped into rows and columns. | |
| | **3.GM.2.8** Find the area of two-dimensional figures by counting total number of same size unit squares that fill the shape without gaps or overlaps. | |
| 3.MD.7b Multiply side lengths to find areas of rectangles with whole- number side lengths in the context of solving real world and mathematical problems, and represent whole-number products as rectangular areas in mathematical reasoning. | **3.GM.2.2** Develop and use formulas to determine the area of rectangles. Justify why length and width are multiplied to find the area of a rectangle by breaking the rectangle into one unit by one unit squares and viewing these as grouped into rows and columns. | |

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| 3.MD.7c Use tiling to show in a concrete case that the area of a rectangle with whole-number side lengths $a$ and $b + c$ is the sum of a x b and a x c. Use area models to represent the distributive property in mathematical reasoning. | . | At this grade level the OAS addresses area models to represent multiplication facts but goes no further with area. The expectation that students reason about the distributive property is not matched in the OAS. |
| 3.MD.7d Recognize area as additive. Find areas of rectilinear figures by decomposing them into non-overlapping rectangles and adding the areas of the non-overlapping parts, applying this technique to solve real world problems. | **4.GM.2.2** Find the area of polygons that can be decomposed into rectangles. | This is a partial match in that there is no expectation in the OAS objective to recognize the additive nature of area or to use that quality in solving problems. |
| 3.MD.8. Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters. | **3.GM.2.1** Find perimeter of polygon, given whole number lengths of the sides, in real-world and mathematical situations. | The CCSS provides more detail than this OAS objective. |
| | **3.N.4.1** Use addition to determine the value of a collection of coins up to one dollar using the cent symbol and a collection of bills up to twenty dollars. | The OAS objective places more emphasis on problems involving currency than the CCSS. |
| | **3.N.4.2** Select the fewest number of coins for a given amount of money up to one dollar. | |
| | **3.GM.2.6** Use an analog thermometer to determine temperature to the nearest degree in Fahrenheit and Celsius. | The CCSS has no match for this OAS |
| 3.G.1. Understand that shapes in different categories (e.g., rhombuses, rectangles, and others) may share attributes (e.g., having four sides), and that the shared attributes can define a | **2.GM.1.2** Describe, compare, and classify two-dimensional figures according to their geometric attributes. | This Gr 2 OAS addresses the expectation that students will consider the attributes of the 2-dimensional figures. |

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| larger category (e.g., quadrilaterals). Recognize rhombuses, rectangles, and squares as examples of quadrilaterals, and draw examples of quadrilaterals that do not belong to any of these subcategories. | **4.GM.1.2** Describe, classify, and sketch quadrilaterals, including squares, rectangles, trapezoids, rhombuses, parallelograms, and kites. Recognize quadrilaterals in various contexts. | This Gr 4 OAS objective addresses all the quadrilaterals in the CCSS counterpart, but it has no requirement to recognize or draw examples that do not belong to any of these subcategories. |
| 3.G.2. Partition shapes into parts with equal areas. Express the area of each part as a unit fraction of the whole. *For example, partition a shape into 4 parts with equal area, and describe the area of each part as 1/4 of the area of the shape.* | . | This concept is addressed in OAS Grade 1 (1.N.3.1 and 1.N.3.2) but is not carried into a Grade 3 progression. |

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| **GRADE 4** | | |
| 4.OA.1. Interpret a multiplication equation as a comparison, e.g., interpret 35 = 5 x 7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations. | . | The OAS objectives do not address multiplicative comparison until Grade 6 (6.N.3.1). |
| 4.OA.2. Multiply or divide to solve word problems involving multiplicative comparison, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem, distinguishing multiplicative comparison from additive comparison. | . | |
| | **4.N.1.4** Estimate products of 3-digit by 1-digit or 2-digit by 2-digit whole numbers using rounding, benchmarks and place value to assess the reasonableness of results. Explore larger numbers using technology to investigate patterns. | |
| | **4.N.1.5** Solve multi-step real-world and mathematical problems requiring the use of addition, subtraction, and multiplication of multi-digit whole numbers. Use various strategies, including the relationship between operations, the use of appropriate technology, and the context of the problem to assess the reasonableness of results. | |

<table>
<tr><th>CCSS</th><th>OAS Final V2 Jan 2016</th><th>Comments OAS Final V2 Jan 2016<br>Clarity Comments are in blue font</th></tr>
<tr><td rowspan="5">4.OA.3. Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.</td><td>4.A.2.1 Use number sense, properties of multiplication and the relationship between multiplication and division to solve problems and find values for the unknowns represented by letters and symbols that make number sentences true.</td><td></td></tr>
<tr><td>4.A.2.2 Solve for unknowns in problems by solving open sentences (equations) and other problems involving addition, subtraction, multiplication, or<br>division with whole numbers. Use real-world situations to represent number sentences and vice versa.</td><td></td></tr>
<tr><td>5.N.1.1 Estimate solutions to division problems in order to <u>assess the reasonableness of results</u>.</td><td rowspan="3">There is no match with the CCSS for these three OAS objectives in Grade 5, indicating that the OAS postpones certain aspects of division (such as remainders and multi-step problems) until grade 5.</td></tr>
<tr><td>5.N.1.3 Recognize that quotients can be represented in a variety of ways, including a whole number with a remainder, a fraction or mixed number, or a decimal and consider the context in which a problem is situated to select and <u>interpret the most useful form of the quotient for the solution</u>.</td></tr>
<tr><td>5.N.1.4 Solve real-world and mathematical problems requiring addition, subtraction, multiplication, and division of multi-digit whole numbers. Use various strategies, including the inverse relationships between operations, the use of technology, and the context of the problem to <u>assess the reasonableness of results</u>.</td></tr>
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| 4.OA.4. Find all factor pairs for a whole number in the range 1–100. Recognize that a whole number is a multiple of each of its factors. Determine whether a given whole number in the range 1–100 is a multiple of a given one-digit number. Determine whether a given whole number in the range 1–100 is prime or composite. | **4.N.1.1** Demonstrate fluency with multiplication and division facts with factors up to 12. | The OAS objective addresses factors of whole numbers to 144 (recognizing that 12 x 12 is the greatest product within this limitation). However it isn't necessarily clear that ALL factor pairs within 100, or an understanding of factors in general, would be a requirement in OAS. Neither is the definition of prime or composite clearly made. |
| | **6.N.1.5** Factor whole numbers and express prime and composite numbers as a product of prime factors with exponents. | This Gr 6 OAS assuming understanding of prime and composite numbers comes two years later than in the CCSS. It is not clear when this concept is defined for students in the OAS. |
| 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. *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.* | **4.A.1.3** Create growth patterns involving geometric shapes and define the single operation rule of the pattern. | The meaning and intention of "growth patterns involving geometric shape" is not clear. (How will the shapes be "growing?" Is the intention here perhaps about geometric dot patterns?) |

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| . | **4.N.1.7** Determine the unknown addend or factor in equivalent and non-equivalent expressions. (e.g., 5 + 6 = 4 + ☐ , 3 x 8 < 3 x ☐). | This OAS objective is used as a partial match in CCSS Gr 3. There are CCSS expectations for K-5 students to compare quantities using comparative symbols ( <, >, =). However there is no alignment possible with the part of this standard that expects grade level students to solve inequalities.<br>In addition there are issues with mathematical accuracy and clarity in this OAS objective: First the examples given are not expressions, but rather are equations and inequalities. Also it is not clear how "the" unknown addend or factor can be determined in a non-equivalent |
| 4.NBT.1. Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. *For example, recognize that 700 ÷ 70 = 10 by applying concepts of place value and division.* | . | This conceptual understanding of place value in the CCSS is not addressed in the OAS. |
| 4.NBT.2. Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons. | **3.N.1.2** Use place value to describe whole numbers between 1,000 and 10,000 in terms of ten thousands, thousands, hundreds, tens and ones, including expanded form.<br><br>**3.N.1.4** Use place value to compare and order whole numbers up to 10,000, using comparative language, numbers, and symbols. | These Grade 3 OAS objectives expect reading, writing, and comparing multi-digit numbers. The CCSS counterpart does not limit to ten thousands. |
| 4.NBT.3. Use place value understanding to round multi-digit whole numbers to any place. | **4.N.1.4** Estimate products of 3-digit by 1-digit or 2-digit by 2-digit whole numbers <ins>using rounding</ins>, benchmarks <ins>and place value</ins> to assess the reasonableness of results. Explore larger numbers using technology to investigate patterns. | |

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| 4.NBT.4. Fluently add and subtract multi-digit whole numbers using the standard algorithm. | **3.N.2.3** Use strategies and algorithms based on knowledge of place value and equality to fluently add and subtract multi-digit numbers. <u>Use strategies and algorithms based on knowledge of place value and equality to fluently add and subtract multi-digit numbers</u>. | Fluency with addition and subtraction of multi-digit whole numbers is addressed in this Grade 3 OAS objective. |
| 4.NBT.5. Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models. | **4.N.1.3** Multiply 3-digit by 1-digit or a 2-digit by 2-digit whole numbers, using efficient and generalizable procedures and strategies, based on knowledge of place value, including but not limited to standard algorithms. | The CCSS limitation goes beyond OAS, in that it requires 4-digits by 1-digit. |
| 4.NBT.6. Find whole-number quotients and remainders with up to four-digit dividends and one-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models. | **4.N.1.6** Use strategies and algorithms based on knowledge of place value, equality and properties of operations to divide 3-digit dividend by 1-digit whole number divisors. (e.g., mental strategies, standard algorithms, partial quotients, repeated subtraction, the commutative, associative, and distributive properties). | This OAS objective limitation (3-digit by 1-digit) does not match that of the CCSS (4 -digit by 1-digit). It also does not require an explanation of the calculations by the various means listed in the CCSS counterpart. |
| 4.NF.1. Explain why a fraction *a* /*b* is equivalent to a fraction (*n* x *a* )/(*n* x *b* ) by using visual fraction models, with attention to how the number and size of the parts differ even though the two fractions themselves are the same size. Use this principle to recognize and generate equivalent fractions. | . | The OAS does not require an explanation of why fractions are equivalent. |

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| 4.NF.2. Compare two fractions with different numerators and different denominators, e.g., by creating common denominators or numerators, or by comparing to a benchmark fraction such as 1/2. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with symbols >, =, or <, and justify the conclusions, e.g., by using a visual fraction model. | **4.N.2.2** Use benchmark fractions (0, 1/4, 1/3, 1/2, 2/3, 3/4, 1) to locate additional fractions on a number line. Use models to order and compare whole numbers and fractions less than and greater than one using comparative language and symbols. | The OAS objective does not specify that different numerators and denominators should be considered in fraction comparisons. In addition comparisons of fractions of the same whole is specified in Gr 3 OAS (3. N.3.4) but not here. |
| 4.NF.3. Understand a fraction *a* /*b* with *a* > 1 as a sum of fractions 1/*b* . | . | These CCSS conceptual standards are not addressed in OAS. These standards represent a key to understanding fractions as numbers, as was introduced in Gr 3. |
| 4.NF.3a Understand addition and subtraction of fractions as joining and separating parts referring to the same whole. | . | |
| 4.NF.3b Decompose a fraction into a sum of fractions with the same denominator in more than one way, recording each decomposition by an equation. Justify decompositions, e.g., by using a visual fraction model. Examples: 3/8 = 1/8 + 1/8 + 1/8 ; 3/8 = 1/8 + 2/8 ; 2 1/8 = 1 + 1 + 1/8 = 8/8 + 8/8 + 1/8. | **4.N.2.3** Decompose a fraction in more than one way into a sum of fractions with the same denominator using concrete and pictorial models and recording results with symbolic representations (e.g., 3/4 = 1/4 + 1/4 + 1/4). | |
| 4.NF.3c Add and subtract mixed numbers with like denominators, e.g., by replacing each mixed number with an equivalent fraction, and/or by using properties of operations and the relationship between addition and subtraction. | 5.N.3 **Add and subtract fractions with like and unlike denominators, <u>mixed numbers</u> and decimals to solve real- world and mathematical problems.** | Mixed numbers are introduced in OAS Gr 5 (5.N.2.3: compare and order, 5.N.2.4: recognize and generate). Operations with mixed numbers begin with this OAS standard (not objective). However the objectives under this standard do not specifically require operations with mixed numbers.<br>This is an example of where an OAS standard contains aspects that are not clarified in the objectives. |

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| 4.NF.3d Solve word problems involving addition and subtraction of fractions referring to the same whole and having like denominators, e.g., by using visual fraction models and equations to represent the problem. | **4.N.2.4** Use fraction models to add and subtract fractions with like denominators in real-world and mathematical situations. | |
| 4.NF.4. Apply and extend previous understandings of multiplication to multiply a fraction by a whole number. | . | These CCSS conceptual and procedural standards are not addressed in this grade level in OAS. Multiplication of fractions is not introduced in OAS until Grade 6. |
| 4.NF.4a Understand a fraction *a* /*b* as a multiple of 1/*b* . *For example, use a visual fraction model to represent 5/4 as the product 5 × (1/4), recording the conclusion by the equation 5/4 = 5 × (1/4).* | . | |
| 4.NF.4b Understand a multiple of *a* /*b* as a multiple of 1/*b* , and use this understanding to multiply a fraction by a whole number. *For example, use a visual fraction model to express 3 × (2/5) as 6 × (1/5), recognizing this product as 6/5. (In general, n × (a/b) = (n × a)/b.)* | . | |
| 4.NF.4c Solve word problems involving multiplication of a fraction by a whole number, e.g., by using visual fraction models and equations to represent the problem. *For example, if each person at a party will eat 3/8 of a pound of roast beef, and there will be 5 people at the party, how many pounds of roast beef will be needed? Between what two whole numbers does your answer lie?* | . | |

<table>
<tr><th>CCSS</th><th>OAS Final V2 Jan 2016</th><th>Comments OAS Final V2 Jan 2016<br>Clarity Comments are in blue font</th></tr>
<tr><td rowspan="2">4.NF.5. Express a fraction with denominator 10 as an equivalent fraction with denominator 100, and use this technique to add two fractions with respective denominators 10 and 100. For example, express 3/10 as 30/100, and add 3/10 + 4/100 = 34/100.</td><td>4.N.2.1 Represent and rename equivalent fractions using fraction models (e.g. parts of a set, area models, fraction strips, number lines).</td><td>This OAS addresses equivalent fractions but does not specifically make the connection to denominators of 10 and 100, leading to connections to decimals and percentages.<br>It is not clear why "represent and rename" is used here rather than the more mathematically precise notion of creating or generating equivalent fractions.</td></tr>
<tr><td>5.N.3.3 <u>Add</u> and subtract <u>fractions with</u> like and <u>unlike denominators</u>, mixed numbers, and decimals, using efficient and generalizable procedures, including but not limited to standard algorithms in order to solve real-world and mathematical problems including those involving money, measurement, geometry, and data.</td><td>This Gr 5OAS seems to point to addition of fractions with unlike denominators. This concept comes one year later in the OAS. The CCSS does not specify this skill to be used in solving a real world problem.</td></tr>
<tr><td rowspan="2">4.NF.6. Use decimal notation for fractions with denominators 10 or 100. For example, rewrite 0.62 as 62/100; describe a length as 0.62 meters; locate 0.62 on a number line diagram.</td><td>4.N.2.5 Represent tenths and hundredths with concrete models, <u>making connections between fractions and decimals.</u></td><td rowspan="2">This CCSS is asking that students use the correct decimal notation. In Gr 4 CCSS concrete models are no longer required to represent fractions.<br>NOTE: There is very little, or no, difference between the requirements in these Gr4 and Gr 5 OAS objectives. The Gr 5 objective has no other in the CCSS.</td></tr>
<tr><td>5.N.2.1 Represent decimal fractions (e.g., 1/10, 1/100) using a variety of models (e.g., 10 by 10 grids, rational number wheel, base-ten blocks, meter stick) and make connections between fractions and decimals.</td></tr>
<tr><td rowspan="2">4.NF.7. Compare two decimals to hundredths by reasoning about their size. Recognize that comparisons are valid only when the two decimals refer to the same whole. Record the results of comparisons with the symbols >, =, or <, and justify the conclusions, e.g., by using a visual model.</td><td>4.N.2.7 Compare and order decimals and whole numbers using place value, a number line and models such as grids and base 10 blocks.</td><td></td></tr>
<tr><td>4.N.2.8 <u>Compare</u> benchmark fractions (1/4, 1/3, 1/2, 2/3, 3/4) and <u>decimals</u> (0.25, 0.50, 0.75) in real-world and mathematical situations.</td><td></td></tr>
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| 4.MD.1. Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two- column table. *For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36), ...* | **4.GM.3.2** Solve problems involving the conversion of one measure of time to another. | |
| | **5.GM.3.3** Recognize and use the relationship between inches, feet, and yards to measure and compare objects. | This Gr 5 OAS objective adds the requirement to measure and compare objects to the requirement to recognition of the relationship between units within a measurement system. |
| | **5.GM.3.4** Recognize and use the relationship between millimeters, centimeters, and meters to measure and compare objects. | |

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| | **4.GM.2.5** Solve problems that deal with measurements of length, when to use liquid volumes, when to use mass, temperatures above zero and money using addition, subtraction, multiplication, or division as appropriate (customary and metric). | Rather than requiring problem solving that involves liquid volumes and masses of objects, this OAS requires problems that deal with WHEN TO USE those two measurement |
| | **4.GM.3.1** Determine elapsed time. | |
| | **4.N.2.6** Represent, read and write decimals up to at least the hundredths place in a variety of contexts including money. | This OAS requires reading and writing decimals but it does not expect problem solving with both fractions and decimals at this level. |

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| 4.MD.2. Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale. | **4.N.3.1** Given a total cost (whole dollars up to $20 or coins) and amount paid (whole dollars up to $20 or coins), find the change required in a variety of ways. Limited to whole dollars up to $20 or sets of coins. | It is not clear that this OAS requires using operations other than subtraction.<br><br>The wording in this OAS is confusing. Is it the intention of this limitation to require either whole dollars to $20 **OR** a collection of coins? How would the total cost be given in coins? Then with "whole dollars" does that imply one dollar bills? Or are 5s and 10s also allowed? In the first case this becomes a trivial case of counting by 1s. In the second it becomes a repeat of the Gr 1 requirement (combining pennies, nickels, and dimes to $1) but with a lesser limit.<br><br>Since the total cost going to be the same as the amount paid, it would make more sense here to use "total cost" and "amount tendered." |
| | 5.N.3 **Add and subtract fractions with like and unlike denominators, mixed numbers and decimals to solve real- world and mathematical problems.** | Operations with fractions and decimals are not addressed in the OAS until Gr 5. |
| 4.MD.3. Apply the area and perimeter formulas for rectangles in real world and mathematical problems. *For example, find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor* | **3.GM.2.2** Develop and use formulas to determine the area of rectangles. Justify why length and width are multiplied to find the area of a rectangle by<br>breaking the rectangle into one unit by one unit squares and viewing these as grouped into rows and columns.<br><br>**3.GM.2.1** Find perimeter of polygon, given whole number lengths of the sides, in real-world and mathematical situations. | These Gr 3 OAS objectives address both area and perimeter. The OAS in Gr 4 do not address perimeter and the Gr 3 area objective does not require real world applications. |

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| *multiplication equation with an unknown factor.* | **4.GM.2.2** Find the area of polygons that can be decomposed into rectangles. | This Gr 4 objective expects area of polygons that are composed of rectangles. There are no Gr 4 OAS objectives that require application of area and perimeter formulas to real world problems. |
| 4.MD.4. Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Solve problems involving addition and subtraction of fractions by using information presented in line plots. *For example, from a line plot find and interpret the difference in length between the longest and shortest specimens in an insect collection.* | **4.D.1.1** Represent data on a frequency table or line plot marked with whole numbers and fractions using appropriate titles, labels, and units. | The CCSS waits to introduce frequency until Gr 7 and frequency tables in Gr 8. The CCSS requirement to solve problems using information gathered in a line plot is not addressed in OAS until Gr 6. |
| . | **4.D.1.2** Use tables, bar graphs, timelines, and Venn diagrams to display data sets. The data may include benchmark fractions or decimals (1/4, 1/3, 1/2, 2/3, 3/4, 0.25, 0.50, 0.75). | ThIs OAS has no match in the CCSS at this level. Bar graphs are requred in the CCSS at grades 2 and 3. CCSS does not specifically address Venn diagrams. |
| . | **4.D.1.3** Solve one- and two-step problems using data in whole number, decimal, or fraction form in a frequency table and line plot. | This Gr 4 OAS match concepts in Gr 3 CCSS except for their use of fractions and decimals. The CCSS do not specifically address frequency tables at this level.<br><br>It is not clear whether students will be performing operations with decimals or fractions. If so this OAS goes beyond its own scope for Gr 4 |

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| 4.MD.5. Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement:<br>a. An angle is measured with reference to a circle with its center at the common endpoint of the rays, by considering the fraction of the circular arc between the points where the two rays intersect the circle. An angle that turns through 1/360 of a circle is called a "one-degree angle," and can be used to measure angles.<br>b. An angle that turns through n one-degree angles is said to have an angle measure of n degrees. | **5.GM.3 Understand angle and length as measurable attributes of real-world and mathematical objects. Use various tools to measure angles and lengths.** | This OAS at the standard level is a partial match for this conceptual foundation CCSS.<br>This OAS standard is mathematically flawed. An angle has an attribute that is measurable just like a line segment has an attribute that is measurable (length). The angles and segments are not the attributes, they are the figures. (The CCSS is clear on this) |
| | **5.GM.3.1** Measure and compare angles according to size. | This Grade 5 OAS requires measuring, comparing, and classifying angles but does not include the conceptual foundation supplied by this CCSS. |
| 4.MD.6. Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure. | **4.GM.2.1** Measure angles in geometric figures and real-world objects with a protractor or angle ruler. | This match in OAS does not require sketching angles when given a measure or that the degree of precision in measuring angles is to the nearest degree. |
| 4.MD.7. Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure. | . | The OAS does not call out the additive nature of angle measure. |
| 4.G.1. Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular | **2.GM.1.4** Recognize right angles and classify angles as smaller or larger than a right angle. | This OAS objective requiring identification right, acute, and obtuse angles and address angle measures in relation to a right angle appears two years earlier than in the CCSS. The OAS does not require defining an angle or drawing them. |

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| angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. | **3.GM.1.3** Classify angles as acute, right, obtuse, and straight. | The K-5 CCSS does not require an understanding of straight angles. |
| | **4.GM.1.1** Identify points, lines, line segments, rays, angles, endpoints, and parallel and perpendicular lines in various contexts. | This OAS partially matches for the requirements of the CCSS but does not specify the types of angles that are to be drawn and does not require the figures be drawn. |
| 4.G.2. Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size. Recognize right triangles as a category, and identify right triangles. | **4.GM.1.2** Describe, classify, and sketch quadrilaterals, including squares, rectangles, trapezoids, rhombuses, parallelograms, and kites. Recognize quadrilaterals in various contexts. | The CCSS requires classification but does not require sketching the 2-dimensional figures. There is also no requirement in the OAS to recognize right triangles. |
| | **2.GM.1.4** Recognize right angles and classify angles as smaller or larger than a right angle. | This OAS objective addressing right angles comes two years earlier than in the CCSS. |
| | **5.GM.1.1** Describe, classify and construct triangles, including equilateral, right, scalene, and isosceles triangles. Recognize triangles in various contexts. | It is not clear that the specific types of triangles included in this OAS would be required at Gr 4 or Gr 5 in the CCSS. Isosceles triangles are first defined and equilateral triangles constructed in CCSS for high school. |
| 4.G.3. Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry. | **6.GM.4.4** Identify and describe the line(s) of symmetry in two-dimensional shapes. | The concept of symmetry is addressed two years later in the OAS than in the CCSS. The OAS does not require identifying symmetric figures or drawing lines of symmetry. |

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| GRADE 5 | . | . |
| 5.OA.1. Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols. | **5.A.2.3** Evaluate expressions involving variables when values for the variables are given. | |
| | **5.A.2.1** Generate equivalent numerical expressions and solve problems involving whole numbers by applying the commutative, associative, and distributive properties and order of operations (no exponents). | These Gr 5 OAS objectives do not address the need for using symbols of inclusion correctly. |
| | **7.A.4.2** Apply understanding of order of operations and grouping symbols when using calculators and other technologies. | This Gr 7 OAS objective addresses effective use of grouping symbols, and implies that the expressions would be numerical, since they are used in a calculator. |
| 5.OA.2. Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them. *For example, express the calculation "add 8 and 7, then multiply by 2" as 2 × (8 + 7). Recognize that 3 × (18932 + 921) is three times as large as 18932 + 921, without having to calculate the indicated sum or product.* | . | This CCSS has no match in the OAS. |
| 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 | **4.A.1.1** Create an input/output chart or table to represent or extend a numerical pattern. | The OAS addresses ordered pairs earlier than in the CCSS. |
| | **4.A.1.2** Describe the single operation rule for a pattern from an input/output table or function machine involving any operation of a whole number. | Functions are introduced in CCSS in Grade 8. In the OAS "function machines" appear in Gr 3 and 4 but disappear until Pre-Algebra (Gr 8).<br>This OAS objective appears to repeat the expectations of 4.A.1.1. |

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| coordinate plane. *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.* | **5.A.1.1** Use tables and rules of up to two operations to describe patterns of change and make predictions and generalizations about real-world and mathematical problems. | |
| | **5.A.1.2** Use a rule or table to represent ordered pairs of whole numbers and graph these ordered pairs on a coordinate plane, identifying the origin and axes in relation to the coordinates. | |
| 5.NBT.1. Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left. | | These CCSS standards addressing the foundational understanding of place value have no matches in the OAS objectives. |
| 5.NBT.2. Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10. | | |
| 5.NBT.3. Read, write, and compare decimals to thousandths. | **5.N.2.2** Represent, read and write decimals using place value to describe decimal numbers including fractional numbers as small as thousandths and<br>whole numbers as large as millions. | This CCSS does not address large whole number rounding. |
| | **5.N.2.3** Compare and order fractions and decimals, including mixed numbers and fractions less than one, and locate on a number line. | This OAS objective does not limit decimals to thousandths. |

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| 5.NBT.3a Read and write decimals to thousandths using base-ten numerals, number names, and expanded form, e.g., 347.392 = 3 x 100 + 4 x 10 + 7 x 1 + 3 x (1/10) + 9 x (1/100) + 2 x (1/1000). | **5.N.2.2** Represent, read and write decimals using place value to describe decimal numbers including fractional numbers as small as thousandths and whole numbers as large as millions. | This CCSS does not address large whole number rounding and does not specifically require using expanded forms for the numbers. |
| 5.NBT.3b Compare two decimals to thousandths based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons. | **5.N.2.3** Compare and order fractions and decimals, including mixed numbers and fractions less than one, and locate on a number line. | This OAS objective does not limit decimals to thousandths. |
| 5.NBT.4. Use place value understanding to round decimals to any place. | . | A Gr 3 OAS objective (3.N.1.4) asks for recognition of when to round; an objective in Grade 4 (4.N.1.4) requires rounding of whole numbers. However there is no OAS that actually requires rounding decimals. |

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| 5.NBT.5. Fluently multiply multi-digit whole numbers using the standard algorithm. | **4.N.1.3** Multiply 3-digit by 1-digit or a 2-digit by 2-digit whole numbers, using efficient and generalizable procedures and strategies, based on knowledge of place value, including but not limited to standard algorithms..<br><br>**5.N.1.4** Solve real-world and mathematical problems requiring addition, subtraction, multiplication, and division of multi-digit whole numbers. Use various strategies, including the inverse relationships between operations, the use of technology, and the context of the problem to assess the reasonableness of results. | The OAS requires fluency in addition and subtraction with multi-digit whole numbers (3.N.2.3) but there is no similar requirement for multiplication. The Gr 4 objective addresses multiplication of multi-digit numbers but with limitations. The Gr 5 objective requires multi-digit multiplication in an application setting but does not ask for fluency with the standard algorithm. |
| 5.NBT.6. Find whole-number quotients of whole numbers with up to four-digit dividends and two-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models. | **5.N.1.2** Divide multi-digit numbers, by one- and two-digit divisors, using efficient and generalizable procedures, based on knowledge of place value,<br>including standard algorithms. | This CCSS is more specific about the limitations in this requirement (4-digit dividends). It is not clear in the OAS that the properties of operations would be required or that explanation of the calculations are required. |
| 5.NBT.7. Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship | **5.N.3.3** <u>Add and subtract</u> fractions with like and unlike denominators, mixed numbers, and decimals, using efficient and generalizable procedures, including but not limited to standard algorithms in order to solve real-world and mathematical problems including those involving money, measurement, geometry, and data. | These three OAS objectives match the requirement to operate with decimals but do not address the conceptual foundation in the CCSS or require an explanation of the reasoning used. |

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| properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. | **5.N.3.4** Find 0.1 more than a number and 0.1 less than a number. Find 0.01 more than a number and 0.01 less than a number. Find 0.001 more than a number and 0.001 less than a number. | This OAS objective is a very specific case of 5.N.3.3. |
| | **6.N.4.3** Multiply and divide fractions and decimals using efficient and generalizable procedures. | Multiplication and division of decimals comes one year later in the OAS than in the CCSS. |
| 5.NF.1. Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators. *For example, 2/3 + 5/4 = 8/12 + 15/12 = 23/12. (In general, a/b + c/d = (ad + bc)/bd.)* | **5.N.3.3** Add and subtract fractions with like and unlike denominators, mixed numbers, and decimals, using efficient and generalizable procedures, including but not limited to standard algorithms in order to solve real-world and mathematical problems including those involving money, measurement, geometry, and data. | |
| | **5.N.2.4** Recognize and generate equivalent decimals, fractions, mixed numbers, and fractions less than one in various contexts. | It is not clear what is meant by "equivalent decimals." |
| 5.NF.2. Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators, e.g., by using visual fraction models or equations to represent the problem. Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers. *For example, recognize an incorrect result 2/5 + 1/2 = 3/7, by observing that 3/7 < 1/2.* | **5.N.3.3** Add and subtract fractions with like and unlike denominators, mixed numbers, and decimals, using efficient and generalizable procedures, including but not limited to standard algorithms in order to solve real-world and mathematical problems including those involving money, measurement, geometry, and data. | |
| | **5.N.3.2** Illustrate addition and subtraction of fractions with like and unlike denominators, mixed numbers, and decimals using a variety of representations (e.g., fraction strips, area models, number lines, fraction rods). | |

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| | **5.N.3.1** Estimate sums and differences of fractions with like and unlike denominators, mixed numbers, and decimals to assess the reasonableness of the results. | |
| 5.NF.3. Interpret a fraction as division of the numerator by the denominator (*a* /*b* = *a* ÷ *b* ). Solve word problems involving division of whole numbers leading to answers in the form of fractions or mixed numbers, e.g., by using visual fraction models or equations to represent the problem. *For example, interpret 3/4 as the result of dividing 3 by 4, noting that 3/4 multiplied by 4 equals 3, and that when 3 wholes are shared equally among 4 people each person has a share of size 3/4. If 9 people want to share a 50-pound sack of rice equally by weight, how many pounds of rice should each person get? Between what two whole numbers does your answer lie?* | . | This CCSS emphasizes interpreting that the fraction, a/b, is numerically equivalent to the result of the operation a ÷ b. There is nothing like this in OAS. |
| 5.NF.4. Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction. | . | OAS waits until Grade 6 to address multiplication of fractions (e.g. see 6.N.3.3) but does not provide this step in the progression, to specify that a fraction be multiplied by a whole number. |
| 5.NF.4a Interpret the product (*a* /*b* ) x *q* as *a* parts of a partition of *q* *into b equal parts; equivalently, as the result of a sequence of operations a x q ÷ b. For example, use a visual fraction model to show (2/3) × 4 = 8/3, and create a story context for this equation. Do the same with (2/3) × (4/5) = 8/15. (In general, (a/b) × (c/d) = ac/bd.)* | . | OAS waits until Grade 6 to address multiplication of fractions (e.g. see 6.N.3.3) but does not provide this step in the progression, to specify that a fraction be multiplied by a whole number. |

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| 5.NF.4b Find the area of a rectangle with fractional side lengths by tiling it with unit squares of the appropriate unit fraction side lengths, and show that the area is the same as would be found by multiplying the side lengths. Multiply fractional side lengths to find areas of rectangles, and represent fraction products as rectangular areas. | . | While the area of rectangles is addressed in OAS Grades 3 (relating to conceptualizing multiplication) and 4 (e.g. see 4.GM.3.2) and in Grade 6 to multiply fractions in general (e.g. 6.N.3.3), there is no requirement to find areas specifically with fractional side lengths. |
| 5.NF.5. Interpret multiplication as scaling (resizing), by:<br>a Comparing the size of a product to the size of one factor on the basis of the size of the other factor, without performing the indicated multiplication.<br>b Explaining why multiplying a given number by a fraction greater than 1 results in a product greater than the given number (recognizing multiplication by whole numbers greater than 1 as a familiar case); explaining why multiplying a given number by a fraction less than 1 results in a product smaller than the given number; and relating the principle of fraction equivalence a/b = (nxa)/(nxb) to the effect of multiplying a/b by 1. | . | This foundational understanding of multiplication of fractions, that shows a progression from the multiplicative comparison in 4.OA.1 and 4.OA.2, has no match in the OAS. |
| 5.NF.6. Solve real world problems involving multiplication of fractions and mixed numbers, e.g., by using visual fraction models or equations to represent the problem. | **6.N.4.3** Multiply and divide fractions and decimals using efficient and generalizable procedures. | The OAS objective in this partial match does not require a real world application. |
| 5.NF.7. Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions. | **6.N.4.2** Illustrate multiplication and division of fractions and decimals to show connections to fractions, whole number multiplication, and inverse relationships. | This OAS addresses division of fractions |

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| 5.NF.7a Interpret division of a unit fraction by a non-zero whole number, and compute such quotients. *For example, create a story context for (1/3) ÷ 4, and use a visual fraction model to show the quotient. Use the relationship between multiplication and division to explain that (1/3) ÷ 4 = 1/12 because (1/12) × 4 = 1/3.* | **6.N.4.2** Illustrate multiplication and division of fractions and decimals to show connections to fractions, whole number multiplication, and inverse relationships. | This Gr 6 OAS appears to match the interpretation requirement of this CCSS involving division of fractions and whole numbers. |
| 5.NF.7b Interpret division of a whole number by a unit fraction, and compute such quotients. *For example, create a story context for 4 ÷ (1/5), and use a visual fraction model to show the quotient. Use the relationship between multiplication and division to explain that 4 ÷ (1/5) = 20 because 20 × (1/5) = 4.* | **6.N.4.2** Illustrate multiplication and division of fractions and decimals to show connections to fractions, whole number multiplication, and inverse relationships. | This Gr 6 OAS appears to match the interpretation requirement of this CCSS for division of fractions and whole numbers. |
| 5.NF.7c Solve real world problems involving division of unit fractions by non-zero whole numbers and division of whole numbers by unit fractions, e.g., by using visual fraction models and equations to represent the problem. *For example, how much chocolate will each person get if 3 people share 1/2 lb of chocolate equally? How many 1/3-cup servings are in 2 cups of raisins?* | . | OAS addresses solving problems division of fractions in Gr 6 (e.g. see 6.N.3.3) but does not provide the foundational understanding of division found in this collection of CCSS. |
| 5.MD.1. Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems. | **6.GM.3.2** Solve problems in various real-world and mathematical contexts that require the conversion of weights, capacities, geometric measurements, and time within the same measurement systems using appropriate units. | This requirement appears in the OAS one year later than in the CCSS. |

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| 5.MD.2. Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Use operations on fractions for this grade to solve problems involving information presented in line plots. *For example, given different measurements of liquid in identical beakers, find the amount of liquid each beaker would contain if the total amount in all the beakers were redistributed equally.* | **5.D.1.2** Create and analyze line and double-bar graphs with whole numbers, fractions, and decimals increments. | The CCSS does not specifically require double-bar graphs.<br>NOTE: It appears that "whole numbers, fractions, and decimals" are used here as adjectives to modify "increments" and should not be plural. |
| 5.MD.3 Recognize volume as an attribute of solid figures and understand concepts of volume measurement.<br>a. A cube with side length 1 unit, called a “unit cube,” is said to have “one cubic unit” of volume, and can be used to measure volume.<br>b. A solid figure which can be packed without gaps or overlaps using n unit cubes is said to have a volume of n cubic units. | **3.GM.1.2** Build a three-dimensional figure using unit cubes when picture/shape is shown. | This OAS objective builds a progression to the Gr 5 requirement to find volume using cubic units starting in Gr 3. The CCSS introduces volume in Gr 5 (see CCSS 5.MD.3). |
| | **5.GM.2.1** Recognize that the volume of rectangular prisms can be determined by the number of cubes (n) and by the product of the dimensions of the prism (a x b x bc = n). Know that rectangular prisms of different dimensions p, q, and r) can have the same volume if a x b x c = p x q x r = n. | |
| | **3.GM.2.7** Count cubes systematically to identify number of cubes needed to pack the whole or half of a three-dimensional structure. | This Gr 3 OAS objective supports the Gr 5 CCSS concept of recognition of volume as an attribute that can be measured by packing with, and then counting, unit cubes.<br>It is not clear in this objective that the "number of cubes" must be of equal size. It is also not clear why packing half of a figure would be a desired skill. |

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| 5.MD.4. Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units. | **4.GM.2.3** Using a variety of tools and strategies, develop the concept that the volume of rectangular prisms with whole-number edge lengths can be found by counting the total number of same-sized unit cubes that fill a shape without gaps or overlaps. Use appropriate measurements such as $cm^3$.<br><br>**5.GM.2.1** Recognize that the volume of rectangular prisms can be determined by the number of cubes (n) and by the product of the dimensions of the prism (a x b x c = n). Know that rectangular prisms of different dimensions p, q, and r) can have the same volume if a x b x c = p x q x r = n. | These two OAS objectives address the concept behind volume but do not actually require that students count unit cubes to determine volumes. That is accomplished by the Gr 3 OAS, two years earlier than in the CCSS. |
| 5.MD.5. Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume. | **5.GM.2.1** Recognize that the volume of rectangular prisms can be determined by the number of cubes ($n$ ) and by the product of the dimensions of the prism ($a \times b \times c = n$ ). Know that rectangular prisms of different dimensions ($p$, $q$ , and $r$ ) can have the same volume if $a$ x $b$ x $c$ = $p$ x $q$ x $r$ = $n$ . | The last part of this OAS objective addresses the relationship between volume and the formula used to solve volume problems. It does not actual require solving real world problems involving volume. |
| 5.MD.5a Find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes, and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent threefold whole-number products as volumes, e.g., to represent the associative property of multiplication. | **5.GM.2.1** Recognize that the volume of rectangular prisms can be determined by the number of cubes ($n$ ) and by the product of the dimensions of the prism ($a \times b \times c = n$ ). Know that rectangular prisms of different dimensions ($p$, $q$ , and $r$ ) can have the same volume if $a$ x $b$ x $c$ = $p$ x $q$ x $r$ = $n$ . | The OAS objective expects an understanding of how volume is found but stops short of actually asking that students find the volume. The OAS does not require finding volume until Gr 8 (PA.GM.2.3) |

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| 5.MD.5b Apply the formulas $V = (l)(w)(h)$ and $V = (b)(h)$ for rectangular prisms to find volumes of right rectangular prisms with whole- number edge lengths in the context of solving real world and mathematical problems. | **PA.GM.2.3** Develop and use the formulas $l = lwh$ and $l = Bh$ to determine the volume of rectangular prisms. Justify why base area (B) and height (h) are multiplied to find the volume of a rectangular prism. Use appropriate measurements such as cm3. | This Pre-Algebra OAS objective comes three years later than the Gr 5 CCSS. |
| 5.MD.5c Recognize volume as additive. Find volumes of solid figures composed of two non-overlapping right rectangular prisms by adding the volumes of the non-overlapping parts, applying this technique to solve real world problems. | . | The OAS has no match for this volume-related concept. |
| 5.G.1. Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., *x* -axis and *x* -coordinate, *y* -axis and *y* -coordinate). | **5.A.1.2** Use a rule or table to represent ordered pairs of whole numbers and graph these ordered pairs on a coordinate plane, identifying the origin and axes in relation to the coordinates. | This CCSS has much more detail than the OAS objective to introduce the coordinate plane. |
| 5.G.2. Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. | **5.A.1.2** Use a rule or table to represent ordered pairs of whole numbers and graph these ordered pairs on a coordinate plane, identifying the origin and axes in relation to the coordinates. | The Grade 5 OAS objective lacks emphasis on real world contexts. In addition |

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| 5.G.3. Understand that attributes belonging to a category of two- dimensional figures also belong to all subcategories of that category. *For example, all rectangles have four right angles and squares are rectangles, so all squares have four right angles.* | . | There is no OAS to match this CCSS requirement. |
| 5.G.4. Classify two-dimensional figures in a hierarchy based on properties. | **4.GM.1.2** Describe, classify, and sketch quadrilaterals, including squares, rectangles, trapezoids, rhombuses, parallelograms, and kites. Recognize quadrilaterals in various contexts. | This Gr 5 OAS objective is limited to quadrilaterals, which is not the case for the CCSS. |
| Precise direct measurement | **5.GM.3.2** Choose an appropriate instrument and measure the length of an object to the nearest whole centimeter or 1/16-inch. | This OAS has no K-5 match in the CCSS.<br>The level of precision for measurements is a progression in the OAS, which becomes finer for fractions of inch measures from Gr 3 to Gr 5 but does not do the same for metric measures. Measurement limits remain to the nearest centimeter in the OAS in Gr 3 (3.GM.2.3) and Gr 4 (4.GM.2.4) and here in Gr 5. Is the intent of this progression to measure very small lengths? Or is it to measure with a finer level of precision? More clarity is needed in this area. |
| Perimeters including circimferences (curves) | **5.GM.2.3** Find the perimeter of polygons and create arguments for reasonable values for the perimeter of shapes that include curves. | This OAS has no match in the CCSS.<br>It is not clear how "the perimeter of shapes that include curves" would be accomplished in Gr 5. Are the measurements direct? Or indirect? Are the figures a composite of both linear sides and curved sides? Do the curves involve the circumference of a circle? Or is this about estimating the "perimeter" of unconventional figures? |

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| GRADE 6 | | |
| 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.N.3.1** Identify and use ratios to compare quantities. Recognize that multiplicative comparison and additive comparison are different. | This OAS includes multiplicative and additive comparisons, a point that is in the CCSS beginning in Gr 4. The OAS benchmark does not include understanding the concept of ratio, though it is mentioned in Standard 6.N.3. |
| 6.RP.2. Understand the concept of a unit rate *a* /*b* associated with a ratio *a:b* with *b* ≠ 0, and use rate language in the context of a ratio relationship. *For example, "This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is 3/4 cup of flour for each cup of sugar." "We paid $75 for 15 hamburgers, which is a rate of $5 per hamburger."* 1 | **6.N.3.2** Determine the unit rate for ratios. | This OAS does not include an expectation to understand the concept of unit rate. |
| 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. | **6.N.3.4** Use multiplicative reasoning and representations to solve ratio and unit rate problems. | This OAS does not include the focus of working with equivalent ratios. |
| 6.RP.3a 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. | **6.N.3.1** Identify and use ratios to compare quantities. Recognize that multiplicative comparison and additive comparison are different. | In this OAS the expectation is to use ratios to compare *quantities.* The CCSS expects students to be able to use tabular representations to compare *ratios.* It may seem subtle, but the difference is significant. |
| | **7.A.2.1** Represent proportional relationships with tables, verbal descriptions, symbols, and graphs; translate from one representation to another. Determine and compare the unit rate (constant of proportionality, slope, or rate of change) given any of these representations. | The concept of making and using tables of ratios relating quantities is not fully built out in the OAS. This Gr 7 OAS takes ratios to the next level but hints at the need to use tables and graphs to represent ratios. |
| 6.RP.3b Solve unit rate problems including those involving unit pricing and constant speed. *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?* | **6.N.3.4** Use multiplicative reasoning and representations to solve ratio and unit rate problems. | |

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| 6.RP.3c 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.N.1.3** Explain that a percent represents parts "out of 100" and ratios "to 100." | This OAS does not consider percent to be a rate as in the CCSS. In the CCSS a percent is a rate. In the OAS it is at one time a "part" and at other times a ratio. Is a percent both a quantity and a comparison of quantities?<br>It is not clear what is meant by "ratios 'to 100.'" |
| | **6.N.3.3** Apply the relationship between ratios, equivalent fractions and percents to solve problems in various contexts, including those involving mixture and concentrations. | There is no clear expectation in the Gr 6 OAS for students to calculate percents, though it might be the intention in this standard. |
| 6.RP.3d Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities. | **6.GM.3.2** Solve problems in various real-world and mathematical contexts that require the conversion of weights, capacities, geometric measurements, and time within the same measurement systems using appropriate units. | The OAS does not specify that "problems involving conversion" are limited to converting measurement units. Here the CCSS expects students to extend ratio reasoning to make conversions. That is not the expectation in OAS. |
| 6.NS.1. Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem. *For example, create a story context for (2/3) ÷ (3/4) and use a visual fraction model to show the quotient; use the relationship between multiplication and division to explain that (2/3) ÷ (3/4) = 8/9 because 3/4 of 8/9 is 2/3. (In general, (a/b) ÷ (c/d) = ad/bc.) How much chocolate will each person get if 3 people share 1/2 lb of chocolate equally? How many 3/4-cup servings are in 2/3 of a cup of yogurt?* | **6.N.4.2** Illustrate multiplication and division of fractions and decimals to show connections to fractions, whole number multiplication, and inverse relationships. | ""Illustrate multiplication and division of fractions and decimals" seems to make sense, but the remainder of the sentence is unclear. What might it mean to illustrate multiplication and division of fractions to fractions here?" |
| | **6.N.4.3** Multiply and divide fractions and decimals using efficient and generalizable procedures. | This OAS match does not include solving word problems involving division of fractions. It also does not require interpretation of the quotients. |
| 6.NS.2. Fluently divide multi-digit numbers using the standard algorithm. | **5.N.1.2** Divide multi-digit numbers, by one- and two-digit divisors, using efficient and generalizable procedures, based on knowledge of place value, including standard algorithms. | This Gr 5 OAS objective sets the stage for it, but fluency with division of multi-digit numbers is not addressed. Since fluency with other computations is required in Grs 3 and 4 of the OAS, this may indicate a departure from fluency as a requirement. |

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| 6.NS.3. Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation. | **5.N.3.3** Add and subtract fractions with like and unlike denominators, mixed numbers, and decimals, using efficient and generalizable procedures, including but not limited to standard algorithms in order to solve real-world and mathematical problems including those involving money, measurement, geometry, and data. | The OAS begins some of this work in Gr 5, as does the CCSS, but does not mention fluency. Since fluency with other computations is required in Grs 3 and 4 of the OAS, this may indicate a departure from fluency as a requirement. |
| | **6.N.4.3** Multiply and divide fractions and decimals using efficient and generalizable procedures. | The OAS does not require the standard algorithms for multiplying and dividing decimals until Gr 7 (7.N.2.3) |
| 6.NS.4. Find the greatest common factor of two whole numbers less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12. Use the distributive property to express a sum of two whole numbers 1–100 with a common factor as a multiple of a sum of two whole numbers with no common factor. *For example, express 36 + 8 as 4 (9 + 2).* | **6.N.1.6** Determine the greatest common factors and least common multiples. Use common factors and multiples to calculate with fractions, find equivalent fractions, and express the sum of two-digit numbers with a common factor using the distributive property. | |
| 6.NS.5. Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. | **6.N.1.1** Represent integers with counters and on a number line and rational numbers on a number line, recognizing the concepts of opposites, direction,and magnitude; use integers and rational numbers in real-world and mathematical situations, explaining the meaning of 0 in each situation. | This OAS aligns to a number of standards in the CCSS. The CCSS provides more explicit clarity for the development of the ideas. |
| 6.NS.6. Understand a rational number as a point on the number line. Extend number line diagrams and coordinate axes familiar from previous grades to represent points on the line and in the plane with negative number coordinates. | **6.N.1.1** Represent integers with counters and on a number line and rational numbers on a number line, recognizing the concepts of opposites, direction,and magnitude; use integers and rational numbers in real-world and mathematical situations, explaining the meaning of 0 in each situation. | |
| | **6.A.1.1** Plot integer- and rational-valued (limited to halves and fourths) ordered-pairs as coordinates in all four quadrants and recognize the reflective relationships among coordinates that differ only by their signs. | |

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| 6.NS.6a Recognize opposite signs of numbers as indicating locations on opposite sides of 0 on the number line; recognize that the opposite of the opposite of a number is the number itself, e.g., –(–3) = 3, and that 0 is its own opposite. | **6.N.1.1** Represent integers with counters and on a number line and rational numbers on a number line, recognizing the concepts of opposites, direction,and magnitude; use integers and rational numbers in real-world and mathematical situations, explaining the meaning of 0 in each situation. | |
| 6.NS.6b Understand signs of numbers in ordered pairs as indicating locations in quadrants of the coordinate plane; recognize that when two ordered pairs differ only by signs, the locations of the points are related by reflections across one or both axes. | **6.A.1.1** Plot integer- and rational-valued (limited to halves and fourths) ordered-pairs as coordinates in all four quadrants and recognize the reflective relationships among coordinates that differ only by their signs. | |
| 6.NS.6c Find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane. | **6.N.1.1** Represent integers with counters and on a number line and rational numbers on a number line, recognizing the concepts of opposites, direction,and magnitude; use integers and rational numbers in real-world and mathematical situations, explaining the meaning of 0 in each situation. | |
| 6.NS.7. Understand ordering and absolute value of rational numbers. | **7.N.2.6** Explain the relationship between the absolute value of a rational number and the distance of that number from zero on a number line. Use the symbol for absolute value. | This OAS addresses an understanding of absolute value of rational numbers but not of ordering them. It comes one year later in the OAS than in CCSS. |
| | **6.N.1.2** Compare and order positive rational numbers, represented in various forms, or integers using the symbols <, >, and = | |
| | **7.N.1.2** Compare and order rational numbers expressed in various forms using the symbols <, >, and =. | The OAS limits comparison of rational numbers to those with positive values in Gr 6. This concept appears one year later in the OAS than |
| 6.NS.7a Interpret statements of inequality as statements about the relative position of two numbers on a number line diagram. *For example, interpret –3 > –7 as a statement that –3 is located to the right of –7 on a number line oriented from left to right.* | **6.N.1.1** Represent integers with counters and on a number line and rational numbers on a number line, recognizing the concepts of opposites, direction,and magnitude; use integers and rational numbers in real-world and mathematical situations, explaining the meaning of 0 in each situation. | Location of rational numbers on the number line is addressed in 6.N.1.1 but there is no requirement to interpret statements of inequality |

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| 6.NS.7b Write, interpret, and explain statements of order for rational numbers in real-world contexts. *For example, write –3 degrees C > –7 degrees C to express the fact that –3 degrees C is warmer than –7 degrees C.* | | |
| 6.NS.7c 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.* | **7.N.2.6** Explain the relationship between the absolute value of a rational number and the distance of that number from zero on a number line. Use the symbol for absolute value. | This CCSS definition of absolute value is missing from this OAS, which comes one year later than in the CCSS. |
| 6.NS.7d Distinguish comparisons of absolute value from statements about order. *For example, recognize that an account balance less than –30 dollars represents a debt greater than 30 dollars.* | | This CCSS concept has no match in the OAS. |
| 6.NS.8. Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate. | **6.A.1.1** Plot integer- and rational-valued (limited to halves and fourths) ordered-pairs as coordinates in all four quadrants and recognize the reflective relationships among coordinates that differ only by their signs. | This OAS has no expectation for real-world problems. |
| | **6.GM.4.3** Use distances between two points that are either vertical or horizontal to each other (not requiring the distance formula) to solve real-world and mathematical problems about congruent two-dimensional figures. | |

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| 6.EE.1. Write and evaluate numerical expressions involving whole-number exponents. | **7.N.2.4** Raise integers to positive integer exponents. | This concept appears one year later in the OAS than in the CCSS. |
| | **7.A.4.1** Use properties of operations (limited to associative, commutative, and distributive) to generate equivalent numerical and algebraic expressions containing rational numbers, grouping symbols and whole number exponents. | The "equivalent numerical … expressions" in this OAS might be the evaluated numerical expressions. |
| 6.EE.2. Write, read, and evaluate expressions in which letters stand for numbers. | **5.A.2.3** Evaluate expressions involving variables when values for the variables are given. | This concept appears one year earlier in the OAS than in the CCSS. |
| | **PA.A.3.1** Use substitution to simplify and evaluate algebraic expressions. | This OAS does not specifically require writing an algebraic expression. This concept appears two years later in the OAS than in the CCSS. |
| 6.EE.2a Write expressions that record operations with numbers and with letters standing for numbers. *For example, express the calculation "Subtract y from 5" as 5 – y.* | | This CCSS requirement has no match in the OAS. |
| 6.EE.2b Identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity. *For example, describe the expression 2 (8 + 7) as a product of two factors; view (8 + 7) as both a single entity and a sum of two terms.* | | This CCSS requirement has no match in the OAS. |
| | **6.A.1.3** Use and evaluate variables in expressions, equations, and inequalities that arise from various contexts, including determining when or if, for a given value of the variable, an equation or inequality involving a variable is true or false. | The expectation to "evaluate variables in expressions..." needs clarification. Is the intention for students to evaluate expressions for certain values of variables? What does it mean to evaluate variables in equations and inequalities? Is this about some sort of evaluative claim of the variables themselves? Also the use of "when" needs further clarification. Determining when an equation or inequality is true would be solving the equation. How would that be related to evaluating expressions? |
| 6.EE.2c Evaluate expressions at specific values of their variables. Include expressions that arise from formulas | **7.A.4 Use order of operations and properties of operations to generate equivalent numerical and algebraic expressions containing rational numbers and** | This OAS standard needs the objective (7.A.4) as a companion to ensure a closer match to the |

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| used in real-world problems. Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations). *For example, use the formulas V = s^3 and A = 6 s^2 to find the volume and surface area of a cube with sides of length s = 1/2.* | **7.A.4.1** Use properties of operations (limited to associative, commutative, and distributive) to generate equivalent numerical and algebraic expressions containing rational numbers, grouping symbols and whole number exponents.<br>**7.A.4.2** Apply understanding of order of operations and grouping symbols when using calculators and other technologies. | CCSS expectation that students would generate equivalent expressions and evaluate expressions for reasons other than just when using technology. The standard expects the ability to "evaluate such expressions" but there is no specific mention of this in a 7.A.4 objectives. These objectives appear one year later in the OAS than in the CCSS. |
| | **PA.A.3.1** Use substitution to simplify and evaluate algebraic expressions. | This OAS comes two years after the CCSS Gr 6 expectation and though very generic, it provides a good match. This Gr 6 CCSS concept/skill is addressed in the OAS over four years. |
| | **A1.A.3.4** Evaluate linear, absolute value, rational, and radical expressions. Include applying a nonstandard operation such as a ø b = 2a + b. | This OAS Algebra 1 benchmark matches the expectation to evaluate algebraic expressions and has no match in the high school CCSS. The requirement to include rational and radical expressions is not addressed at this Gr level. (This OAS is also matched with a CCSS at Gr 8.) |
| 6.EE.3. Apply the properties of operations to generate equivalent expressions. *For example, apply the distributive property to the expression 3 (2 + x) to produce the equivalent expression 6 + 3x; apply the distributive property to the expression 24x + 18y to produce the equivalent expression 6 (4x + 3y); apply properties of operations to y + y + y to produce the equivalent expression 3y.* | **6.A.2.1** Generate equivalent expressions and evaluate expressions involving positive rational numbers by applying the commutative, associative, and distributive properties and order of operations to solve real-world and mathematical problems. | The CCSS separates generation of equivalent expressions from solving problems. |
| | **7.A.4.1** Use properties of operations (limited to associative, commutative, and distributive) to generate equivalent numerical and algebraic expressions containing rational numbers, grouping symbols and whole number exponents. | This Gr 7 OAS is similar but also includes rational numbers. |
| | **PA.A.3.2** Justify steps in generating equivalent expressions by identifying the properties used, including the properties of operations (associative, commutative, and distributive laws) and the order of operations, including grouping symbols. | This OAS, with the exception of justifying steps, is much like the Gr 6 expectations. |

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| 6.EE.4. Identify when two expressions are equivalent (i.e., when the two expressions name the same number regardless of which value is substituted into them). *For example, the expressions y + y + y and 3y are equivalent because they name the same number regardless of which number y stands for.* | | This CCSS definition of equivalence is not included in the OAS. |
| 6.EE.5. Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true. | **6.A.1.3** Use and evaluate variables in expressions, equations, and inequalities that arise from various contexts, including determining when or if, for a given value of the variable, an equation or inequality involving a variable is true or false. | This OAS appears to match the procedural part of the CCSS expectation: that students can determine whether a given value for a variable makes an equation true. However it is not clear that OAS students will have the same understanding of "solving an equation or inequality" that is required in this CCSS. It is not clear whether it is the intention for students to evaluate expressions for certain values of variables. Is this about making some sort of evaluation about the variables themselves? Additionally, the use of "when" does not make apparent sense. |
| | **5.A.2.2** Determine whether an equation or inequality involving a variable is true or false for a given value of the variable. | There is no CCSS to match this Gr 5 OAS. NOTE: The placement of this OAS seems to be somewhat out of alignment with 4.A.2.1, as students have already had to find (not just check) values that make number sentences true. |
| 6.EE.6. Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. | **6.A.3.1** Represent real-world or mathematical situations using expressions, equations and inequalities involving variables and rational numbers. | This OAS matches the procedural part of this CCSS but misses out on the conceptual foundation of understanding the meaning and purpose of a variable. |

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| 6.EE.7. Solve real-world and mathematical problems by writing and solving equations of the form $x + p = q$ and $px = q$ for cases in which $p$, $q$ and $x$ are all nonnegative rational numbers. | **6.A.3.2** Use number sense and properties of operations and equality to solve real-world and mathematical problems involving equations in the form x + p = q and px = q, where x, p, and q are nonnegative rational numbers. Graph the solution on a number line, interpret the solution in the original context, and assess the reasonableness of the solution. | This OAS includes the requirement that students record the answer on a number line. It also adds interpreting and assessing the result. |
| 6.EE.8. Write an inequality of the form $x > c$ or $x < c$ to represent a constraint or condition in a real-world or mathematical problem. Recognize that inequalities of the form $x > c$ or $x < c$ have infinitely many solutions; represent solutions of such inequalities on number line diagrams. | **6.A.3.1** Represent real-world or mathematical situations using expressions, equations and <u>inequalities</u> involving variables and rational numbers. | |
| 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. 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* | **6.A.1.2** Represent relationships between <u>two varying quantities</u> involving no more than two operations with rules, graphs, and tables; translate between any two of these representations. | This OAS does not include the concept of independent and dependent variables or analysis of the relationship. |
| | **PA.A.1.1** Recognize that a function is a relationship between an <u>independent variable and a dependent variable</u> in which the value of the independent variable determines the value of the dependent variable. | This reference to independent and dependent variables comes in OAS Gr 8, two years later than in the CCSS. |
| 6.G.1. Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems. | **6.GM.1.2** Develop and use formulas to determine the area of triangles. | This OAS specifically calls out connecting the work to the formulas. |
| | **6.GM.1.3** Find the area of right triangles, other triangles, special quadrilaterals, and polygons that can be decomposed into triangles and other shapes to solve real-world and mathematical problems. | |
| | **6.GM.1.1** Develop and use formulas for the area of squares and parallelograms using a variety of methods including but not limited to the standard algorithm. | This OAS specifically calls out connecting the work to the formulas. |
| | **7.GM.2.1** Develop and use the formula to determine the area of a trapezoid to solve problems. | This OAS specifically calls out connecting the work to the formulas. Finding the area of trapezoids is separated from areas of triangles, squares, and parallelograms by a year. |

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| 6.G.2. Find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas *V = l w h* and *V = B h* to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems. | **7.GM.1.2** Using a variety of tools and strategies, develop the concept that the volume of rectangular prisms with rational-valued edge lengths can be found by counting the total number of same-sized unit cubes that fill a shape without gaps or overlaps. Use appropriate measurements such as cm3. | The intention of the CCSS standard is to connect that the formula for volume continues to work even with fractional edge lengths. In this Gr 7 OAS objective, this connection is not made. Further, it is unclear how students might use "unit cubes" in the case of fractional lengths. |
| | **PA.GM.2.3** Develop and use the formulas V=lwh and V=Bh to determine the volume of rectangular prisms. Justify why base area (B) and height (h) are multiplied to find the volume of a rectangular prism. Use appropriate measurements such as cm3. | This Gr 8 OAS falls far below this Gr 6 CCSS standard and seems to be a small extension of OAS 5.GM.2.1. |
| 6.G.3. Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems. | **6.GM.4.3** Use distances between two points that are either vertical or horizontal to each other (not requiring the distance formula) to solve real-world and mathematical problems about congruent two-dimensional figures. | |
| 6.G.4. Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems. | **5.GM.1.3** Recognize and draw a net for a three-dimensional figure (e.g., cubes, rectangular prisms, pyramids). | This OAS comes one year earlier than in the CCSS but does not require using the nets to find surface area or in solving real world problems. This OAS does not have a Gr 5 match in the CCSS. |
| | **5.GM.2.2** Recognize that the surface area of a three-dimensional figure with rectangular faces with whole numbered edges can be found by finding the area of each component of the net of that figure. Know that three-dimensional shapes of different dimensions can have the same surface area. | This OAS comes one year earlier than in the CCSS. This OAS does not have a Gr 5 match in the CCSS. |
| | **PA.GM.2.1** Calculate the surface area of a rectangular prism using decomposition or nets. Use appropriate measurements such as cm^2. | This Gr 8 OAS is the first explicit expectation to actually calculate surface area. |

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| 6.SP.1. Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers. *For example, "How old am I?" is not a statistical question, but "How old are the students in my school?" is a statistical question because one anticipates variability in students' ages.* | | This conceptual CCSS has no match in the OAS. |
| 6.SP.2. Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape. | | This conceptual CCSS has no match in the OAS. |
| 6.SP.3. Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number. | | This conceptual CCSS has no match in the OAS. |
| 6.SP.4. Display numerical data in plots on a number line, including dot plots, histograms, and box plots. | **4.D.1.1** Represent data on a frequency table or <u>line plot</u> marked with whole numbers and fractions using appropriate titles, labels, and units. | The CCSS waits to introduce frequency until Gr 7 and frequency tables in Gr 8. This Gr 4 CCSS addresses the requirement to use line/dot plots. |
| | **6.D.1.3** Create and analyze <u>box and whisker plot</u>s observing how each segment contains one quarter of the data. | This Gr 6 OAS addresses box plots. |
| | **7.D.1.2** Use reasoning with proportions to display and interpret data in circle graphs (pie charts) and <u>histograms</u>. Choose the appropriate data display and know how to create the display using a spreadsheet or other graphing technology. | The CCSS does not specifically address circle graphs. |

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| 6.SP.5 Summarize numerical data sets in relation to their context, such as by:<br>a. Reporting the number of observations.<br>b. Describing the nature of the attribute under investigation, including how it was measured and its units of measurement.<br>c. Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.<br>d. Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered. | **6.D.1.1** Calculate the mean, median, and mode for a set of real-world data. | |
| | **6.D.1.2** Explain and justify which measure of central tendency (mean, median, or mode) would provide the most descriptive information for a given set of data. | This Gr 6 OAS does not go as far as the CCSS counterpart. It does not require variability or relating the measures to the shape of the distribution and the context of the data. |
| | **5.D.1.1** Find the measures of central tendency (mean, median, or mode) and range of a set of data. Understand that the mean is a “leveling out” or central balance point of the data. | The "definition" for mean given here is not mathematically precise. Perhaps it should be rewritten as, "Understand that the mean can be imagined (or thought of) as a leveling out of the data..." |

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| 7.RP.1. Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. *For example, if a person walks 1/2 mile in each 1/4 hour, compute the unit rate as the complex fraction 1/2/1/4 miles per hour, equivalently 2 miles per hour.* | **6.N.3.4** Use multiplicative reasoning and representations to solve ratio and unit rate problems. | The CCSS is specific to ratios of fractions here. The Gr 6 objective does not indicate that other than ratios of whole numbers would be addressed. |
| 7.RP.2. Recognize and represent proportional relationships between quantities. | **7.A.1.1** Describe that the relationship between two variables, x and y, is proportional if it can be expressed in the form y/x= k or y = kx; distinguish proportional relationships from other relationships, including inversely proportional relationships (xy = k or y = k/x). | |
| | **7.A.2.1** Represent proportional relationships with tables, verbal descriptions, symbols, and graphs; translate from one representation to another. Determine and compare the unit rate (constant of proportionality, slope, or rate of change) given any of these representations. | |
| 7.RP.2a Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin. | **7.A.1.1** Describe that the relationship between two variables, x and y, is proportional if it can be expressed in the form y/x= k or y = kx; distinguish proportional relationships from other relationships, including inversely proportional relationships (xy = k or y = k/x). | |
| | **7.A.1.2** Recognize that the graph of a proportional relationship is a line through the origin and the coordinate (1,r), where both r and the slope are the unit rate (constant of proportionality, k). | The OAS does not call out equivalent ratios. |
| 7.RP.2b Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships. | **7.A.2.1** Represent proportional relationships with tables, verbal descriptions, symbols, and graphs; translate from one representation to another. Determine and compare the unit rate (constant of proportionality, slope, or rate of change) given any of these representations. | |

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| 7.RP.2c Represent proportional relationships by equations. *For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as t = pn .* | **7.A.2.1** Represent proportional relationships with tables, verbal descriptions, symbols, and graphs; translate from one representation to another. Determine and compare the unit rate (constant of proportionality, slope, or rate of change) given any of these representations. | |
| 7.RP.2d Explain what a point *(x, y)* on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, *r)* where *r* is the unit rate. | **7.A.1.2** Recognize that the graph of a proportional relationship is a line through the origin and the coordinate (1,r), where both r and the slope are the unit rate (constant of proportionality, k). | The OAS does not expect an explanation. |
| | **7.A.2.4** Use proportional reasoning to assess the reasonableness of solutions. | This OAS has no direct match in the CCSS. |
| 7.RP.3. Use proportional relationships to solve multistep ratio and percent problems. *Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.* | **7.A.2.3** Use proportional reasoning to solve real-world and mathematical problems involving ratios. | |
| | **7.A.2.2** Solve multi-step problems involving proportional relationships involving distance-time, percent increase or decrease, discounts, tips, unit pricing, similar figures, and other real-world and mathematical situations. | |
| 7.NS.1. Apply and extend previous understandings of addition and subtraction to add and subtract rational numbers; represent addition and subtraction on a horizontal or vertical number line diagram. | **7.N.2.2** Illustrate multiplication and division of integers using a variety of representations. | This OAS addresses integers but does not extend to all rational numbers. This focuses on demonstrating understanding. |
| | **7.N.2.3** Solve real-world and mathematical problems involving addition, subtraction, multiplication and division of rational numbers; use efficient and generalizable procedures including but not limited to standard algorithms. | This OAS includes the rational numbers. |
| 7.NS.1a Describe situations in which opposite quantities combine to make 0. *For example, a hydrogen atom has 0 charge because its two constituents are oppositely charged.* | | In OAS Gr 6 (6.N.1.1) students must understand the "concept of opposites" but are not required to relate them to real world situations. |
| 7.NS.1b Understand *p + q* as the number located a distance \|*q*\| from *p* , in the positive or negative direction depending on whether *q* is positive or negative. Show that a number and its opposite have a sum of 0 (are additive inverses). Interpret sums of rational numbers by describing real-world contexts. | **6.N.2.2** Illustrate addition and subtraction of integers using a variety of representations. | The CCSS addresses addition, this OAS includes addition and subtraction. The CCSS is more specific. |

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| 7.NS.1c Understand subtraction of rational numbers as adding the additive inverse, $p - q = p + (-q)$. Show that the distance between two rational numbers on the number line is the absolute value of their difference, and apply this principle in real-world contexts. | **6.N.2.2** Illustrate addition and subtraction of integers using a variety of representations. | The CCSS addresses subtraction, this OAS includes addition and subtraction. The CCSS is more specific. |
| 7.NS.1d Apply properties of operations as strategies to add and subtract rational numbers. | **6.N.2.3** Add and subtract integers; use efficient and generalizable procedures including but not limited to standard algorithms. | The OAS introduces adding and subtracting integers one year before the CCSS. |
| | **7.N.2.3** Solve real-world and mathematical problems involving addition, subtraction, multiplication and division of rational numbers; use efficient and generalizable procedures including but not limited to standard algorithms. | |
| 7.NS.2. Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers. | **7.N.2.3** Solve real-world and mathematical problems involving addition, subtraction, multiplication and division of rational numbers; use efficient and generalizable procedures including but not limited to standard algorithms. | The OAS does not specify working from previous understandings. Too often, understandings of multiplication and division are separated from procedures in this work. |
| 7.NS.2a Understand that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as $(-1)(-1) = 1$ and the rules for multiplying signed numbers. Interpret products of rational numbers by describing real-world contexts. | | This CCSS standard for conceptual understanding has no match in the OAS. |
| 7.NS.2b Understand that integers can be divided, provided that the divisor is not zero, and every quotient of integers (with non-zero divisor) is a rational number. If $p$ and $q$ are integers, then $-(p/q) = (-p)/q = p/(-q)$. Interpret quotients of rational numbers by describing real- world contexts. | | This CCSS standard for conceptual understanding has no match in the OAS. |
| 7.NS.2c Apply properties of operations as strategies to multiply and divide rational numbers. | **7.N.2.2** Illustrate multiplication and division of integers using a variety of representations. | This OAS addresses integers but not application of the properties of operations with all rational numbers. |
| | **7.N.1.1** Know that every rational number can be written as the ratio of two integers or as a terminating or repeating decimal. | The OAS doe not specify actually doing the conversion. Long division is not mentioned. |

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| 7.NS.2d Convert a rational number to a decimal using long division; know that the decimal form of a rational number terminates in 0s or eventually repeats. | **5.N.1.2** Divide multi-digit numbers, by one- and two-digit divisors, using efficient and generalizable procedures, based on knowledge of place value, including standard algorithms. | This Gr 5 OAS could lead to converting between fractions and decimals as expected in 7.N.1.1. However the OAS does not go far enough to explicitly require the conversion addressed in this CCSS. |
| | **5.N.1.3** Recognize that quotients can be represented in a variety of ways, including a whole number with a remainder, a fraction or mixed number, or a decimal and consider the context in which a problem is situated to select and interpret the most useful form of the quotient for the solution. | This Gr 5 OAS could lead to converting between fractions and decimals as expected in 7.N.1.1. However the OAS does not go far enough to explicitly require the conversion addressed in this CCSS. |
| 7.NS.3. Solve real-world and mathematical problems involving the four operations with rational numbers. | **7.A.3.3** Represent real-world or mathematical situations using equations and inequalities involving variables and rational numbers. | This OAS specifies the inclusion of variables. |
| | **7.N.2.3** Solve real-world and mathematical problems involving addition, subtraction, multiplication and division of rational numbers; use efficient and generalizable procedures including but not limited to standard algorithms. | |
| 7.EE.1. Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients. | **7.A.4.1** Use properties of operations (limited to associative, commutative, and distributive) to generate equivalent numerical and algebraic expressions containing rational numbers, grouping symbols and whole number exponents. | The limits on exponents in algebraic expressions are not clear in this OAS. The CCSS restricts the work to linear expressions. |
| 7.EE.2. Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. *For example, a + 0.05a = 1.05a means that "increase by 5%" is the same as "multiply by 1.05."* | | This CCSS standard for conceptual understanding has no match in the OAS. |
| 7.EE.3. Solve multi-step real-life and mathematical | **6.N.1.4** Determine equivalencies among fractions, decimals, and percents. Select among these representations to solve problems. | This OAS speaks to working with the numbers in different forms. |
| | **6.N.4.4** Solve and interpret real-world and mathematical problems including those involving money, measurement, geometry, and data requiring arithmetic with decimals, fractions and mixed numbers. | |

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| problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. *For example: If a woman making $25 an hour gets a 10% raise, she will make an additional 1/10 of her salary an hour, or $2.50, for a new salary of $27.50. If you want to place a towel bar 9 3/4 inches long in the center of a door that is 27 1/2 inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation.* | **6.N.4.1** Estimate solutions to problems with whole numbers, decimals, fractions, and mixed numbers and use the estimates to assess the reasonableness of results in the context of the problem. | This OAS addresses the "assess the reasonableness of answers…" part of this CCSS. |
| | **6.N.2.1** Estimate solutions to addition and subtraction of integers problems in order to assess the reasonableness of results. | This OAS addresses the "assess the reasonableness of answers…" part of this CCSS. |
| | **7.N.1.3** Recognize and generate equivalent representations of rational numbers, including equivalent fractions. | This OAS addresses the "in any form" part of this CCSS. |
| | **7.N.2.1** Estimate solutions to multiplication and division of integers in order to assess the reasonableness of results. | This OAS addresses the "assess the reasonableness of answers…" part of this CCSS. |
| | **7.N.2.5** Solve real-world and mathematical problems involving calculations with rational numbers and positive integer exponents. | This problem solving OAS addresses all rational numbers. Each of the benchmarks in this collection meets one or more aspect of the CCSS. However none require the strategic use of tools. |

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| 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. | **6.A.3.1** Represent real-world or mathematical situations using expressions, equations and inequalities involving variables and rational numbers. | This OAS does not mention solving the equations. |
| | **7.A.3.1** Write and solve problems leading to linear equations with one variable in the form px+q=r and p(x+q)=r where p, q, and r are rational numbers. | |
| | **PA.A.4.3** Represent real-world situations using equations and inequalities involving one variable. | This Gr 8 OAS does not have a match in Gr 8. It does not include reasoning about the quantities. |
| 7.EE.4a Solve word problems leading to equations of the form $px + q = r$ and $p(x + q) = r$, where $p$, $q$, and $r$ are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. *For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?* | **7.A.3.1** Write and solve problems leading to linear equations with one variable in the form px + q = r and p(x + q) = r where p, q, and r are rational numbers. | This OAS misses word problems, fluency, comparing solutions, and identifying operations. |
| 7.EE.4b 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. *For 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.* | **7.A.3.2** Represent, write, solve, and graph problems leading to linear inequalities with one variable in the form x+p>q and x+p<q where p, and q are nonnegative rational numbers. | The OAS limits to nonnegative rational numbers. |
| | **PA.A.4.2** Represent, write, solve, and graph problems leading to linear inequalities with one variable in the form x+p>q and x+p<q where p, and q are rational numbers. | The Gr 8 expectation permits all rational numbers. |
| | **A1.A.2.1** Represent relationships in various contexts with linear inequalities; solve the resulting inequalities, graph on a coordinate plane, and interpret the solutions. | This Algebra 1 OAS is needed in this collection to meet the requirement to interpret the solutions. |
| 7.G.1. Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale. | **7.GM.4.2** Apply proportions, ratios, and scale factors to solve problems involving scale drawings and determine side lengths and areas of similar triangles and rectangles. | This OAS does not require reproducing a drawing at a different scale. |

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| 7.G.2. Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle. | | This CCSS skill has no match in the OAS. |
| 7.G.3. Describe the two-dimensional figures that result from slicing three- dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids. | | This CCSS concept has no clear match in the OAS. |

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| 7.G.4. Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle. | **7.GM.3.1** Demonstrate an understanding of the proportional relationship between the diameter and circumference of a circle and that the unit rate (constant of proportionality) is π and can be approximated by rational numbers such as 22/7 and 3.14. | This OAS has expectations for understanding relationships, but does not address an informal derivation of the relationship between the circumference and area of a circle. |
| | **7.GM.3.2** Calculate the circumference and area of circles to solve problems in various contexts, in terms of π and using approximations for π. | |
| | **G.C.1.1** Apply the properties of circles to solve problems involving circumference and area, approximate values and in terms of π, using algebraic and logical reasoning. | This HS OAS has no other match in the CCSS. Here it provides a reference to the relationship between the circumference and area of a circle but does not specifically require an informal derivation. This concept appears about three years later in the OAS than in the CCSS. |
| 7.G.5. Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure. | **6.GM.2.1** Solve problems using the relationships between the angles (vertical, complementary, and supplementary) formed by intersecting lines. | The algebra connection to this geometry CCSS standard is missing in the Gr 6 OAS. There are no Gr 7 benchmarks to meet this CCSS. |
| | **G.2D.1.2** Apply the properties of angles, including corresponding, exterior, interior, vertical, complementary, and supplementary angles to solve realworld and mathematical problems using algebraic reasoning and proofs. | This high school OAS comes closer to a match for this CCSS but comes three years later. |
| 7.G.6. Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, | **7.GM.1.1** Using a variety of tools and strategies, develop the concept that surface area of a rectangular prism with rational-valued edge lengths can be found by wrapping the figure with same-sized square units without gaps or overlap. Use appropriate measurements such as cm2. | This Gr 7 OAS does not meet the requirement to solve problems but it adds a conceptual base for that skill. It does not address volume. |
| | **7.GM.2.2** Find the area and perimeter of composite figures to solve real-world and mathematical problems. | This OAS does not address volume. (Volume of prisms is addressed in 5.GM.2.1, PA.GM.2.3) |
| | **PA.GM.2.1** Calculate the surface area of a rectangular prism using decomposition or nets. Use appropriate measurements such as cm2. | This OAS is one year behind the CCSS. |

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| quadrilaterals, polygons, cubes, and right prisms. | **PA.GM.2.2** Calculate the surface area of a cylinder, in terms of π and using approximations for π, using decomposition or nets. Use appropriate measurements such as cm2. | The CCSS does not specifically call for finding the surface area of a cylinder. However this expectation is reasonable at this grade level since area of a circle is required in 7.G.4. |
| | **G.2D.1.6** Apply the properties of polygons to solve real-world and mathematical problems involving perimeter and area (e.g., triangles, special quadrilaterals, regular polygons up to 12 sides, composite figures). | This high school OAS matches the "real world" problem aspect of the CCSS, which is not addressed in earlier grades with respect to area and volume. |

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| 7.SP.1. Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences. | **PA.D.2.2** Determine how samples are chosen (random, limited, biased) to draw and support conclusions about generalizing a sample to a population. | This OAS addresses part of the CCSS. |
| 7.SP.2. Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. *For example, estimate the mean word length in a book by randomly sampling words from the book; predict the winner of a school election based on randomly sampled survey data. Gauge how far off the estimate or prediction might be.* | **7.D.1.1** Design simple experiments, collect data and calculate measures of central tendency (mean, median, and mode) and spread (range). Use these quantities to draw conclusions about the data collected and make predictions. | The OAS places no emphasis on variation. |
| 7.SP.3. Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities, measuring the difference between the centers by expressing it as a multiple of a measure of variability. *For example, the mean height of players on the basketball team is 10 cm greater than the mean height of players on the soccer team, about twice the variability (mean absolute deviation) on either team; on a dot plot, the separation between the two distributions of heights is noticeable.* | | This CCSS statistics concept has no clear match in the OAS. |
| 7.SP.4. Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations. *For example, decide whether the words in a chapter of a seventh-grade science book are generally longer than the words in a chapter of a fourth-grade science book.* | | This CCSS statistics concept has no clear match in the OAS. |

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| 7.SP.5. Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around 1/2 indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event. | **6.D.2.1** Represent possible outcomes using a probability continuum from impossible to certain. | The OAS begins work with probability in Gr 6. |

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| 7.SP.6. Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability. *For example, when rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times.* | **6.D.2.3** Demonstrate simple experiments in which the probabilities are known and compare the resulting relative frequencies with the known probabilities, recognizing that there may be differences between the two results. | This Gr 6 OAS is a good match and comes one year earlier than the CCSS. |
| | **PA.D.2.1** Calculate experimental probabilities and represent them as percents, fractions and decimals between 0 and 1 inclusive. Use experimental probabilities to make predictions when actual probabilities are unknown. | This is the closest match for this Gr 8 OAS. |
| 7.SP.7. Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. | **7.D.2.1** Determine the theoretical probability of an event using the ratio between the size of the event and the size of the sample space; represent probabilities as percents, fractions and decimals between 0 and 1. | |
| | **7.D.2.2** Calculate probability as a fraction of sample space or as a fraction of area. Express probabilities as percents, decimals and fractions. | |
| | **7.D.2.3** Use proportional reasoning to draw conclusions about and predict relative frequencies of outcomes based on probabilities. | |
| 7.SP.7a Develop a uniform probability model by assigning equal probability to all outcomes, and use the model to determine probabilities of events. *For example, if a student is selected at random from a class, find the probability that Jane will be selected and the probability that a girl will be selected.* | **7.D.2.1** Determine the theoretical probability of an event using the ratio between the size of the event and the size of the sample space; represent probabilities as percents, fractions and decimals between 0 and 1. | |
| 7.SP.7b Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process. *For example, find the approximate probability that a spinning penny will land heads up or that a tossed paper cup will land open-end down. Do the outcomes for the spinning penny appear to be equally likely based on the observed frequencies?* | | This CCSS concept has no clear match in the OAS. Using frequency tables is addressed in OAS Gr 3 and 4 but without this level of understanding. |
| 7.SP.8. Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation. | **A1.D.2.1** Select and apply counting procedures, such as the multiplication and addition principles and tree diagrams, to determine the size of a sample space (the number of possible outcomes) and to calculate probabilities. | This Algebra 1 OAS matches many of the requirements of the CCSS at this level but it comes two years later. |

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| 7.SP.8a Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs. | **A1.D.2.1** Select and apply counting procedures, such as the multiplication and addition principles and tree diagrams, to determine the size of a sample space (the number of possible outcomes) and to calculate probabilities. | |
| 7.SP.8b Represent sample spaces for compound events using methods such as organized lists, tables and tree diagrams. For an event described in everyday language (e.g., "rolling double sixes"), identify the outcomes in the sample space which compose the event. | **6.D.2.2** Determine the sample space for a given experiment and determine which members of the sample space are related to certain events. Sample space may be determined by the use of tree diagrams, tables or pictorial representations. | The work with sample spaces in the OAS begins in Gr 6. They are not connected to compound probability at this level. |
| 7.SP.8c Design and use a simulation to generate frequencies for compound events. *For example, use random digits as a simulation tool to approximate the answer to the question: If 40% of donors have type A blood, what is the probability that it will take at least 4 donors to find one with type A blood?* | **A1.D.2.3** Calculate experimental probabilities by <u>performing simulations</u> or experiments involving a probability model <u>and using relative frequencies of outcomes</u>. | This Algebra 1 OAS matches the requirements of the CCSS at this level but it comes two years later. |

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| **GRADE 8** | | |
| 8.NS.1. Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number. | **7.N.1.1** Know that every rational number can be written as the ratio of two integers or as a terminating or repeating decimal. | This Gr 7 OAS indicates knowing about repeating decimals but does not expect students to show anything. |
| | **PA.N.1.4** Classify real numbers as rational or irrational. Explain why the rational number system is closed under addition and multiplication and why the irrational system is not. Explain why the sum of a rational number and an irrational number is irrational; and the product of a non-zero rational number and an irrational number is irrational. | This OAS distinguishes rational and irrational but does not work with decimals. The last part of this OAS is not required here but is addresses in the CCSS N.RN.3. |
| 8.NS.2. Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., √2). *For example, by truncating the decimal expansion of √2, show that √2 is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.* | **PA.N.1.5** Compare real numbers; locate real numbers on a number line. Identify the square root of a perfect square to 400 or, if it is not a perfect square root, locate it as an irrational number between two consecutive positive integers. | |
| 8.EE.1. Know and apply the properties of integer exponents to generate equivalent numerical expressions. *For example, 3^2 × 3^(–5) = 3^(–3) = 1/3^3 = 1/27.* | **PA.N.1.1** Develop and apply the properties of integer exponents, including a^0= 1 (with a ≠ 0), to generate equivalent numerical and algebraic expressions. | |
| 8.EE.2. Use square root and cube root symbols to represent solutions to equations of the form *x*^ 2 = *p* and *x*^ 3 = *p* , where *p* is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that √2 is irrational. | **A1.A.3.4** Evaluate linear, absolute value, rational, and radical expressions. Include applying a nonstandard operation such as a ø b = 2a + b. | This OAS Algebra 1 benchmark matches the expectation to evaluate radical expression and has no match in the high school CCSS. It does not address solving the equations that lead to square and cube roots. |
| 8.EE.3. Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. *For example, estimate the population of the United States as 3 × 10^8 and the population of the world as 7 × 10^9, and determine that the world population is more than 20 times larger.* | **PA.N.1.2** Express and compare approximations of very large and very small numbers using scientific notation. | Being able to express how many times larger or smaller a number in scientific notation is than another, is not specifically addressed in the OAS. |

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| 8.EE.4. Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology. | **PA.N.1.3** Multiply and divide numbers expressed in scientific notation, express the answer in scientific notation. | This Gr 8 CCSS is not limited to just multiplication and division. |
| 8.EE.5. Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. *For example, compare a distance-time graph to a distance-time equation to determine which of* | **7.A.2.1** Represent proportional relationships with tables, verbal descriptions, symbols, and graphs; translate from one representation to another. Determine and compare the unit rate (constant of proportionality, slope, or rate of change) given any of these representations. | This Gr 7 OAS addresses graphing proportional relationships and determining the unit rate. The OAS does includes translating forms but does not require comparison of two different proportional relationships, represented |
| 8.EE.6. Use similar triangles to explain why the slope $m$ is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at $b$ . | | This CCSS concept has no clear match in the OAS. |
| 8.EE.7. Solve linear equations in one variable. | **7.A.3.1** Write and solve problems leading to linear equations with one variable in the form px + q = r and p(x + q) = r where p, q, and r are rational numbers. | This Gr 7 OAS also aligns with the CCSS in Gr 7. The OAS, like the CCSS, addresses this for specific types of problems in Gr 7. This Gr 8 CCSS goes beyond the scope of this OAS by not prescribing the forms that the linear equations should take. |
| 8.EE.7a Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form x = a, a = a, or a = b results (where a and b are different numbers). | **PA.A.4.1** Illustrate, write, and solve mathematical and real-world problems using linear equations with one variable with one solution, infinitely many solutions, or no solutions. Interpret solutions in the original context. | |
| 8.EE.7b Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms. | **7.A.3.1** Write and solve problems leading to linear equations with one variable in the form px + q = r and p(x + q) = r where p, q, and r are rational numbers. | The CCSS expectation is higher here, as the OAS 7.A.3.1 matched part of CCSS 7.EE.4a |

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| 8.EE.8. Analyze and solve pairs of simultaneous linear equations. | **A1.A.1.3** Analyze and solve real-world and mathematical problems involving systems of linear equations with a maximum of two variables by graphing (may include graphing calculator or other appropriate technology), substitution, and elimination. Interpret the solutions in the original context. | This concept appears one year later in OAS than in the CCSS. |
| 8.EE.8a 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. | | This conceptual foundation for understanding systems of equations is missing in the OAS. |
| 8.EE.8b 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.* | **A1.A.1.3** Analyze and solve real-world and mathematical problems involving systems of linear equations with a maximum of two variables by graphing (may include graphing calculator or other appropriate technology), substitution, and elimination. Interpret the solutions in the original context. | This concept appears one year later in OAS than in the CCSS. |
| 8.EE.8c 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.* | **A1.A.1.3** Analyze and solve real-world and mathematical problems involving systems of linear equations with a maximum of two variables by graphing (may include graphing calculator or other appropriate technology), substitution, and elimination. Interpret the solutions in the original context. | This concept appears one year later in OAS than in the CCSS. |
| 8.F.1. Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output. | **PA.A.1.1** Recognize that a function is a relationship between an independent variable and a dependent variable in which the value of the independent variable determines the value of the dependent variable. | |
| 8.F.2. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.* | | This CCSS concept has no clear match in the OAS. |

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| 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. *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.* | **PA.A.1.3** Identify a function as linear if it can be expressed in the form y = *mx* + *b* or if its graph is a straight line. | This OAS does not include functions that are non-linear. |
| | **A1.F.2.1** Distinguish between linear and nonlinear (including exponential) functions arising from real-world and mathematical situations that are represented in tables, graphs, and equations. Understand that linear functions grow by equal intervals and that exponential functions grow by equal factors over equal intervals. | This Algebra 1 OAS comes one year later but does not expect students to provide examples of nonlinear functions. |
| | **PA.A.2.4** Predict the effect on the graph of a linear function when the slope or y-intercept changes. Use appropriate tools to examine these effects. | This OAS has no counterpart in the CCSS. |
| 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. | **PA.A.1.2** Use linear functions to represent and explain real-world and mathematical situations. | |
| | **PA.A.2.1** Represent linear functions with tables, verbal descriptions, symbols, and graphs; translate from one representation to another. | The CCSS does not require translating from one form to another. Are the translations grounded in revealing something about the relationship between the quantities? |
| | **PA.A.2.3** Identify graphical properties of linear functions including slope and intercepts. Know that the slope equals the rate of change, and that the y-intercept is zero when the function represents a proportional | The OAS part about the proportional relationship is part of CCSS 7.RP.2. |
| | **PA.A.2.5** Solve problems involving linear functions and interpret results in the original context. | This CCSS does not explicitly require solving problems in a context. |

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| | **A1.A.4.3** Express linear equations in slope-intercept, point-slope, and standard forms and convert between these forms. Given sufficient information (slope and y-intercept, slope and one-point on the line, two points on the line, x- and y-intercept, or a set of data points), write the equation of a line. | The CCSS does not require conversion between the forms. This expectation was also found in PA.A.2.1. |
| | **A1.A.4.1** Calculate and interpret slope and the x- and y-intercepts of a line using a graph, an equation, two points, or a set of data points to solve realworld and mathematical problems. | This Algebra 1 OAS requires interpretation of the slope (unit rate) but comes one year later than in the CCSS and does not fully make the connection to interpretation in terms of the graph or table of values. |
| 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. | **PA.A.2.2** Identify, describe, and analyze linear relationships between two variables. | This OAS may be a match, but there is no indication as to what aspects of the relationships are to be identified and described. |
| | **A1.F.2.1** Distinguish between linear and nonlinear (including exponential) functions arising from real-world and mathematical situations that are represented in tables, graphs, and equations. Understand that linear functions grow by equal intervals and that exponential functions grow by equal factors over equal intervals | |
| 8.G.1 Verify experimentally the properties of rotations, reflections, and translations:<br>a. Lines are taken to lines, and line segments to line segments of the same length.<br>b. Angles are taken to angles of the same measure.<br>c. Parallel lines are taken to parallel lines. | **6.GM.4.1** Predict, describe, and apply translations (slides), reflections (flips), and rotations (turns) to a two-dimensional figure. | This Gr 6 OAS comes two years earlier than in the CCSS. It does not share the experimental verifications. |
| | **G.2D.1.9** Use numeric, graphic and algebraic representations of transformations in two dimensions, such as reflections, translations, dilations, and rotations about the origin by multiples of 90˚, to solve problems involving figures on a coordinate plane and identify types of symmetry. | |

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| 8.G.2. Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them. | **6.GM.4.2** Recognize that translations, reflections, and rotations preserve congruency and use them to show that two figures are congruent. | This Gr 6 OAS comes two years earlier than in the CCSS. |
| 8.G.3. Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates. | **7.GM.4.1** Describe the properties of similarity, compare geometric figures for similarity, and determine scale factors resulting from dilations. | |
| | **7.GM.4.3** Graph and describe translations and reflections of figures on a coordinate plane and determine the coordinates of the vertices of the figure after the transformation. | This Gr 7 OAS does not address rotations. |
| 8.G.4. Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them. | **7.GM.4.1** Describe the properties of similarity, compare geometric figures for similarity, and determine scale factors resulting from dilations. | The OAS does not require describing a sequence. |
| 8.G.5. Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. *For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.* | **6.GM.2.2** Develop and use the fact that the sum of the interior angles of a triangle is 180̊ to determine missing angle measures in a triangle. | This OAS Gr 6 benchmark come two years earlier than this CCSS and does not address the exterior angles of a triangle. |
| | **G.2D.1.1** Apply the properties of parallel and perpendicular lines, including properties of angles formed by a transversal, to solve real-world and mathematical problems and determine if two lines are parallel, using algebraic reasoning and proofs. | These high school OAS come two years later than in the CCSS. |
| | **G.2D.1.2** Apply the properties of angles, including corresponding, exterior, interior, vertical, complementary, and supplementary angles to solve realworld and mathematical problems using algebraic reasoning and proofs. | |
| 8.G.6. Explain a proof of the Pythagorean Theorem and its converse. | **PA.GM.1.1** Informally justify the Pythagorean Theorem using measurements, diagrams, or dynamic software and use the Pythagorean Theorem to solve problems in two and three dimensions involving right triangles. | |

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| 8.G.7. Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. | **PA.GM.1.1** Informally justify the Pythagorean Theorem using measurements, diagrams, or dynamic software and use the Pythagorean Theorem to solve problems in two and three dimensions involving right triangles. | |
| 8.G.8. Apply the Pythagorean Theorem to find the distance between two points in a coordinate system. | **PA.GM.1.2** Use the Pythagorean Theorem to find the distance between any two points in a coordinate plane. | |
| 8.G.9. Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems. | **PA.GM.2.4** Develop and use the formulas $V=\pi r^2h$ and V = Bh to determine the volume of right cylinders, in terms of π and using approximations for π. Justify why base area (B) and height (h) are multiplied to find the volume of a right cylinder. Use appropriate measurements such as cm^3.<br>**G.3D.1.1** Solve real-world and mathematical problems using the surface area and volume of prisms, cylinders, pyramids, cones, spheres, and composites of these figures. Use nets, measuring devices, or formulas as appropriate. | Volumes of cones and spheres are not addressed in OAS until high school. |
| | **PA.D.1.1** Describe the impact that inserting or deleting a data point has on the mean and the median of a data set. Know how to create data displays using a spreadsheet and use a calculator to examine this impact. | This OAS has no clear match in the CCSS. |
| | **PA.D.1.2** Explain how outliers affect measures of central tendency. | While CCSS 8.SP.1 mentions outliers, it is in the context of bivariate, not univariate, data. Outliers are addressed in CCSS S-ID, but that is in conjunction with spread (standard deviation, interquartile range). |
| 8.SP.1. Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association. | **PA.D.1.3** Collect, display and interpret data using scatterplots. Use the shape of the scatterplot to informally estimate a line of best fit, make statements about average rate of change, and make predictions about values not in the original data set. Use appropriate titles, labels and units. | This CCSS does not require collection of data. |
| 8.SP.2. Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line. | **PA.D.1.3** Collect, display and interpret data using scatterplots. Use the shape of the scatterplot to informally estimate a line of best fit, make statements about average rate of change, and make predictions about values not in the original data set. Use appropriate titles, labels and units. | This CCSS does not require collection of data. |

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| 8.SP.3. Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. *For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height.* | **PA.D.1.3** Collect, display and interpret data using scatterplots. Use the shape of the scatterplot to informally estimate a line of best fit, make statements about average rate of change, and make predictions about values not in the original data set. Use appropriate titles, labels and units. | This OAS is not clear in the expectation that the equations are used to make the predictions. |
| 8.SP.4. Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. *For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?* | | Using frequency tables is addressed in OAS Gr 3 and 4 but without this level of understanding. |

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| **NUMBER AND QUANTITY** | | |
| N.RN.1. Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define 51/3 to be the cube root of 5 because we want (51/3)3 = 5(1/3)3 to hold, so (51/3)3 must equal 5.* | | The OAS introduce rational exponents with rewriting expressions (A2.A.2.4) and operations (A2.N.1.4) and do not provide conceptual support for the meaning and use of rational exponents. |
| N.RN.2. Rewrite expressions involving radicals and rational exponents using the properties of exponents. | **A1.N.1.1** Write square roots and cube roots of monomial algebraic expressions in simplest radical form. | This OAS is more specific than the CCSS standard. The CCSS does not require "simplest radical form." |
| | **A1.N.1.2** Add, subtract, multiply, and simplify square roots of monomial algebraic expressions and divide square roots of whole numbers, rationalizing the denominator when necessary. | The CCSS does not emphasize rationalization of the denominator.<br>This OAS expectation is to rationalize the denominator "when necessary."  When is it necessary? |
| | **A2.A.2.4** Rewrite expressions involving radicals and rational exponents using the properties of exponents. | This single OAS is a perfect match to the CCSS. |
| N.RN.3. Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational. | **PA.N.1.4** Classify real numbers as rational or irrational. Explain why the rational number system is closed under addition and multiplication and why the irrational system is not. <u>Explain why the sum of a rational number and an irrational number is irrational; and the product of a non-zero rational number and an irrational number is irrational.</u> | |

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| 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. | | This CCSS requirement has no OAS match. |
| N.Q.2. Define appropriate quantities for the purpose of descriptive modeling. | | This CCSS requirement has no OAS match. |
| N.Q.3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. | | This CCSS requirement has no OAS match. |
| N.CN.1. Know there is a complex number *i* such that *i*^ 2 = –1, and every complex number has the form *a* + *bi* with *a* and *b* real. | **A2.N.1.1** Find the value of i^n for any whole number n. | This OAS objective goes beyond (but subsumes) this CCSS in that it asks for all powers of i, rather than just i^2. This is left to teacher discretion in the CCSS in standard N.CN.2. |
| N.CN.2. Use the relation *i*^ 2 = –1 and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. | **A2.N.1.2** Simplify, add, subtract, multiply, and divide complex numbers. | Division of complex numbers is not addressed in this CCSS but is addressed in N.CN.3, a (+) standard. |
| N.CN.3. (+) Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers. | **A2.N.1.2** Simplify, add, subtract, multiply, and divide complex numbers. | This (+)-designated CCSS aligns with the "divide" part of this OAS. However it is not explicitly stated that conjugates are needed to perform division of complex numbers. The OAS does not address moduli. |

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| N.CN.4. (+) Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number. | | This (+)-designated CCSS has no match in the OAS. |
| N.CN.5. (+) Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation. *For example,* (–1 + √3 i)^3 = 8 *because* (–1 + √3 *i* ) *has modulus* 2 *and argument* 120°. | | This (+)-designated CCSS has no match in the OAS. |
| N.CN.6. (+) Calculate the distance between numbers in the complex plane as the modulus of the difference, and the midpoint of a segment as the average of the numbers at its endpoints. | | This (+)-designated CCSS has no match in the OAS. |
| N.CN.7 Solve quadratic equations with real coefficients that have complex solutions. | A2.A.1.1 Represent real-world or mathematical problems using quadratic equations and solve using various methods (including graphing calculator or other appropriate technology), factoring, completing the square, and the quadratic formula. Find non-real roots when they exist. | This OAS also addresses real world problems. |
| N.CN.8 (+) Extend polynomial identities to the complex numbers. *For example, rewrite x*^ 2 + 4 *as* (*x* + 2*i* )(*x* – 2*i* ). | | This (+)-designated CCSS has no match in the OAS. |

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| N.CN.9 (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials. | | This (+)-designated CCSS has no match in the OAS. |
| N.VM.1. (+) Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., $\boldsymbol{v}$, $\lvert\boldsymbol{v}\rvert$, $\lVert\boldsymbol{v}\rVert$, $v$). | | This (+)-designated CCSS has no match in the OAS. |
| N.VM.2. (+) Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point. | | This (+)-designated CCSS has no match in the OAS. |
| N.VM.3. (+) Solve problems involving velocity and other quantities that can be represented by vectors. | | This (+)-designated CCSS has no match in the OAS. |
| N.VM.4. (+) Add and subtract vectors. | | This (+)-designated CCSS has no match in the OAS. |
| N.VM.4a (+) Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes. | | This (+)-designated CCSS has no match in the OAS. |
| N.VM.4b (+) Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum. | | This (+)-designated CCSS has no match in the OAS. |

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| N.VM.4c (+) Understand vector subtraction ***v*** – ***w*** as ***v*** + (–***w*** ), where –***w*** is the additive inverse of ***w*** , with the same magnitude as ***w*** and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise. | | This (+)-designated CCSS has no match in the OAS. |
| N.VM.5. (+) Multiply a vector by a scalar. | | This (+)-designated CCSS has no match in the OAS. |
| N.VM.5a (+) Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as *c* (*v* x, *v* y) = (*cv* x, *cv* y). | | This (+)-designated CCSS has no match in the OAS. |
| N.VM.5b (+) Compute the magnitude of a scalar multiple *c**v*** using \|\|*c**v***\|\| = \|*c*\|*v*. Compute the direction of *c**v*** knowing that when \|*c*\|*v* ≠ 0, the direction of *c**v*** is either along ***v*** (for *c* > 0) or against ***v*** (for *c* < 0). | | This (+)-designated CCSS has no match in the OAS. |
| N.VM.6. (+) Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network. | **A2.N.1.3** Use matrices to organize and represent data. Identify the order (dimension) of a matrix, add and subtract matrices of appropriate dimensions, and multiply a matrix by a scalar to create a new matrix to solve problems. | This (+)-designated CCSS is matched in the OAS A2 standard. |

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| N.VM.7. (+) Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled. | **A2.N.1.3** Use matrices to organize and represent data. Identify the order (dimension) of a matrix, add and subtract matrices of appropriate dimensions, and multiply a matrix by a scalar to create a new matrix to solve problems. | This (+)-designated CCSS is matched in the OAS A2 standard. |
| N.VM.8. (+) Add, subtract, and multiply matrices of appropriate dimensions. | **A2.N.1.3** Use matrices to organize and represent data. Identify the order (dimension) of a matrix, add and subtract matrices of appropriate dimensions, and multiply a matrix by a scalar to create a new matrix to solve problems. | This (+)-designated CCSS is partially matched in the OAS A2 standard. This OAS stops short of requiring multiplication of a matrix by a matrix. |
| N.VM.9. (+) Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties. | | This (+)-designated CCSS has no match in the OAS. |
| N.VM.10. (+) Understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse. | | This (+)-designated CCSS has no match in the OAS. |
| N.VM.11. (+) Multiply a vector (regarded as a matrix with one column) by a matrix of suitable dimensions to produce another vector. Work with matrices as transformations of vectors. | | This (+)-designated CCSS has no match in the OAS. |

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| N.VM.12. (+) Work with 2 X 2 matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of area. | | This (+)-designated CCSS has no match in the OAS. |

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| ALGEBRA | | |
| A.SSE.1. Interpret expressions that represent a quantity in terms of its context. | | There is no OAS match for this CCSS related to expressions and their structure. |
| A.SSE.1a Interpret parts of an expression, such as terms, factors, and coefficients. | | There is no OAS match for this CCSS related to expressions and their structure. |
| 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 a factor not depending on P.* | | There is no OAS match for this CCSS related to expressions and their structure. |
| A.SSE.2. Use the structure of an expression to identify ways to rewrite it. *For example, see x*^ 4 – *y*^ 4 *as* (*x*^ 2)^2 – (*y*^ 2)^2, *thus recognizing it as a difference of squares that can be factored as* (*x*^ 2 – *y*^ 2)(*x*^ 2 + *y*^ 2). | **A2.A.2.1** Factor polynomial expressions including but not limited to trinomials, differences of squares, sum and difference of cubes, and factoring by grouping using a variety of tools and strategies. | This OAS addresses one way to rewrite a polynomial expression but does not point to using the structure to do so. |
| A.SSE.3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. | **A2.A.2.3** Recognize that a quadratic function has different equivalent representations [f (x) = ax^2 + bx + c, f(x) = a(-x – h)^2 + k ), and f(x)=(x-h)(x-k)]. Identify and use the representation that is most appropriate to solve real-world and mathematical problems. | This CCSS goes beyond the OAS in that it expects students to be able to produce an equivalent form of an expression. The OAS expects recognition and identification. |
| A.SSE.3a Factor a quadratic expression to reveal the zeros of the function it defines. | **A1.A.3.3** Factor common monomial factors from polynomial expressions and factor quadratic expressions with a leading coefficient of 1. | This CCSS goes beyond this OAS by factoring polynomials for a purpose. The relationship between the expression and the function it defines is also missing in OAS. |

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| A.SSE.3b Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines. | **A2.A.1.1** Represent real-world or mathematical problems using quadratic equations and solve using various methods (including graphing calculator ornother appropriate technology), factoring, completing the square, and the quadratic formula. Find non-real roots when they exist. | This OAS does not explicitly include the maximum or minimum value. |
| A.SSE.3c Use the properties of exponents to transform expressions for exponential functions. *For example the expression* 1.15^t *can be rewritten as* (1.15^(1/12))^(12*t )* ≈ 1.012^(12t) *to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.* | **A2.N.1.4** Understand and apply the relationship of rational exponents to integer exponents and radicals to solve problems. | |
| A.SSE.4 Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. *For example, calculate mortgage payments.** | **A2.A.1.7** Solve real-world and mathematical problems that can be modeled using arithmetic or finite geometric sequences or series given the nth terms and sum formulas. Graphing calculators or other appropriate technology may be used. | The OAS does not require deriving the formula. |
| A.APR.1. Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials. | **A1.A.3.2** Simplify polynomial expressions by adding, subtracting, or multiplying.<br>**A2.A.2.2** Add, subtract, multiply, divide, and simplify polynomial and rational expressions. | These OAS benchmarks for Algebra 1 and 2 address the procedures of operating with polynomials but do not speak to understanding the system of polynomials or, specifically, to the concept of closure |
| A.APR.2. Know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number $a$, the remainder on division by $x - a$ is $p(a)$, so $p(a) = 0$ if and only if $(x - a)$ is a factor of $p(x)$. | | This OAS has no match in the CCSS. |

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| A.APR.3. Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial. | **A2.A.1.4** Solve polynomial equations with real roots using various methods and tools that may include factoring, polynomial division, synthetic division, graphing calculators or other appropriate technology. | This OAS includes synthetic division and could go beyond polynomials with suitable factorizations. Using the zeros to construct the graph is not in the OAS. |
| A.APR.4. Prove polynomial identities and use them to describe numerical relationships. *For example, the polynomial identity* $(x^2 + y^2)^2 = (x^2 – y^2)^2 + (2xy)^2$ *can be used to generate Pythagorean triples.* | | This OAS has no match in the CCSS. |
| A.APR.5. (+) Know and apply the Binomial Theorem for the expansion of $(x + y)^n$ in powers of $x$ and $y$ for a positive integer $n$, where $x$ and $y$ are any numbers, with coefficients determined for example by Pascal's Triangle. | | This (+)-designated CCSS has no match in the OAS. |
| A.APR.6. Rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division, or, for the more complicated examples, a computer algebra system. | **A2.A.2.2** Add, subtract, multiply, <u>divide,</u> and simplify <u>polynomial and rational expressions</u>. | The OAS does not provide the same level of detail as the CCSS for how division of polynomials is to be interpreted and performed. |

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| A.APR.7. (+) Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions. | | This (+)-designated CCSS has no match in the OAS. |

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| A.CED.1. Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions .* | **A1.A.1.1** Use knowledge of solving equations with rational values to represent and solve mathematical and real-world problems (e.g., angle measures, geometric formulas, science, or statistics) and interpret the solutions in the original context. | This generally stated OAS objective is addressed in the Standards for Mathematical Practice. Since this OAS is related to linear equations (including absolute value) and systems of linear equations, it is assumed that this will be the mathematical context. |
| | **A2.A.1.2** Represent real-world or mathematical problems using exponential equations, such as compound interest, depreciation, and population growth, and solve these equations graphically (including graphing calculator or other appropriate technology) or algebraically. | |
| | **A1.A.2.2** Represent relationships in various contexts with compound and absolute value inequalities and solve the resulting inequalities by graphing and interpreting the solutions on a number line. | There is less emphasis on absolute value equations in the CCSS than in the OAS. This OAS requires absolute value inequalities. |
| A.CED.2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes | **A2.A.1.1** Represent real-world or mathematical problems using quadratic equations and solve using various methods (including graphing calculator or other appropriate technology), factoring, completing the square, and the quadratic formula. Find non-real roots when they exist. | This OAS is limited to quadratic equations. It does not require two or more variables. |

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| quantities; graph equations on coordinate axes with labels and scales. | **A2.A.1.2** Represent real-world or mathematical problems using exponential equations, such as compound interest, depreciation, and population growth, and solve these equations graphically (including graphing calculator or other appropriate technology) or algebraically. | This OAS is limited to exponential equations. It does not require two or more variables. |
| 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.* | | The OAS makes no mention of representing constraints by equations. |
| 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.* | **A1.A.3.1** Solve equations involving several variables for one variable in terms of the others. | |
| | **A1.A.1.2** Solve absolute value equations and interpret the solutions in the original context. | There is less emphasis on absolute value equations in the CCSS than in the OAS. |
| 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. | | This CCSS requirement has no OAS match. |
| A.REI.2. Solve simple rational and radical equations in one variable, and give examples | **A2.A.1.3** Solve one-variable rational equations and check for extraneous solutions. | |

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| equations in one variable, and give examples showing how extraneous solutions may arise. | **A2.A.1.5** Solve square root equations with one variable and check for extraneous solutions. | The CCSS does not restrict "radical equations" to just those involving square roots. |

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| A.REI.3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. | **A1.A.2.1** Represent relationships in various contexts with linear inequalities; solve the resulting inequalities, graph on a coordinate plane, and interpret the solutions. | |
| | **A1.A.1.1** Use knowledge of solving equations with rational values to represent and solve mathematical and real-world problems (e.g., angle measures, geometric formulas, science, or statistics) and interpret the solutions in the original context. | Based on A1.A.1 (the standard), this includes linear equations. |
| A.REI.4. Solve quadratic equations in one variable. | **A2.A.1.1** Represent real-world or mathematical problems using quadratic equations and solve using various methods (including graphing calculator or other appropriate technology), factoring, completing the square, and the quadratic formula. Find non-real roots when they exist. | |
| A.REI.4a Use the method of completing the square to transform any quadratic equation in $x$ into an equation of the form $(x - p)$^2 = q that has the same solutions. Derive the quadratic formula from this form. | | This CCSS requirement has no OAS match. There is no OAS expectation to transform quadratic forms or derive the quadratic formula. |

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| A.REI.4b Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers $a$ and $b$. | **A2.A.1.1** Represent real-world or mathematical problems using quadratic equations and solve using various methods (including graphing calculator or other appropriate technology), factoring, completing the square, and the quadratic formula. Find non-real roots when they exist. | |
| A.REI.5. Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions. | | This CCSS proof is not required in the OAS. |
| A.REI.6. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. | **A1.A.1.3** Analyze and solve real-world and mathematical problems involving systems of linear equations with a maximum of two variables by graphing (may include graphing calculator or other appropriate technology), substitution, and elimination. Interpret the solutions in the original context. | |
| | **A2.A.1.8** Represent real-world or mathematical problems using systems of linear equations with a maximum of three variables and solve using various methods that may include substitution, elimination, and graphing (may include graphing calculators or other appropriate technology). | This OAS clarifies an expectation of solving systems with three variables. |

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| A.REI.7. Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. *For example, find the points of intersection between the line* $y = -3x$ and the circle $x^2 + y^2 = 3$. | **A2.A.1.9** Solve systems of equations containing one linear equation and one quadratic equation using tools that may include graphing calculators or other appropriate technology. | |
| A.REI.8. (+) Represent a system of linear equations as a single matrix equation in a vector variable. | | This (+)-designated CCSS has no match in the OAS. |
| A.REI.9. (+) Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension 3 X 3 or greater). | | This (+)-designated CCSS has no match in the OAS. |
| A.REI.10. 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). | | This conceptual understanding CCSS has no match in the OAS. |
| A.REI.11. Explain why the $x$-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions. | | This conceptual understanding CCSS has no match in the OAS. |

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| A.REI.12. 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. | **A1.A.2.1** Represent relationships in various contexts with linear inequalities; solve the resulting inequalities, graph on a coordinate plane, and interpret the solutions. | |
| | **A1.A.2.3** Solve systems of linear inequalities with a maximum of two variables; graph and interpret the solutions on a coordinate plane. | |
| **FUNCTIONS** | | |
| 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 $y = f(x)$. | **A1.F.1.1** Distinguish between relations and functions. | |
| | **A1.F.1.2** Identify the dependent and independent variables as well as the domain and range given a function, equation, or graph. Identify restrictions on the domain and range in real-world contexts. | This OAS also expects identification of restrictions on the domain and range. |
| 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. | **A1.F.3.2** Use function notation; evaluate a function, including nonlinear, at a given point in its domain algebraically and graphically. Interpret the results in terms of real-world and mathematical problems. | |
| | **A2.F.1.1** Use algebraic, interval, and set notations to specify the domain and range of functions of various types and evaluate a function at a given point in its domain. | This OAS addressing notation specific to sets and intervals is not included in the CCSS. |

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| F.IF.3. Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. *For example, the Fibonacci sequence is defined recursively by f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1) for n ≠ 1.* | **A1.A.3.5** Recognize that arithmetic sequences are linear using equations, tables, graphs, and verbal descriptions. Use the pattern, find the next term. | There is no mention of recursion in the OAS.<br><br>It would be clearer and more mathematically precise to say that arithmetic sequences are are represented by linear functions... |
| | **A1.A.3.6** Recognize that geometric sequences are exponential using equations, tables, graphs and verbal descriptions. Given the formula f(x)=a(r)^x,find the next term and define the meaning of *a* and *r* within the context of the problem. | There is no mention of recursion in the OAS.<br><br>It would be clearer and more mathematically precise to say that geometric sequences are represented by exponential functions...<br><br>NOTE: Given that this and A1.F.2.1 are the only mentions of exponential relationships in Algebra 1, it is very unclear what the overall Algebra 1 expectations are for this mathematical topic. |
| F.IF.4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal 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. | **A1.A.4.4** Translate between a graph and a situation described qualitatively. | The OAS does not have a general objective that expects interpretation of key features of the graphs of various functions. |

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| 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.** | **A1.F.1.2** Identify the dependent and independent variables as well as the domain and range given a function, equation, or graph. Identify restrictions on the domain and range in real-world contexts. | |
| F.IF.6. 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. | | Average rate of change is not addressed in the HS OAS. |
| 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. | | The OAS does not have a generally stated objective that expects graphing functions and identifying the key features of the graph. Specific cases are mentioned below. |
| F.IF.7a Graph linear and quadratic functions and show intercepts, maxima, and minima. | **A1.F.3.1** Identify and generate equivalent representations of linear equations, graphs, tables, and real-world situations. | |
| | **A2.F.1.3** Graph a quadratic function. Identify the x- and y-intercepts, maximum or minimum value, axis of symmetry, and vertex using various methods and tools that may include a graphing calculator or appropriate technology. | |
| | **A1.F.1.4** Given a graph modeling a real-world situation, read and interpret the linear piecewise function (excluding step functions). | Step Functions are not excluded in the CCSS. This OAS does not require actually graphing these functions at this level. Graphing absolute value functions may be in *standard* (not benchmark) A1.A.1 but it is unclear. |

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| F.IF.7b Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. | **A2.F.1.7** Graph a radical function (square root and cube root only) and identify the x- and y-intercepts using various methods and tools that may include a graphing calculator or other appropriate technology. | |
| | **A2.F.1.8** Graph piecewise functions with no more than three branches (including linear, quadratic, or exponential branches) and analyze the function by identifying the domain, range, intercepts, and intervals for which it is increasing, decreasing, and constant. | |
| F.IF.7c Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. | **A2.F.1.5** Analyze the graph of a polynomial function by identifying the domain, range, intercepts, zeros, relative maxima, relative minima, and intervals of increase and decrease. | CCSS requires creation of the graph. OAS stops short of that by just asking that students identify characteristics of a given polynomial graph. |
| F.IF.7d (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. | **A2.F.1.6** Graph a rational function and identify the x- and y-intercepts, vertical and horizontal asymptotes, using various methods and tools that may include a graphing calculator or other appropriate technology. (Excluding slant or oblique asymptotes and holes.) | This OAS is matched with a (+) CCSS, designated as for students planning for careers or study involving higher mathematics. |
| F.IF.7e Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude. | **A2.F.1.4** Graph exponential and logarithmic functions. Identify asymptotes and x- and y-intercepts using various methods and tools that may include graphing calculators or other appropriate technology. Recognize exponential decay and growth graphically and algebraically. | This OAS adds the expectation that students can recognize growth and decay from both a graph and an equation. |

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| F.IF.8. Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. | **A1.A.4.3** Express linear equations in slope-intercept, point-slope, and standard forms and convert between these forms. Given sufficient information (slope and y-intercept, slope and one-point on the line, two points on the line, x- and y-intercept, or a set of data points), write the equation of a line. | |
| | **A2.A.2.3** Recognize that a quadratic function has different equivalent representations [f (x) = ax^2 + bx + c, f(x) = a(-x – h)^2 + k ), and f(x)=(x-h)(x-k)]. Identify and use the representation that is most appropriate to solve real-world and mathematical problems. | |
| F.IF.8a Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. | **A2.A.1.1** Represent real-world or mathematical problems using quadratic equations and solve using various methods (including graphing calculator or<br>other appropriate technology), factoring, completing the square, and the quadratic formula. Find non-real roots when they exist. | In this OAS "represent" may include both graphically and algebraically. In this CCSS the expectation is to find the connections between the two. It is not completely clear that expectation is mirrored in the OAS. |
| F.IF.8b Use the properties of exponents to interpret expressions for exponential functions. *For example, identify percent rate of change in functions such as y = (1.02)^t, y = (0.97)^t, y = (1.01)^(12t), y = (1.2)^(t/10), and classify them as representing exponential growth or decay.* | | OAS does not address using the properties of exponents to look at structure to interpret exponential functions. |

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| F.IF.9. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.* | | The OAS does not require comparison of two functions represented in different ways. |
| | **A1.F.3.1** Identify and generate equivalent representations of linear equations, graphs, tables, and real-world situations. | This is not a match to F.IF.9. The OAS deals with only one function here. This OAS is essentially a repeat of PA.A.2.1 |
| F.BF.1. Write a function that describes a relationship between two quantities. | **A1.F.1.3** Write linear functions, using function notation, to model real-world and mathematical situations. | This OAS objective matches the language of the CCSS but is limited to linear functions. |
| F.BF.1a Determine an explicit expression, a recursive process, or steps for calculation from a context. | | OAS makes no mention of recursive processes. |

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| F.BF.1b Combine standard function types using arithmetic operations. *For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.* | **A1.F.3.3** Add, subtract, and multiply functions using function notation. | It would be clearer to state that students will add, subtract, and multiply functions written in function notation. |
| | **A2.F.2.1** Add, subtract, multiply, and divide functions using function notation and recognize domain restrictions. | It would be clearer to state: Add, subtract, multiply, and divide functions written in function notation. Describe the domain restrictions of the resulting functions. |
| F.BF.1c (+) Compose functions. *For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time.* | **A2.F.2.2** Combine functions by composition and recognize that g(x)=f^(-1)(x), the inverse function of f(x), if and only if f(g(x)=g(f(x)). | This OAS is matched with a (+) CCSS, designated as for students planning for careers or study involving higher mathematics. |
| F.BF.2. Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms. | **A1.A.3.5** Recognize that arithmetic sequences are linear using equations, tables, graphs, and verbal descriptions. Use the pattern, find the next term. | This OAS is limits work with arithmetic sequences to finding the next term in an *using the pattern* . This is essentially the same sort of pattern work done in the elementary grades. CCSS expects using sequences to model situations. |
| | **A1.A.3.6** Recognize that geometric sequences are exponential using equations, tables, graphs and verbal descriptions. Given the formula f(x)=a(r)^x,find the next term and define the meaning of *a* and *r* within the context of the problem. | This OAS is limits work with geometric sequences to finding the next term given the formula. |

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| | **A2.A.1.7** Solve real-world and mathematical problems that can be modeled using arithmetic or finite geometric sequences or series given the nth terms and sum formulas. Graphing calculators or other appropriate technology may be used. | The OAS falls short of the CCSS in that it lacks recursion. |
| F.BF.3. Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k f(x)$, $f(kx)$, 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.* | **A1.F.2.2** Recognize the graph of the functions f(x)=x and f(x)=\|x\| and predict the effects of transformations [f(x+c) and f(x)+c where c is a positive or negative constant] algebraically and graphically using various methods and tools that may include graphing calculators. | |
| | **A2.F.1.2** Recognize the graphs of exponential, radical (square root and cube root only), quadratic, and logarithmic functions. Predict the effects of transformations [f(x+c), f(x)+c, f(cx), and f(cx), where c is a positive or negative real-valued constant] algebraically and graphically, using various methods and tools that may include graphing calculators or other appropriate technology. | |
| F.BF.4. Find inverse functions. | **A2.F.2.3** Find and graph the inverse of a function, if it exists, in real-world and mathematical situations. Know that the domain of a function f is the range of the inverse function f^(-1), and the range of the function f is the domain of the inverse function f^(-1). | This Algebra 2 OAS goes beyond the scope of the CCSS by requiring graphing and knowledge of the domain and range of inverse functions. |

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| F.BF.4a Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse. *For example, $f(x) = 2x^3$ or $f(x) = (x+1)/(x-1)$ for $x \neq 1$.* | **A2.F.2.3** Find and graph the inverse of a function, if it exists, in real-world and mathematical situations. Know that the domain of a function f is the range of the inverse function $f^{-1}$, and the range of the function f is the domain of the inverse function $f^{-1}$. | This Algebra 2 OAS goes beyond the scope of the CCSS by requiring graphing and knowledge of the domain and range of inverse functions. |
| F.BF.4b (+) Verify by composition that one function is the inverse of another. | **A2.F.2.2** Combine functions by composition and recognize that $g(x)=f^{-1}(x)$, the inverse function of $f(x)$, if and only if $f(g(x))=g(f(x))$. | This OAS is matched with a (+) CCSS, designated as for students planning for careers or study involving higher mathematics. |
| F.BF.4c (+) Read values of an inverse function from a graph or a table, given that the function has an inverse. | | This (+)-designated CCSS has no match in the OAS. |
| F.BF.4d (+) Produce an invertible function from a non-invertible function by restricting the domain. | | This (+)-designated CCSS has no match in the OAS. |
| F.BF.5 (+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents. | **A2.A.1.6** Solve common and natural logarithmic equations using the properties of logarithms.<br><br>**A2.F.2.4** Apply the inverse relationship between exponential and logarithmic functions to convert from one form to another. | These OAS are matched with a (+) CCSS, designated as for students planning for careers or study involving higher mathematics. |
| F.LE.1. Distinguish between situations that can be modeled with linear functions and with exponential functions. | **A1.F.2.1** Distinguish between linear and nonlinear (including exponential) functions arising from real-world and mathematical situations that are represented in tables, graphs, and equations. Understand that linear functions grow by equal intervals and that exponential functions grow by equal factors over equal intervals. | |

| CCSS | OAS Final V2 2016 | Comments OAS Final V2 Jan 2016 Clarity Comments are in blue font |
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| F.LE.1a Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals. | **A1.F.2.1** Distinguish between linear and nonlinear (including exponential) functions arising from real-world and mathematical situations that are represented in tables, graphs, and equations. Understand that linear functions grow by equal intervals and that exponential functions grow by equal factors over equal intervals. | The OAS expectation is to "distinguish" rather than "prove"<br><br>"Grow by equal intervals" is not quite accurate. The function's outputs may increase or decrease as the inputs increase. Also, A1.F.2 (the standard, not the objective seems to imply that percent of change (relative) is the same as rate of change. |
| F.LE.1b Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. | **A1.F.2.1** Distinguish between linear and nonlinear (including exponential) functions arising from real-world and mathematical situations that are represented in tables, graphs, and equations. Understand that linear functions grow by equal intervals and that exponential functions grow by equal factors over equal intervals. | |
| F.LE.1c Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another. | **A1.F.2.1** Distinguish between linear and nonlinear (including exponential) functions arising from real-world and mathematical situations that are represented in tables, graphs, and equations. Understand that linear functions grow by equal intervals and that exponential functions grow by equal factors over equal intervals. | |
| F.LE.2 Construct linear and exponential | **PA.A.2.1** Represent linear functions with tables, verbal descriptions, symbols, and graphs; translate from one representation to another. | The OAS Gr 8 expectation to "translate" could overlap with the CCSS standard. |

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| F.LE.2. Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). | **A1.A.4.3** Express linear equations in slope-intercept, point-slope, and standard forms and convert between these forms. Given sufficient information (slope and y-intercept, slope and one-point on the line, two points on the line, x- and y-intercept, or a set of data points), write the equation of a line. | This OAS addresses linear functions but there is no similar OAS for exponential functions or arithmetic and geometric sequences. |
| 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. | | This CCSS has no OAS match. |
| F.LE.4. For exponential models, express as a logarithm the solution to *ab^( ct) = d* where *a* , *c* , and *d* are numbers and the base *b* is 2,10,or *e* ; evaluate the logarithm using technology. | **A2.A.1.2** Represent real-world or mathematical problems using exponential equations, such as compound interest, depreciation, and population growth, and solve these equations graphically (including graphing calculator or other appropriate technology) or algebraically. | *The OAS does not require solving exponential equations using logarithms.* |
| F.LE.5. Interpret the parameters in a linear or exponential function in terms of a context. | | This CCSS has no OAS match. |
| F.TF.1. Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle. | | This CCSS has no OAS match. |
| F.TF.2. Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle. | | This CCSS has no OAS match. |

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| F.TF.3. (+) Use special triangles to determine geometrically the values of sine, cosine, tangent for π/3, π/4 and π/6, and use the unit circle to express the values of sine, cosine, and tangent for $\pi - x$ , $\pi + x$ , and $2\pi - x$ in terms of their values for $x$ , where $x$ is any real number. | **G.RT.1.2** Verify and apply properties of right triangles, including properties of 45-45-90 and 30-60-90 triangles, to solve problems using algebraic and logical reasoning. | This OAS is a partial match with the CCSS (+)-designated standard. The OAS does not use radian measures. |
| F.TF.4. (+) Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions. | | This (+)-designated CCSS has no match in the OAS. |
| F.TF.5. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline. | | This CCSS has no OAS match. |
| F.TF.6. (+) Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed. | | This (+)-designated CCSS has no match in the OAS. |
| F.TF.7. (+) Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.* | | This (+)-designated CCSS has no match in the OAS. |
| F.TF.8. Prove the Pythagorean identity sin^2(A) + cos^2(A) = 1 and use it to find sin(A), cos(A), or tan(A) given sin(A), cos(A), or tan(A) and the quadrant of the angle. | | This CCSS has no OAS match. |
| F.TF.9. (+) Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems. | | This (+)-designated CCSS has no match in the OAS. |
| **GEOMETRY** | | |

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| | **G.2D.1 Discover, evaluate and analyze the relationships between lines, angles, and polygons to solve real-world and mathematical problems; express proofs in a form that clearly justifies the reasoning, such as two-column proofs, paragraph proofs, flow charts, or illustrations.** | This OAS standard (not objective) needs revision for clarity. It is not clear what the "relationship between lines, angles, and polygons" would be. By "lines" is "sides" what is intended? |
| | **G.RL.1.2** Analyze and draw conclusions based on a set of conditions using inductive and deductive reasoning. Recognize the logical relationships between a conditional statement and its inverse, converse, and contrapositive. | There are no content standards in the CCSS to match this collection of OAS benchmarks. They align best to CCSS **MP.3,** *Construct viable arguments and critique the reasoning of others.* |
| | **G.RL.1.3** Assess the validity of a logical argument and give counterexamples to disprove a statement. | There is no CCSS match to this OAS. |
| G.CO.1. Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc. | **G.RL.1.1** Understand the use of undefined terms, definitions, postulates, and theorems in logical arguments/proofs. | The OAS provides no list of undefined terms. |
| G.CO.2. Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch). | | There is no OAS to match this CCSS requirement. |

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| G.CO.3. Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself. | **G.2D.1.9** Use numeric, graphic and algebraic representations of transformations in two dimensions, such as reflections, translations, dilations, and rotations about the origin by multiples of 90̊, to solve problems involving figures on a coordinate plane and identify types of symmetry. | The OAS does not specifically call out the types of 2-dimensional figures to be included. The CCSS does not limit to rotations to multiples of 90 degrees. |
| G.CO.4. Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments. | | While the OAS expects students to use transformations to solve problems, there is no call to develop the definitions. |
| G.CO.5. Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another. | **G.2D.1.9** Use numeric, graphic and algebraic representations of transformations in two dimensions, such as reflections, translations, dilations, and rotations about the origin by multiples of 90̊, to solve problems involving figures on a coordinate plane and identify types of symmetry. | |
| G.CO.6. Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent. | **G.2D.1.7** Apply the properties of congruent or similar polygons to solve real-world and mathematical problems using algebraic and logical reasoning. | |
| G.CO.7. 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. | | There is no OAS to match this CCSS requirement. |

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| G.CO.8. Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions. | **G.2D.1.8** Construct logical arguments to prove triangle congruence (SSS, SAS, ASA, AAS and HL) and triangle similarity (AA, SSS, SAS). | There is a significant difference in this alignment. The CCSS expects being able to explain why the criteria work. OAS seems to just have students use the criteria. |
| G.CO.9. Prove theorems about lines and angles. *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.* | **G.2D.1.1** Apply the properties of parallel and perpendicular lines, including properties of angles formed by a transversal, to solve real-world and mathematical problems and determine if two lines are parallel, using algebraic reasoning and proofs. | |
| | **G.2D.1.2** Apply the properties of angles, including corresponding, exterior, interior, vertical, complementary, and supplementary angles to solve realworld and mathematical problems using algebraic reasoning and proofs. | |
| G.CO.10. Prove theorems about triangles. *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.* | | The OAS mentions proofs with lines, angles, and polygons, but not proofs about triangles. |

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| G.CO.11. Prove theorems about parallelograms. *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.* | **G.2D.1.3** Apply theorems involving the interior and exterior angle sums of polygons and use them to solve real-world and mathematical problems using algebraic reasoning and proofs. | CCSS is asking for a proof, while the OAS only requires that theorems are applied. OAS is not limited to parallelograms, but applies to any polygon. |
| | **G.2D.1.4** Apply the properties of special quadrilaterals (square, rectangle, trapezoid, isosceles trapezoid, rhombus, kite, parallelogram) and use them to solve real-world and mathematical problems involving angle measures and segment lengths using algebraic reasoning and proofs. | The CCSS addresses parallelograms rather than all quadrilaterals and expects proof of related theorems, while the OAS stops with applying the properties and using proofs to solve includes quadrilaterals that are not parallelograms. |
| G.CO.12. 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. | | Geometric constructions are not addressed in the OAS. |
| G.CO.13. Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle. | | Geometric constructions are not addressed in the OAS. |

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| G.SRT.1 Verify experimentally the properties of dilations given by a center and a scale factor:<br>a. 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.<br>b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor. | **G.2D.1.9** Use numeric, graphic and algebraic representations of transformations in two dimensions, such as reflections, translations, dilations, and rotations about the origin by multiples of 90̊ , to solve problems involving figures on a coordinate plane and identify types of symmetry. | This OAS addresses other transformations than dilations and focuses on problem solving rather than on understanding the concepts involved, as does this CCSS. |
| G.SRT.2. Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides. | **G.2D.1.7** Apply the properties of congruent or similar polygons to solve real-world and mathematical problems using algebraic and logical reasoning. | This OAS defines congruence and similarity in terms of transformations in the glossary. However there is no expectation in the OAS for students to explain the meaning similarity and congruence in those, or any, terms. |
| G.SRT.3. Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar. | | There is no OAS to match this CCSS requirement. G.2D.1.8 is about using, not establishing, the criteria. |
| G.SRT.4. Prove theorems about triangles. *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.* | | The OAS mentions proofs with lines, angles, and polygons, but not proofs about triangles. |
| G.SRT.5. Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. | **G.2D.1.7** Apply the properties of congruent or similar polygons to solve real-world and mathematical problems using algebraic and logical reasoning. | |

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| G.SRT.6. Understand 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. | | This CCSS has no OAS match. |
| G.SRT.7. Explain and use the relationship between the sine and cosine of complementary angles. | | This CCSS has no OAS match. |

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| G.SRT.8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. | **G.RT.1.1** Apply the distance formula and the Pythagorean Theorem and its converse to solve real-world and mathematical problems, as approximate and exact values, using algebraic and logical reasoning (include Pythagorean Triples). | |
| | **G.RT.1.3** Use the definition of the trigonometric functions to determine the sine, cosine, and tangent ratio of an acute angle in a right triangle. Apply the inverse trigonometric functions as ratios to find the measure of an acute angle in right triangles. | There has been no other mention of inverse functions in either Algebra 1 or Geometry. Inverse functions are not introduced until Algebra 2. |
| | **G.RT.1.4** Apply the trigonometric functions as ratios (sine, cosine, and tangent) to find side lengths in right triangles in real-world and mathematical problems. | |
| G.SRT.9. (+) Derive the formula *A* = 1/2 *ab* sin(C) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side. | | This (+)-designated CCSS has no match in the OAS. |
| G.SRT.10. (+) Prove the Laws of Sines and Cosines and use them to solve problems. | | This (+)-designated CCSS has no match in the OAS. |
| G.SRT.11. (+) Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces). | | This (+)-designated CCSS has no match in the OAS. |

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| G.C.1. Prove that all circles are similar. | | This CCSS has no OAS match. |
| 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.1.2** Apply the properties of circles and relationships among angles; arcs; and distances in a circle among radii, chords, secants and tangents to solve problems using algebraic and logical reasoning. | The OAS expects students to apply and not to identify or describe the relationships. |
| G.C.3. Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle. | | This CCSS has no OAS match. |
| G.C.4. (+) Construct a tangent line from a point outside a given circle to the circle. | | This (+)-designated CCSS has no match in the OAS. |
| G.C.5. Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector. | | This CCSS has no OAS match. |
| G.GPE.1 Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation. | **G.C.1.3** Recognize and write the radius *r* , center (h,k), and standard form of the equation of a circle $(x – h)^2 + (y – k)^2 = r^2$ with and without graphs. | This OAS focuses on recognition of the key features of the circle from an equation rather than on deriving the equation. |
| | **G.C.1.4** Apply the distance and midpoint formula, where appropriate, to develop the equation of a circle in standard form. | This OAS meets the requirement to write the equation of the circle and appears to do so from a graph. This matches the frist part of G.GPE.1.<br>It is not clear how the midpoint formula would be used in developing the equation of a circle. |

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| G.GPE.2 Derive the equation of a parabola given a focus and directrix. | | This CCSS has no OAS match. |
| G.GPE.3 (+) Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant. | | This (+)-designated CCSS has no match in the OAS. |
| G.GPE.4. Use coordinates to prove simple geometric theorems algebraically. *For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, 3) lies on the circle centered at the origin and containing the point (0, 2).* | **G.2D.1.5** Use coordinate geometry to represent and analyze line segments and polygons, including determining lengths, midpoints, and slopes of line segments. | The analysis required in this OAS *might* imply some level of logical argument. |
| G.GPE.5. 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). | **A1.A.4.2** Solve mathematical and real-world problems involving lines that are parallel, perpendicular, horizontal, or vertical. | In using the slope for this OAS purpose, a proof of the slope criteria could be formulated. |
| G.GPE.6. Find the point on a directed line segment between two given points that partitions the segment in a given ratio. | **G.2D.1.5** Use coordinate geometry to represent and analyze line segments and polygons, including determining lengths, midpoints, and slopes of line segments. | Only midpoints are addressed, while the CCSS implies any number of partitions of a segment. |
| G.GPE.7. Use coordinates to compute | **G.2D.1.5** Use coordinate geometry to represent and analyze line segments and polygons, including determining lengths, midpoints, and slopes of line segments. | |

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| perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula. | **G.2D.1.6** Apply the properties of polygons to solve real-world and mathematical problems involving perimeter and area (e.g., triangles, special quadrilaterals, regular polygons up to 12 sides, composite figures). | This OAS does not mention the distance formula, but it is mentioned in G.C.1.4. |

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| G.GMD.1. Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. Use dissection arguments, Cavalieri's principle, and informal limit arguments. | | This CCSS has no OAS match. |
| G.GMD.2. (+) Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures. | | This (+)-designated CCSS has no match in the OAS. |
| G.GMD.3. Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems. | **G.3D.1.1** Solve real-world and mathematical problems using the surface area and volume of prisms, cylinders, pyramids, cones, spheres, and composites of these figures. Use nets, measuring devices, or formulas as appropriate. | Volume and surface area of right rectangular prisms are addressed in CCSS Gr 7. |
| G.GMD.4. Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects. | | This CCSS has no OAS match. |
| 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). | | This CCSS has no OAS match. |
| G.MG.2. Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot). | | This CCSS has no OAS match. |

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| | **G.3D.1.2** Use ratios derived from similar three-dimensional figures to make conjectures, generalize, and to solve for unknown values such as angles, side lengths, perimeter or circumference of a face, area of a face, and volume. | This OAS has no match in the CCSS. |
| 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).� | | This CCSS has no OAS match. |

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| **Statistics and Probability** | | |
| S.ID.1. Represent data with plots on the real number line (dot plots, histograms, and box plots). | **6.D.1.3** Create and analyze box and whisker plots observing how each segment contains one quarter of the data.<br>**7.D.1.2** Use reasoning with proportions to display and interpret data in circle graphs (pie charts) and histograms. Choose the appropriate data display and know how to create the display using a spreadsheet or other graphing technology. | These topics are a review of CCSS 6.SP.4. Similarly, these topics are covered in OAS 3.D.1.1, 4.D.1.1, 6.D.1.3, 7.D.1.2. Pie or circle graphs are not specifically addressed in the CCSS. Dot plots are not specifically addressed in the OAS. |
| S.ID.2. 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. | **A1.D.1.1** Describe a data set using data displays, describe and compare data sets using summary statistics, including measures of central tendency, location, and spread. Know how to use calculators, spreadsheets, or other appropriate technology to display data and calculate summary statistics. | This OAS objective includes the expectation that technology would be used appropriately. This would be covered by CCSS MP.5 in the Standards for Mathematical Practice. |
| | **A1.D.1.3** Interpret graphs as being discrete or continuous. | This OAS has no match in the CCSS.<br>This OAS objective is related to data that motivates a discrete or continuous graph, however, it does not make that clear. See the wording of A2.D.1.3 for an example. |
| | **A2.D.1.3** Based upon a real-world context, recognize whether a discrete or continuous graphical representation is appropriate and then create the graph. | This OAS has no match in the CCSS.<br><br>This wording is much clearer than the Algebra 1 counterpart (A1.D.1.3). However some mention of data as the basis for this is still needed. |

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| S.ID.3. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). | **PA.D.1.2** Explain how outliers affect measures of central tendency. | Outliers are addressed in the OAS Gr 8, PA.D.1.2, but this CCSS goes beyond that to interpreting differences in data sets. |
| S.ID.4. Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve. | **A2.D.1.1** Use the mean and standard deviation of a data set to fit it to a normal distribution (bell-shaped curve). | This CCSS adds the conceptual requirement of recognition that for some data sets a normal distribution does not apply. |
| S.ID.5. 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. | | This OAS has no match in the CCSS. |
| S.ID.6. Represent data on two quantitative | **A1.D.1.2** Collect data and use scatterplots to analyze patterns and describe linear relationships between two variables. Using graphing technology, determine regression lines and correlation coefficients; use regression lines to make predictions and correlation coefficients to assess the reliability of those predictions. | |

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| S.ID.6. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. | **A2.D.1.2** Collect data and use scatterplots to analyze patterns and describe linear, exponential or quadratic relationships between two variables. Using graphing calculators or other appropriate technology, determine regression equation and correlation coefficients; use regression equations to make predictions and correlation coefficients to assess the reliability of those predictions. | This Algebra 2 OAS goes beyond the requirement of the CCSS.<br><br>An article seems to be missing here: ("... determine ["a" or" the"] regression equation...") |
| S.ID.6a Fit a function to the data; use functions fitted to data to solve problems in the context of the data. *Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.* | **A1.D.1.2** Collect data and use scatterplots to analyze patterns and describe linear relationships between two variables. Using graphing technology, determine regression lines and correlation coefficients; use regression lines to make predictions and correlation coefficients to assess the reliability of those predictions. | |
| | **A2.D.1.2** Collect data and use scatterplots to analyze patterns and describe linear, exponential or quadratic relationships between two variables. Using graphing calculators or other appropriate technology, determine regression equation and correlation coefficients; use regression equations to make predictions and correlation coefficients to assess the reliability of those predictions. | |
| S.ID.6b Informally assess the fit of a function by plotting and analyzing residuals. | | This OAS has no match in the CCSS. |

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| S.ID.6c Fit a linear function for a scatter plot that suggests a linear association. | **A1.D.1.2** Collect data and use scatterplots to analyze patterns and describe linear relationships between two variables. Using graphing technology, determine regression lines and correlation coefficients; use regression lines to make predictions and correlation coefficients to assess the reliability of those predictions. | |
| | **A2.D.1.2** Collect data and use scatterplots to analyze patterns and describe linear, exponential or quadratic relationships between two variables. Using graphing calculators or other appropriate technology, determine regression equation and correlation coefficients; use regression equations to make predictions and correlation coefficients to assess the reliability of those predictions. | This OAS goes beyond the scope of the requirements of the CCSS by expecting analysis of exponential and quadratic associations. |
| S.ID.7. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. | | There is no OAS objective to match this CCSS. |
| S.ID.8. Compute (using technology) and | **A1.D.1.2** Collect data and use scatterplots to analyze patterns and describe linear relationships between two variables. Using graphing technology, determine regression lines and correlation coefficients; use regression lines to make predictions and correlation coefficients to assess the reliability of those predictions. | |

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| S.ID.8. Compute (using technology) and interpret the correlation coefficient of a linear fit. | **A2.D.1.2** Collect data and use scatterplots to analyze patterns and describe linear, exponential or quadratic relationships between two variables. Using graphing calculators or other appropriate technology, determine regression equation and correlation coefficients; use regression equations to make predictions and correlation coefficients to assess the reliability of those predictions. | This OAS goes beyond the scope of the requirements of the CCSS by expecting analysis of exponential and quadratic associations. |
| S.ID.9. Distinguish between correlation and causation. | **A2.D.2.2** Identify and explain misleading uses of data. Recognize when arguments based on data confuse correlation and causation. | |
| S.IC.1. Understand statistics as a process for making inferences about population parameters based on a random sample from that population. | | This CCSS foundational understanding is not included in the OAS. |
| S.IC.2. Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. *For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?* | **A1.D.2.3** Calculate experimental probabilities by performing simulations or experiments involving a probability model and using relative frequencies of outcomes. | |
| S.IC.3. Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each. | | There is no OAS objective to match this CCSS. |

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| S.IC.4. Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling. | | There is no OAS objective to match this CCSS. |
| S.IC.5. Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant. | | There is no OAS objective to match this CCSS. |
| S.IC.6. Evaluate reports based on data. | **A2.D.2.1** Evaluate reports based on data published in the media by identifying the source of the data, the design of the study, and the way the data are analyzed and displayed. Given spreadsheets, tables, or graphs, recognize and analyze distortions in data displays. Show how graphs and data can be distorted to support different points of view. | The OAS provides much more detail in this objective related to evaluation of reports based on data. |
| S.CP.1. Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events (“or,” “and,” “not”). | **A1.D.2.2** Describe the concepts of intersections, unions, and complements using Venn diagrams to evaluate probabilities. Understand the relationships between these concepts and the words AND, OR, and NOT. | Venn diagrams are not specifically addressed in the CCSS. |
| S.CP.2. Understand that two events *A* and *B* are independent if the probability of *A* and *B* occurring together is the product of their probabilities, and use this characterization to determine if they are independent. | **PA.D.2.3** Compare and contrast dependent and independent events. | |

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| S.CP.3. Understand the conditional probability of *A* given *B* as *P* (*A* and *B* )/*P* (*B* ), and interpret independence of *A* and *B* as saying that the conditional probability of *A* given *B* is the same as the probability of *A* , and the conditional probability of *B* given *A* is the same as the probability of *B* . | | There is no OAS objective to match this CCSS. |
| S.CP.4. Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. *For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.* | | There is no OAS objective to match this CCSS. |
| S.CP.5. Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. *For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.* | | There is no OAS objective to match this CCSS. |

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| S.CP.6. Find the conditional probability of *A* given *B* as the fraction of *B*'s outcomes that also belong to *A,* and interpret the answer in terms of the model. | | There is no OAS objective to match this CCSS. |
| S.CP.7. Apply the Addition Rule, P(A or B) = P(A) + P(B) – P(A and B), and interpret the answer in terms of the model. | | There is no OAS objective to match this CCSS. |
| S.CP.8. (+) Apply the general Multiplication Rule in a uniform probability model, P(A and B) = P(A)P(B\|A) = P(B)P(A\|B), and interpret the answer in terms of the model. | | This (+)-designated CCSS has no match in the OAS. |
| S.CP.9. (+) Use permutations and combinations to compute probabilities of compound events and solve problems. | | This (+)-designated CCSS has no match in the OAS. |
| S.MD.1. (+) Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions. | | This (+)-designated CCSS has no match in the OAS. |
| S.MD.2. (+) Calculate the expected value of a random variable; interpret it as the mean of the probability distribution. | | This (+)-designated CCSS has no match in the OAS. |

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| S.MD.3. (+) Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value. *For example, find the theoretical probability distribution for the number of correct answers obtained by guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes.* | | This (+)-designated CCSS has no match in the OAS. |
| S.MD.4. (+) Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. *For example, find a current data distribution on the number of TV sets per household in the United States, and calculate the expected number of sets per household. How many TV sets would you expect to find in 100 randomly selected households?* | | This (+)-designated CCSS has no match in the OAS. |
| S.MD.5. (+) Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values. | | This (+)-designated CCSS has no match in the OAS. |
| S.MD.5a (+) Find the expected payoff for a game of chance. *For example, find the expected winnings from a state lottery ticket or a game at a fast- food restaurant.* | | This (+)-designated CCSS has no match in the OAS. |

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| S.MD.5b (+) Evaluate and compare strategies on the basis of expected values. *For example, compare a high-deductible versus a low-deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident.* | | This (+)-designated CCSS has no match in the OAS. |
| S.MD.6. (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator). | | This (+)-designated CCSS has no match in the OAS. |
| S.MD.7. (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game). | **A1.D.2.4** Apply probability concepts to real-world situations to make informed decisions. | Since this OAS is for Algebra 1 it is unlikely that the same kind of examples and expectations would apply as are provided in this (+)-designated CCSS. |