Kentucky Core Academic Progression of Standards and Related Intervention Supports

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Kentucky Core Academic Progression of Standards and Related Intervention Supports

MATHEMATICS K - 5

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**Domain: Counting and Cardinality**

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| **Kindergarten Only** | | |
| **Cluster:** Know number names and the count sequence. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| K.CC.1  K.CC.2  K.CC.3 | Count to 100 by ones and by tens.  Count forward beginning from a given number within the known sequence (instead of having to begin at 1).  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). | R – [Count to 100 by ones and tens Resource Page](http://math.about.com/od/CommonCoreMath/a/Strategies-For-Kindergarten-Common-Core-Math.htm)  ML – [Counting by Tens (Includes Music Video)](http://kristenkeepingitclassy.blogspot.com/2012/03/counting-by-10s.html)  A – [Splat Square](http://oswego.org/ocsd-web/games/SplatSquares/splatsq100.html)  PL – [Helping Kindergartens Make Sense of Numbers to 100](http://www.math.vcu.edu/g1/journal/Journal_11/11_Jaslow_Jacobs.pdf)  R – [Number Formation Sheets](http://www.twinkl.co.uk/search)  A – [Numerous Counting Games](http://www.ictgames.com/counting.htm) |
| **Cluster:** Counting to tell the number of objects. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| K.CC.4  K.CC.5 | Understand the relationship between numbers and quantities; connect counting to cardinality.  a. 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.  b. 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.  c. Understand that each successive number name refers to a quantity that is one larger.  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. | V – [Learn to Count with Shawn the Train](https://www.youtube.com/watch?v=yxAIBFsRpqU)  ML – [Building Numbers to 5](http://illuminations.nctm.org/Lesson.aspx?id=1616)  ML – [Frogs on a Log](http://illuminations.nctm.org/Lesson.aspx?id=3250)  V – [Mingle & Count Game Modeled and Explained by the Teacher](https://www.teachingchannel.org/videos/mingle-count-a-game-of-number-sense)  R – [Counting Objects Resource Page](http://www.mathwire.com/strategies/countobj.html)  A – [Counting Games](http://math.rice.edu/~lanius/counting/index2.html)  A – [Curious George Hide and Seek Numbers](http://pbskids.org/curiousgeorge/busyday/hideseek/teacher.html)  ML – [How many letters are in your name? Lesson Plan](http://illuminations.nctm.org/Lesson.aspx?id=3263)  V – [One to One Correspondence Strategies Discussion](https://www.youtube.com/watch?v=1dlKXYv4x-A) |
| **Cluster:** Comparing numbers. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| K.CC.6  K.CC.7 | 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. (Note: Include groups with up to ten objects.)  Compare two numbers between 1 and 10 presented as written numerals. | V – [Subitizing and Who Has More Discussion](https://www.youtube.com/watch?v=QJW6FfKRbUs&feature=related)  ML – [Comparing Lesson Plan including Resources](http://www.coedu.usf.edu/main/departments/sped/mathvids/plans/cmls/C_intro.html)  R – [Comparing Numbers Resource Page](http://www.helpingwithmath.com/by_subject/place_value/comparing_numbers.htm)  ML – [Comparing and Ordering Lesson Plan including Resources](http://alex.state.al.us/lesson_view.php?id=24051) |

**Domain: Operations and Algebraic Thinking**

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| **Kindergarten** | | |
| **Cluster:** Understanding addition as putting together and adding to, and understanding subtraction as taking apart and taking from. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| K.OA.1  K.OA.2  K.OA.3  K.OA.4  K.OA.5 | Represent addition and subtraction with objects, fingers, mental images, drawings, sounds (e.g., claps), acting out situations, verbal explanations, expressions, or equations. (Note: Drawings need not show details, but should show the mathematics in the problem -- this applies wherever drawings are mentioned in the Standards.)  Solve addition and subtraction word problems, and add and subtract within 10, e.g., by using objects or drawings to represent the problem.  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).  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.  Fluently add and subtract within 5. | ML - [Comparing Connecting Cubes Unit](http://illuminations.nctm.org/Lesson.aspx?id=329)  V – [Video about Multiple Representations](http://www.mhpdonline.com/video_library/index1.php?PROGRAM=1&VIDEO=-1&MODE=1&CHAPTER=2)  ML – [Take Away Lesson Plan](http://illuminations.nctm.org/Lesson.aspx?id=810)  A – [Build Five Towers](http://www.k-5mathteachingresources.com/support-files/build-five-towers.pdf)  ML – [Multiple Lesson Plans K-1](http://mathsolutions.com/books-resources/classroom-lessons/)  PL – [Show and Tell: Representing and Communicating Mathematical Ideas in K-2](http://www.mathsolutions.com/documents/9780941355506_CH1.pdf)  ML – [Lesson Plan Incorporating Literature](http://www.k-5mathteachingresources.com/support-files/Ten-Flashing-Fireflies.pdf)  V – [Counting On Video](http://www.brainpop.com/educators/community/bp-jr-topic/counting-on/)  A – [Sums of Five](http://www.k-5mathteachingresources.com/support-files/sumsoffive.pdf)  ML – [Lesson Plan Incorporating Literature](http://www.learnnc.org/lp/pages/3733?ref=search)    A – [Shake and Spill](http://www.k-5mathteachingresources.com/support-files/shake5andspill.pdf) |
| **Grade 1** | | |
| **Cluster:** Represent and solve problems involving addition and subtraction. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 1.OA.1  1.OA.2 | 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.  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. | R – [First Grade Standards Resource Page](http://www.ixl.com/math/grade-1)  PL – [Helping ELL Students Make Sense of Word Problems](http://www.mathsolutions.com/documents/978-0-941355-84-1_L1.pdf)  R – [First Grade Number Activities](http://www.k-5mathteachingresources.com/1st-grade-number-activities.html)  S – [Strategy Development](https://catalyst.uw.edu/gopost/conversation/ekazemi/34782)  A – [Variety of Games](http://www.smartfirstgraders.com/addition-games.html)  V – [Counting On Video](http://www.brainpop.com/educators/community/bp-jr-topic/counting-on/) |
| **Cluster:** Understand and apply properties of operations and the relationship between addition and subtraction. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 1.OA.3  1.OA.4 | Apply properties of operations as strategies to add and subtract. (Note: Students need not use formal terms for these properties.)  *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.)*  Understand subtraction as an unknown-addend problem. *For example, subtract 10 – 8 by finding the number that makes 10 when added to 8.* | A – [Domino Fact Families](http://www.k-5mathteachingresources.com/support-files/dominofactfamilies1.oa3.pdf)  ML – [Multiple Lesson Plans](http://cc.betterlesson.com/common_core?from=landing#common_core/browse/52/ccss-math-content-1-oa-b-3-apply-properties-of-operations-as-strategies-to-add-and-subtract-examples-if-8-3-11-is-known-then-3-8?from=domain_core_lesson_count&_suid=140605190654605939593151064068)  R – [Subtraction Resource Page](http://www.smartfirstgraders.com/subtraction-activities.html)  A – [Ten Frame for Subtraction Activity](http://www.k-5mathteachingresources.com/support-files/tenframesubtraction.pdf)  R – [Story Problems for Addition and Subtraction](http://www.primaryresources.co.uk/maths/pdfs/3wordprobs1.pdf) |
| **Cluster:** Add and subtract within 20. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 1.OA.5  1.OA.6 | Relate counting to addition and subtraction (e.g., by counting on 2 to add 2).  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 the relationship between addition and subtraction (e.g., knowing that 8 + 4 = 12, one knows 12 – 8 = 4); and creating equivalent but easier or known sums (e.g., adding 6 + 7 by creating the known equivalent 6 + 6 + 1 = 12 + 1 = 13). | V – [Videos and Songs for Addition and Subtraction](http://studyjams.scholastic.com/studyjams/jams/math/index.htm)  R – [Missing Addend Game](http://www.kidsnumbers.com/addition_missing_number.php)  R – [Multiple Hundred Board Activities](http://www.mathwire.com/100board/hb2.html)  A – [I Have, Who Has Activity Instructions and Printables](http://www.k-5mathteachingresources.com/support-files/ihavewhohaseasyfacts.pdf)  ML – [Multiple Lesson Plans](http://cc.betterlesson.com/common_core?from=landing#common_core/browse/52/ccss-math-content-1-oa-b-3-apply-properties-of-operations-as-strategies-to-add-and-subtract-examples-if-8-3-11-is-known-then-3-8?from=domain_core_lesson_count&_suid=140605190654605939593151064068)  R – [First Grade Standards Resource Page](http://www.ixl.com/math/grade-1) |
| **Cluster:** Work with addition and subtraction equations. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 1.OA.7  1.OA.8 | 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.*  Determine the unknown whole number in an addition or subtraction equation relating to 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 =* 􀃍*.* | A – [Balance – Students must make equations true](http://teams.lacoe.edu/documentation/classrooms/linda/algebra/activities/balance/balance.html)  PL – [Breaking Numbers Apart – Decomposing](http://www.mathsolutions.com/documents/0-941355-74-8_L.pdf)  A – [True or False – Number Sentences](http://www.k-5mathteachingresources.com/support-files/trueorfalse.pdf)  A – [Equal Sums](http://www.k-5mathteachingresources.com/support-files/equalsums.pdf)  ML – [More or Less](http://www.mathsolutions.com/documents/0-941355-74-8_L3.pdf) |
| **Grade 2** | | |
| **Cluster:** Represent and solve problems involving addition and subtraction. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 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*.* | A – [Second Grade Number Activities](http://www.k-5mathteachingresources.com/2nd-grade-number-activities.html)  [R – Addition and Subtraction Resource Page](http://www.onlinemathlearning.com/addition-subtraction-word-problem.html)  R – [Solving Word Problems Strategy Poster](http://www.abcteach.com/free/p/poster_strategiesforwordproblems.pdf)  V – [Videos and Songs for Addition and Subtraction](http://studyjams.scholastic.com/studyjams/jams/math/index.htm)  ML – [Multiple Lesson Plans](http://cc.betterlesson.com/common_core?from=landing#common_core/browse/52/ccss-math-content-1-oa-b-3-apply-properties-of-operations-as-strategies-to-add-and-subtract-examples-if-8-3-11-is-known-then-3-8?from=domain_core_lesson_count&_suid=140605190654605939593151064068)  PL – [Relationship Between Adding and Subtracting](http://www.yale.edu/ynhti/curriculum/units/2004/5/04.05.01.x.html) |
| **Cluster:** Add and subtract within 20. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 2.OA.2 | Fluently add and subtract within 20 using mental strategies. (Note: See standard 1.OA.6 for a list of mental strategies). By end of Grade 2, know from memory all sums of two one-digit numbers. | R – [Unit Focused on Addition and Subtraction](http://www.uen.org/Lessonplan/preview?LPid=10985)  S – [Mental Math Strategies](http://olc.spsd.sk.ca/de/math1-3/p-mentalmath.html)  ML – [Lesson Plans for Adding and Subtracting](http://www.uen.org/Lessonplan/preview.cgi?LPid=28201)  [R – Addition and Subtraction Resource Page](http://www.onlinemathlearning.com/addition-subtraction-word-problem.html)  V – [Mental Math Strategies](https://www.youtube.com/watch?v=wZmlDfRekpU&feature=player_embedded%23!)  PL – [Mental Math Calculations Article](http://www.scribd.com/doc/208030/1999-Mental-Calculation-Strategies-for-Addition-and-Subtraction)  PL – [Developing…Addition and Subtraction Facts](http://www.ldonline.org/spearswerling/Developing_Automatic_Recall_of_Addition_and_Subtraction_Facts) |
| **Cluster:** Work with equal groups of objects to gain foundations for multiplication. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 2.OA.3  2.OA.4 | 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.  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. | R – [Even and Odd Resource Page](http://www.onlinemathlearning.com/even-and-odd-numbers.html)  V – [Odd Todd and Even Steven](https://www.youtube.com/watch?v=XT9aqgpjdyw)  A – [Teaching Even and Odd in Guided Math Groups](http://guidedmath.wordpress.com/2010/07/29/teaching-odd-and-even-numbers-in-guided-math-groups/)  ML – [Lesson Plan for Teaching Even and Odd](http://mathandreadinghelp.org/even_and_odd_number_lessons.html)  V – [Using Arrays to Build Number Concepts](https://www.youtube.com/watch?v=DDoFS9CNFs0&feature=player_embedded)  R – [Interactive Array Games](http://www.ehow.com/list_6026216_interactive-math-array-games.html) |
| **Grade 3** | | |
| **Cluster:** Represent and solve problems involving multiplication and division. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 3.OA.1  3.OA.2  3.OA.3  3.OA.4 | Interpret products of whole numbers, e.g., interpret 5 × 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.*  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.*  Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.  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 = ?.* | R – [Third Grade Number Activities](http://www.k-5mathteachingresources.com/3rd-grade-number-activities.html)  V – [Videos and Songs about Multiplication and Division](http://studyjams.scholastic.com/studyjams/jams/math/index.htm)  ML – [Lesson Focused on Multiplication Strategies and Arrays](http://www.nsa.gov/academia/_files/collected_learning/elementary/arithmetic/multiplication_strategies_day_at_zoo.pdf)  A – [Array Picture Cards](http://www.k-5mathteachingresources.com/support-files/arraypicturecards.pdf)  V – [Strategies for Multiplication](http://www.teachertube.com/video/strategies-for-multiplication-1882)  R – [Multiplication Idea Bank](http://www.mathcats.com/grownupcats/ideabankmultiplication.html)  V – [Multiplication is Repeated Addition](http://www.multiplication.com/teach/teach-the-times-tables)  R – [All About Multiplication](http://illuminations.nctm.org/Lesson.aspx?id=302)  V – [Basic Multiplication by Khan Academy](http://www.khanacademy.org/math/arithmetic/multiplication-division/multiplication_fun/v/basic-multiplication)  A – [Math Journal Topics Related to Multiplication](http://www.k-5mathteachingresources.com/3rd-grade-math-journals.html)  V – [Making Equal Groups](http://www.brainpopjr.com/math/multiplicationanddivision/makingequalgroups/preview.weml)  V – [Understand Division Problems](https://learnzillion.com/lessons/48-understand-division-problems-matching-equations-to-realworld-examples-)  ML – [Multiple Division Lesson Plans and Ideas](http://www.math-lesson-plans.com/Division.html)  ML – [Everybody Wins Lesson](http://www.mathsolutions.com/documents/0-941355-42-X_L1.pdf)  R – [Arithmetic Four Game](http://www.shodor.org/interactivate/activities/ArithmeticFour/) |
| **Cluster:** Understand properties of multiplication and the relationship between multiplication and division. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 3.OA.5  3.OA.6 | Apply properties of operations as strategies to multiply and divide. (Note: Students need not use formal terms for these properties.) *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.)*  Understand division as an unknown-factor problem. *For example, find 32 ÷ 8 by finding the number that makes 32 when multiplied by 8.* | ML – [Properties](http://alex.state.al.us/lesson_view.php?id=26430)  V – [Teach the Times](http://www.multiplication.com/teach/teach-the-times-tables)  R – [Standard Examples and Tools](http://www.ciclt.net/ul/mgresa/3rd%20GR%20MATH-CCGPS.pdf)  A – [3rd Grade Activities and Examples by Topic](http://www.ixl.com/math/grade-3)  ML – [Task with Instructional Supports](http://www.scboces.org/cms/lib03/NY24000912/Centricity/Domain/106/3rd_Grade_-_Cookie_Dough.pdf)  A – [Division as Unknown Factor Examples](http://www.k-5mathteachingresources.com/support-files/division-as-unknown-factor.pdf)  A – [Missing Factors Game](http://www.ixl.com/math/grade-3/missing-factors-facts-to-12) |
| **Cluster:** Multiply and divide within 100. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 3.OA.7 | Fluently multiply and divide within 100, using strategies such as the relationship between multiplication and division (e.g., knowing that 8 × 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. | V – [Discussion of the Relationship between Multiplication and Division](https://www.youtube.com/watch?v=DQVRU4vEHMY)  PL – [Variety of Strategies and Resources](http://www.googolpower.com/content/articles/how-to-teach-the-times-tables-through-multiplication-songs)  A – [The Product Game](http://illuminations.nctm.org/Activity.aspx?id=4213)  V – [Wide Variety of Fun Videos, Songs, and Activities](http://studyjams.scholastic.com/studyjams/jams/math/index.htm)  ML – [Multiplication: It’s in the Cards Unit](http://illuminations.nctm.org/Lesson.aspx?id=545) |
| **Cluster:** Solve problems involving the four operations, and identify and explain patterns in arithmetic. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 3.OA.8  3.OA.9 | 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 strategies including rounding. (Note: This standard is limited to problems posed with whole numbers and having whole-number answers; students should know how to perform operations in the conventional order when there are no parentheses to specify a particular order -- Order of Operations.)  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.* | V – [Short Video Example](https://www.youtube.com/watch?v=vyEGYamK2D4)  ML – [Solving Word Problems Unit with Resources](http://teachers.yale.edu/curriculum/search/viewer.php?id=initiative_07.06.05_u)  ML – [In-Depth Lesson with Real-World Connections](http://alex.state.al.us/lesson_view.php?id=9833)  PL – [Article about Teaching Problem Solving](http://www.homeschoolmath.net/teaching/problem_solving.php)  ML – [Unit about Partitioning Problems](http://teachers.yale.edu/curriculum/search/viewer.php?id=initiative_07.06.05_u#e)  A – [Variety of Story Problems](http://www.quia.com/pop/13193.html?AP_rand=1526425433)  V – [Number Patterns](https://www.youtube.com/watch?v=qzIFTeNmaQQ&feature=BFa&list=PL1297DBC01393A441&lf=results_main)  ML – [Patterns Lesson Plan with Resources](http://alex.state.al.us/lesson_view.php?id=24148) |
| **Grade 4** | | |
| **Cluster:** Use the four operations with whole numbers to solve problems. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 4.OA.1  4.OA.2  4.OA.3 | Interpret a multiplication equation as a comparison, e.g., interpret 35 = 5 × 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.  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.  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. | ML – [Lesson Incorporating a Spy Game](http://www.shodor.org/interactivate/lessons/SpyGame/)  R – [App Using the Order of Operations](http://www.shodor.org/interactivate/activities/OrderOfOperationsFou/)  A – [Various Games Using Word Problems with All Operations](http://www.ixl.com/math/grade-4/addition-subtraction-multiplication-and-division-word-problems)  V – [Chessboard Algebra and Function Machines](https://www.teachingchannel.org/videos/algebra-lesson-planning)  ML – [Introduction Lesson about Arithmetic and Geometric Sequences](https://www.teachingchannel.org/videos/algebra-lesson-planning)  A – [Interactive Word Problems for All Operations](http://www.ixl.com/math/grade-4/addition-subtraction-multiplication-and-division-word-problems)  A – [Interactive Word Problems with Extra or Missing Information](http://www.ixl.com/math/grade-4/addition-subtraction-multiplication-and-division-word-problems) |
| **Cluster:** Gain familiarity with factors and multiples. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 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.  Generate and analyze patterns. | ML – [Factors Lesson to Understand Factors of Whole Numbers](http://www.shodor.org/interactivate/lessons/Factors/)  ML – [Finding Factors Lesson](http://www.shodor.org/interactivate/lessons/FindingFactors/)  A – [Factor Trail Game](http://illuminations.nctm.org/LessonDetail.aspx?id=L719) |
| **Cluster:** Generate and analyze patterns. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 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.* | ML – [Representing Patterns and Evaluating Expressions](http://www.uen.org/Lessonplan/preview?LPid=23495)  ML – [Tessellate Lesson and Activity](http://www.shodor.org/interactivate/activities/Tessellate/)  A – [Interactive Activity – Numeric Patterns](http://www.ixl.com/math/grade-4/numeric-patterns-word-problems)  R – [Illustrative Math Project about Patterns](http://illustrativemathematics.org/standards/k8)  V – [Math Patterns](http://www.khanacademy.org/exercise/math-patterns) |
| **Grade 5** | | |
| **Cluster:** Write and interpret numerical expressions. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 5.OA.1  5.OA.2 | Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.  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.* | R – [Illustrations and Explanations](http://illustrativemathematics.org/standards/k8)  A – [Target Number Dash Task Card](http://www.k-5mathteachingresources.com/support-files/targetnumberdash5.oa1.pdf)  A – [Verbal Expressions Activity](http://www.k-5mathteachingresources.com/support-files/5.oa2.pdf)  ML – [Simplify Expressions](http://www.uen.org/Lessonplan/preview?LPid=23376)  R – [Order of Operations Rap Song](http://utah.pbslearningmedia.org/resource/mgbh.math.oa.pemdas/) |
| **Cluster:** Analyze patterns and relationships. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 5.OA.3 | Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns, and graph the ordered pairs on a coordinate plane. *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.* | A – [Functions in the Wild Lesson with Video Resource](http://utah.pbslearningmedia.org/resource/mwnetmathnumexpbiancawi/creating-numerical-patterns-with-rules-bianca-functions-in-the-wild/)  A – [Petals Around the Rose Game](http://illuminations.nctm.org/LessonDetail.aspx?id=L576)  ML - [Stop that Machine – Solutions to Functions](http://utah.pbslearningmedia.org/resource/mwnetmathopalpattstopmach/)  A – [Finding Patterns to Make Predictions](http://utah.pbslearningmedia.org/resource/mgbh.math.oa.steps/finding-patterns-to-make-predictions/)  V – [Visualizing and Interpreting Relationships Between Patterns - Khan](https://www.khanacademy.org/exercise/visualizing-and-interpreting-relationships-between-patterns) |

**Domain: Number and Operations in Base Ten**

*Note: Grade 4 expectations in this domain are limited to whole numbers less than or equal to 1,000,000.*

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| **Kindergarten** | | |
| **Cluster:** Working with numbers 11-19 to gain foundations for place value. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 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. | A – [Representation of Numbers up to 20](http://www.ixl.com/math/kindergarten/represent-numbers-up-to-20)  ML – [Interactive Lesson and Activity](http://illuminations.nctm.org/LessonDetail.aspx?ID=U153)  ML – [Interactive Lesson and Activity](http://illuminations.nctm.org/Activity.aspx?id=3526) |
| **Grade 1** | | |
| **Cluster:** Extend the counting sequence. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 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. | ML – [Lesson with Resources and Video Clip](http://gpb.pbslearningmedia.org/resource/vtl07.math.number.nums.lpcount/counting-and-place-value/)  ML – [Curious George Learns to Count Literature Unit](http://www.houghtonmifflinbooks.com/features/cgsite/learnstocount_lp.shtml) |
| **Cluster:** Understand place value. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 1.NBT.2  1.NBT.3 | Understand that the two digits of a two-digit number represent amounts of tens and ones. Understand the following as special cases:  a. 10 can be thought of as a bundle of ten ones — called a “ten.”  b. The numbers from 11 to 19 are composed of a ten and one, two, three, four, five, six, seven, eight, or nine ones.  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).  Compare two two-digit numbers based on meanings of the tens and ones digits, recording the results of comparisons with the symbols >, =, and <. | PL – [Place Value Center Discussion](http://www.learner.org/resources/series32.html?pop=yes&pid=873)  A – [Task Card for Understanding Place Value](http://www.k-5mathteachingresources.com/support-files/make-it-four-ways.pdf)  V – [Video Series Focusing on Developmental Stages of Number Sense](http://illuminations.nctm.org/Reflections_preK-2.html)  ML – [Grouping Unit with Resources and Activities](http://illuminations.nctm.org/LessonDetail.aspx?id=L876)  ML – [Variety of Activities to Engage with Numbers](http://www.teachervision.fen.com/math/lesson-plan/48937.html)  A – [Place Value Game](http://www.sheppardsoftware.com/mathgames/placevalue/fruit_shoot_place_value.htm)  V – [Short Clip Sharing the Greater Than/Less Than Trick](http://www.teachertube.com/viewVideo.php?title=Greater_Than_and_Less_Than_Trick&video_id=185391)  ML – [Comparing Numbers Less Than 100 Lesson](http://www.homeschoolmath.net/teaching/pv/greater_than.php) |
| **Cluster:** Use place value understanding and properties of operations to add and subtract. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 1.NBT.4  1.NBT.5  1.NBT.6 | 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.  Given a two-digit number, mentally find 10 more or 10 less than the number, without having to count; explain the reasoning used.  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. | A – [Concepts of Adding Using the Day of the Month](http://www.learner.org/resources/series32.html?pop=yes&pid=882)  S – [Variety of Strategies](http://thinkmath.edc.org/index.php/Addition_and_subtraction)  ML – [Using Place Value for Addition and Subtraction](http://teachers.yale.edu/curriculum/search/viewer.php?id=initiative_11.06.01_u&skin=h)  ML – [Place Value Unit Focusing on Addition of Two-Digit Numbers](http://teachers.yale.edu/curriculum/search/viewer.php?id=initiative_11.06.03_u&skin=h)  A – [Adding Multiples of Ten Game](http://www.ictgames.com/add10Depth/index.html)  R – [Adding Sets of Ten Task Card](http://www.k-5mathteachingresources.com/support-files/addingsetsof101.nbt4.pdf)  ML – [Skip Counting Lesson](http://carmenjohnson.hubpages.com/hub/Skip-Counting-Lesson)  V – [Ten Sweets Per Pack](http://www.youtube.com/watch?v=VL1Bwcf2zaQ&feature=related)  A – [Subtracting by Tens](http://www.ixl.com/math/grade-1/subtract-tens) |
| **Grade 2** | | |
| **Cluster:** Understand place value. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 2.NBT.1  2.NBT.2  2.NBT.3  2.NBT.4 | 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:  a.100 can be thought of as a bundle of ten tens — called a “hundred.”  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).  Count within 1000; skip-count by 5s, 10s, and 100s.  Read and write numbers to 1000 using base-ten numerals, number names, and expanded form.  Compare two three-digit numbers based on meanings of the hundreds, tens, and ones digits, using >, =, and < symbols to record the results of comparisons. | R – [Math Rocks Song about Place Value](http://www.youtube.com/watch?v=vZLbnFE_Yf4&feature=plcp&context=C3166d3dUDOEgsToPDskJFAImgQ1_rGV0a-xyPd_6v)  V – [Example Lesson](http://mssmiths2ndgradeclassroom.weebly.com/addition-and-subtraction-3-digit-numbers.html)  ML – [Place Value Lesson Plan](https://www.uen.org/Lessonplan/preview.cgi?LPid=21500)  ML – [Interactive Lesson](http://www.theteachersguide.com/lesson%20plans/Math/ATH0019.html)  A – [Place Value Activity](http://www.softschools.com/math/practice/place_value.jsp)  V – [Skip Counting](http://www.mathwithlarry.com/lessons/lesson005.htm)  V – [Counting by Tens](http://sciencepoems.net/video/countbytens.aspx)  V – [Writing in Standard Form](http://www.dailymotion.com/video/xeajpg_how-to-write-numbers-in-standard-fo_techx)  S – [Expanded Form Made Simple](http://www.lessonplanspage.com/mathplacevalueexpandedform24-htm/)  R – [Number Cards](http://www.superteacherideas.com/math10-expandedform.html)  A – [Spell the Number Game](http://www.funbrain.com/numwords/index.html)  R – [Number Word Concentration](http://www.k-5mathteachingresources.com/support-files/numberwordconcentration.pdf)  V – [Comparing Numbers](http://www.brainpopjr.com/math/numbersense/comparingnumbers/preview.weml)  S – [Learning to Compare Numbers](http://www.smartfirstgraders.com/greater-than-less-than.html)  ML - [Place Value Challenge](http://www.k-5mathteachingresources.com/support-files/placevaluechallenge3digits.pdf)  ML – [Number Muncher Game](http://www.beaconlearningcenter.com/Lessons/2583.htm)  A – [Comparing Number Values](http://www.abcya.com/comparing_number_values.htm) |
| **Cluster:** Use place value understanding and properties of operations to add and subtract. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 2.NBT.5  2.NBT.6  2.NBT.7  2.NBT.8  2.NBT.9 | Fluently add and subtract within 100 using strategies based on place value, properties of operations, and/or the relationship between addition and subtraction.  Add up to four two-digit numbers using strategies based on place value and properties of operations.  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 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 decompose tens or hundreds.  Mentally add 10 or 100 to a given number 100–900, and mentally subtract 10 or 100 from a given number 100–900.  Explain why addition and subtraction strategies work, using place value and the properties of operations. (Note: Explanations may be supported by drawings or objects.) | V – [Addition Techniques](http://www.neok12.com/php/watch.php?v=zX7f797d6004624b69445e7f&t=Addition)  V – [Teaching Subtraction](http://www.youtube.com/watch?v=5SZfXi_44Rg&feature=related)  S – [Variety of Strategies for Adding and Subtracting](http://www.schools.nsw.edu.au/learning/7-12assessments/naplan/teachstrategies/yr2010/index.php?id=numeracy/nn_numb/nn_numb_s2a_10)  ML [– Using the Inverse Relationship Between Addition and Subtraction](http://www.tpspublishing.com/pdf_sample/g2-ns-sample/g2_classroom.pdf)  ML – [There’s More Than One Way to Add](http://www.uen.org/Lessonplan/preview.cgi?LPid=21446)  PL – [Article about Teaching Two-Digit Addition](http://mathandreadinghelp.org/ideas_for_teaching_2_digit_addition.html)  ML – [Let’s Party Lesson Plan](http://alex.state.al.us/lesson_view.php?id=24010)  V – [Montessori Way of Subtracting](http://www.youtube.com/watch?v=9VYNTlb91D8&feature=player_embedded%23%21-)  PL – [Article Focusing on Techniques for Teaching Subtraction](http://www.ehow.com/info_8266487_techniques-teaching-subtraction.html)  R – [Fact Sheet with Five Different Methods for Mental Math](http://www.scribd.com/doc/6911100/4/Hundreds-tens-and-ones)  A – [Using Base Ten Blocks to Support Adding and Subtracting](http://nlvm.usu.edu/en/nav/topic_t_1.html)  V – [How to Add Tens, Hundreds, and Thousand with Resources](http://www.adaptedmind.com/v.php?vId=146)  R – [Mentally Adding by Ten Song](http://mathandmusic.edc.org/index.php/Adding_10_to_any_number)  A – [Add Ten Sub Challenge Game](http://www.ictgames.com/submarinenopad2.html)  PL – [Subtraction Across Zero](http://ethemes.missouri.edu/themes/903)  V – [Why Borrowing Works](http://www.khanacademy.org/math/arithmetic/addition-subtraction/v/why-borrowing-works) |
| **Grade 3** | | |
| **Cluster:** Use place value understanding and properties of operations to perform multi-digit arithmetic.  *(Note: A range of algorithms may be used.)* | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 3.NBT.1  3.NBT.2  3.NBT.3 | Use place value understanding to round whole numbers to the nearest 10 or 100.  Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction.  Multiply one-digit whole numbers by multiples of 10 in the range 10–90 (e.g., 9 × 80, 5 × 60) using strategies based on place value and properties of operations. | V – [Rounding Numbers to the Nearest Ten or Hundred](http://www.mathvids.com/lesson/mathhelp/493-rounding-numbers)  R – [Rounding Resources](http://www.aaastudy.com/g32_rox1.htm)  A – [Variety of Math Games Related to Rounding](http://www.softschools.com/math/games/)  ML – [Literature Connected Lesson Plan About Rounding](http://www.mathstart.net/books/level_2/detail.php?level_id=2&book_id=28)  PL – [Alternative Procedures for Computation](http://www.mec-math.org/community-engagement/public-awareness/thinking-about-alternative.pdf)  V – [Modeling How to Subtract Using Base Ten Manipulatives](http://schoolwaxtv.com/notepad-tutor-subtraction-including-borrowing-2-digit-subtraction-regrouping)  V – [Short Video About Multiplying a Single Digit by a Multiple of Ten](http://www.youtube.com/watch?v=4UVd0Yx7qMQ&feature=related)  V – [Multiplying Tens](http://www.youtube.com/watch?v=_AdRQffD5cM&feature=related)  V – [Real World Multiplication](http://teachingtoday.glencoe.com/videos/view/real-world-multiplication)  ML – [All About Multiplication Unit](http://illuminations.nctm.org/LessonDetail.aspx?id=U109)  R – [Multiplication Song](http://www.youtube.com/watch?v=jPO5zAwfRSc) |
| **Grade 4** | | |
| **Cluster:** Generalize place value understanding for multi-digit whole numbers. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 4.NBT.1  4.NBT.2  4.NBT.3 | 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.*  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.  Use place value understanding to round multi-digit whole numbers to any place. |  |
| **Cluster:** Use place value understanding and properties of operations to perform multi-digit arithmetic. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 4.NBT.4  4.NBT.5  4.NBT.6 | Fluently add and subtract multi-digit whole numbers using the standard algorithm.  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.  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. |  |
| **Grade 5** | | |
| **Cluster:** Understand the place value system. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 5.NBT.1  5.NBT.2  5.NBT.3  5.NBT.4 | 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.  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.  Read, write, and compare decimals to thousandths.  a. Read and write decimals to thousandths using base-ten numerals, number names, and expanded form, e.g., 347.392 = 3 × 100 + 4 × 10 + 7 × 1 + 3 × (1/10) + 9 × (1/100) + 2 × (1/1000).  b. Compare two decimals to thousandths based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.  Use place value understanding to round decimals to any place. |  |
| **Cluster:** Perform operations with multi-digit whole numbers and with decimals to hundredths. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 5.NBT.5  5.NBT.6  5.NBT.7 | Fluently multiply multi-digit whole numbers using the standard algorithm.  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.  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 between addition and subtraction; relate the strategy to a written method and explain the reasoning used. |  |

**Domain: Number and Operations – Fractions**

*Notes:*

* *Number and Operations - Fractions begin in Grade 3.*
* *Grade 3 expectations in this domain are limited to fractions with denominators 2, 3, 4, 6, and 8.*
* *Grade 4 expectations in this domain are limited to fractions with denominators 2, 3, 4, 5, 6, 8, 10, 12, and 100.*

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| **Grade 3** | | |
| **Cluster:** Develop understanding of fractions as numbers. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 3.NF.1  3.NF.2  3.NF.3 | 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*.  Understand a fraction as a number on the number line; represent fractions on a number line diagram.  a. 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. 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.  b. 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.  Explain equivalence of fractions in special cases, and compare fractions by reasoning about their size.  a. Understand two fractions as equivalent (equal) if they are the same size, or the same point on a number line.  b. 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.  c. 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.*  d. 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. |  |
| **Grade 4** | | |
| **Cluster:** Extend understanding of fraction equivalence and ordering. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 4.NF.1  4.NF.2 | Explain why a fraction *a*/*b* is equivalent to a fraction (*n* × *a*)/(*n* × *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.  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. |  |
| **Cluster:** Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 4.NF.3  4.NF.4 | Understand a fraction *a*/*b* with *a* > 1 as a sum of fractions 1/*b*.  a. Understand addition and subtraction of fractions as joining and separating parts referring to the same whole.  b. 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.*  c. 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.  d. 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.  Apply and extend previous understandings of multiplication to multiply a fraction by a whole number.  a. 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).*  b. 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.)*  c. 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?* |  |
| **Cluster:** Understand decimal notation for fractions, and compare decimal fractions. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 4.NF.5  4.NF.6  4.NF.7 | 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.* (Note: Students who can generate equivalent fractions can develop strategies for adding fractions with unlike denominators in general. But addition and subtraction with unlike denominators in general is not a requirement at this grade.)  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.*  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. |  |
| **Grade 5** | | |
| **Cluster:**  Use equivalent fractions as a strategy to add and subtract fractions. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 5.NF.1  5.NF.2 | 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.)*  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.* |  |
| **Cluster:** Apply and extend previous understandings of multiplication and division to multiply and divide fractions. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 5.NF.3  5.NF.4  5.NF.5  5.NF.6  5.NF.7 | 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?*  Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction.  a. Interpret the product (*a*/*b*) × *q* as *a* parts of a partition of *q* into *b* equal parts; equivalently, as the result of a sequence ofoperations *a* × *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.)*  b. 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.  Interpret multiplication as scaling (resizing), by:  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.  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 = (n×a)/(n×b) to the effect of multiplying a/b by 1.  Solve real world problems involving multiplication of fractions and mixed numbers, e.g., by using visual fraction models or equations to represent the problem.  Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions. (Note: Students able to multiply fractions in general can develop strategies to divide fractions in general, by reasoning about the relationship between multiplication and division. But division of a fraction by a fraction is not a requirement at this grade.)  a. 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.  b. 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.  c. 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? |  |

**Domain: Measurement and Data**

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| **Kindergarten** | | |
| **Cluster:** Describe and compare measureable attributes. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| K.MD.1  K.MD.2 | Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object.  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.* | V – [SID the Science Kid Explores Measurement by PBS](http://www.youtube.com/watch?v=3hlkRcTmFxY&feature=related)  V – [Measurement Video Series](http://www.learner.org/courses/learningmath/measurement/index.html)  ML – [Multiple Measurement Lessons by Standard](http://illuminations.nctm.org/Lessons.aspx)  ML – [Hop on Pop Literacy and Measurement Lesson Plan](http://alex.state.al.us/lesson_view.php?id=12851)  A – [Measurement Hunt](http://illuminations.nctm.org/LessonDetail.aspx?id=L873)  PL – [Measurement Course](http://www.learner.org/courses/learningmath/measurement/index.html)  R – [Jack and the Beanstalk Measurement Centers](http://www.uen.org/Lessonplan/preview?LPid=10692) |
| **Cluster:** Classify objects and count the number of objects in each category. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| K.MD.3 | Classify objects or people into given categories; count the numbers in each category and sort the categories by count. (Note: Limit category counts to be less than or equal to 10.) | PL – [Measurement Course](http://www.learner.org/courses/learningmath/measurement/index.html)  A – [Animal Cracker Sorting](http://alex.state.al.us/lesson_view.php?id=5776)  A – S[orting, Ordering, and Classifying Game](http://www.ixl.com/math/kindergarten/put-numbers-up-to-30-in-order)  R – [Jack and the Beanstalk Measurement Centers](http://www.uen.org/Lessonplan/preview?LPid=10692) |
| **Grade 1** | | |
| **Cluster:** Measure lengths indirectly and by iterating length units. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 1.MD.1  1.MD.2 | Order three objects by length; compare the lengths of two objects indirectly by using a third object.  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.* | V – [Measurement Video Series](http://www.learner.org/courses/learningmath/measurement/index.html)  V – [SID the Science Kid Explores Measurement by PBS](http://www.youtube.com/watch?v=3hlkRcTmFxY&feature=related)  ML – [Multiple Measurement Lessons by Standard](http://illuminations.nctm.org/Lessons.aspx)  PL – [Measurement Course](http://www.learner.org/courses/learningmath/measurement/index.html)  R – [Jack and the Beanstalk Measurement Centers](http://www.uen.org/Lessonplan/preview?LPid=10692) |
| **Cluster:** Tell and write time. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 1.MD.3 | Tell and write time in hours and half-hours using analog and digital clocks. | R – [Interactive Clock](http://www.bbc.co.uk/schools/dynamo/den/clock/index.htm)  A – [Match Analog and Digital Clocks Game](http://www.ixl.com/math/grade-1/match-analog-and-digital-clocks) |
| **Cluster:** Represent and interpret data. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 1.MD.4 | Organize, represent, and interpret data 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. | A – [Animal Cracker Sorting](http://alex.state.al.us/lesson_view.php?id=5776)  ML – [Bar Graph Sorter](http://www.shodor.org/interactivate/activities/BarGraphSorter/)  A – [Data Picking](http://www.bbc.co.uk/schools/mathsfile/shockwave/games/datapick.html)  ML – [Daily Graphing Activities and Discussions](http://www.uen.org/Lessonplan/preview?LPid=10696) |
| **Grade 2** | | |
| **Cluster:** Measure and estimate lengths in standard units. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 2.MD.1  2.MD.2  2.MD.3  2.MD.4 | Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.  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.  Estimate lengths using units of inches, feet, centimeters, and meters.  Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard length unit. | V – [Measurement Video Series](http://www.learner.org/courses/learningmath/measurement/index.html)  ML – [Multiple Measurement Lessons by Standard](http://illuminations.nctm.org/Lessons.aspx)  PL – [Measurement Course](http://www.learner.org/courses/learningmath/measurement/index.html)  R – [Jack and the Beanstalk Measurement Centers](http://www.uen.org/Lessonplan/preview?LPid=10692)  A – [Find Someone Using Measurement](http://mixinginmath.terc.edu/activities/findsomeone.cfm)  A – [Is it Possible? Estimating Measurement](http://mixinginmath.terc.edu/activities/isitpossible.cfm)  ML – [Flip the Beans (Measurement Skills)](http://www.uen.org/Lessonplan/preview?LPid=21491) |
| **Cluster:** Relate addition and subtraction to length. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 2.MD.5  2.MD.6 | 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.  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. | ML – [Patriotic Tour (Measurement Lesson)](http://www.uen.org/Lessonplan/preview?LPid=28230)  PL – [Video Discussion on a Variety of Measurement Topics](http://www.learner.org/vod/vod_window.html?pid=1989)  R – [Variety of Resources for Measurement Concepts](http://www.teachingmadeeasier.com/)  ML – [Measurement Unit with Resources](http://www.learner.org/courses/learningmath/measurement/session1/index.html)  A – [Word Problems with Customary Measurements](http://www.ixl.com/math/grade-2/customary-units-of-length-word-problems)  A – [Word Problems with Metric Measurements](http://www.ixl.com/math/grade-2/metric-units-of-length-word-problems)  ML – [Practicing Measurement Using a Body Map](http://illuminations.nctm.org/LessonDetail.aspx?id=U187) |
| **Cluster:** Work with time and money. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 2.MD.7  2.MD.8 | Tell and write time from analog and digital clocks to the nearest five minutes, using a.m. and p.m.  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?* | ML – [How to Read a Clock and Elapsed Time Activity](http://www.shodor.org/interactivate/activities/ElapsedTimeTwo/)  V – [Hip Hop Around the Clock](http://www.youtube.com/watch?v=biann2PWqIA)  A – [Giraffe Pull Game](http://www.arcademicskillbuilders.com/games/giraffe-pull/giraffe-pull.html)  R – [Collection of Activities for Time, Money, and Measurement](http://mathcentral.uregina.ca/RR/database/RR.09.96/danylczuk2.html)  A – [Making Change Game](http://www.ixl.com/math/grade-2/making-change)  A – [Piggy Banks Task](http://www.uen.org/core/math/downloads/piggy_banks.pdf)  ML – [Primary Economics](http://illuminations.nctm.org/LessonDetail.aspx?id=L874) |
| **Cluster:** Represent and interpret data. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 2.MD.9  2.MD.10 | 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.  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 together, take-apart, and compare problems using information presented in a bar graph. | ML – [Ladybug Lengths](http://illuminations.nctm.org/LessonDetail.aspx?id=L123)  ML – [Length of My Feet](http://illuminations.nctm.org/LessonDetail.aspx?ID=L124)  A –[Measurement Line Plot](http://www.k-5mathteachingresources.com/support-files/measurementlineplot.pdf)  V – [Video Lesson on Graphs](http://math4children.com/Videos/graphs/index.html)  R – [Primary Poster to Display Findings](http://mypages.iit.edu/~smile/mp2098.htm)  A – [Create Line Plots](http://www.ixl.com/math/grade-2/create-line-plots)  ML – [Where Do I Fit on the Graph?](http://www.uen.org/Lessonplan/preview?LPid=10867)  A – [Mr. E Graphs – Sort and Graph According to Attributes](http://www.uen.org/Lessonplan/preview?LPid=18836) |
| **Grade 3** | | |
| **Cluster:** Solve problems involving measurement and estimation of intervals of time, liquid volumes, and masses of objects. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 3.MD.1  3.MD.2 | Tell and write time to the nearest minute 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.  Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). (Note: Excludes compound units such as cm3 and finding the geometric volume of a container.) 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. (Note: Excludes multiplicative comparison problems - problems involving notions of “times as much”) | V – [Measurement Video Series](http://www.learner.org/courses/learningmath/measurement/index.html)  ML – [Multiple Measurement Lessons by Standard](http://illuminations.nctm.org/Lessons.aspx)  PL – [Measurement Course](http://www.learner.org/courses/learningmath/measurement/index.html)  V – [Elapsed Time with Math Track](http://www.johnnyskey.com/mckenzie-learns-elapsed-time.asp)  V – [Step-by-Step Approach for Elapsed Time](http://www.youtube.com/watch?v=dOYZ56Dcxug)  A – [Time for a Crime Online Activity](http://teacher.scholastic.com/maven/timefor/index.htm)  V – [Weight and Capacity](http://www.youtube.com/watch?v=0MzxMJuSg0M&feature=related)  V – [Metric Measurement: Capacity](http://www.youtube.com/watch?v=p3WplGVyxJk&feature=related)  V – [Metric Measurement: Weight](http://www.youtube.com/watch?v=6q98k4ybJKw)  S – [Strategies for Measuring the Metric System](http://www.mathsisfun.com/measure/metric-system-introduction.html) |
| **Cluster:** Represent and interpret data. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 3.MD.3  3.MD.4 | 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.*  Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters. | V – [Real-World Graphing Video](http://www.youtube.com/watch?v=Vmh2-ZKJPJU)  V – [Image Keys for Pictographs](http://www.youtube.com/watch?v=DCJ_9MKNfAg&feature=related)  R – [Constructing Bar Graphs](http://www.mathgoodies.com/lessons/graphs/construct_bar.html)  PL – [Teaching Data Display](http://www.teachervision.fen.com/skill-builder/graphs-and-charts/48945.html)  ML – [Flavorful Graphing](http://www.beaconlearningcenter.com/Lessons/2277.htm)  ML – [Game Day Graphing](http://www.beaconlearningcenter.com/Lessons/173.htm)  A – [Collecting and Representing Data Task](http://www.k-5mathteachingresources.com/support-files/collectingandrepresentingdata.pdf)  PL – [Data Analysis and Statistics for Teachers](http://www.learner.org/resources/series158.html?pop=yes&pid=1686)  V – [Basic Line Plot Video](http://teachertube.com/viewVideo.php?title=Watch_Video_on_Pictographs_and_Line_Plots___Pre_Algebra_Help&video_id=46155)  PL – [Article about Common Misconceptions Related to Graphs](http://www.epcae.org/uploads/documents/Graphs_Sept%2020.pdf)  PL – [Teaching Data Display Article](http://www.teachervision.fen.com/skill-builder/graphs-and-charts/48945.html)  ML – [Frogs in Flight Plan on Data Analysis](http://www.nsa.gov/academia/_files/collected_learning/elementary/data_analysis/line-plots_frogs-in-flight.pdf)  ML – [Guinness Book of Records Lesson and Activity](http://www.nsa.gov/academia/_files/collected_learning/elementary/data_analysis/guinness_book_of_records.pdf) |
| **Cluster:** Geometric measurement: understand concepts of area and relate area to multiplication and to addition. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 3.MD.5  3.MD.6  3.MD.7 | Recognize area as an attribute of plane figures and understand concepts of area measurement.  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.  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.  Measure areas by counting unit squares (square cm, square m, square in, square ft, and improvised units).  Relate area to the operations of multiplication and addition.  a. 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.  b. 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.  c. 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* × *b* and *a* × *c*. Use area models to represent the distributive property in mathematical reasoning.  d. 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. | PL – [Measurement Course](http://www.learner.org/courses/learningmath/measurement/index.html)  V – [Area](http://www.learner.org/courses/learningmath/measurement/session6/video.html?pop=yes&pid=1994)  V – [Area Tiling](http://www.teachervision.fen.com/measuring-space/video/57055.html?detoured=1)  R – [When Units Go Square](http://www4.ncsu.edu/unity/lockers/users/f/felder/public/kenny/papers/units2.html)  ML – [Square Units Lesson with Resources](http://www.homeschoolmath.net/teaching/g/area.php)  R – [Area App](http://www.shodor.org/interactivate/activities/AreaExplorer/)  V – [Measuring Area](http://www.teachervision.fen.com/measurement/pro-dev/57073.html?detoured=1)  A – [Designing a Flower Bed Task Card](http://www.k-5mathteachingresources.com/support-files/designingaflowerbed.pdf)  R – [Printable Area Cards](http://www.k-5mathteachingresources.com/support-files/rectangularareacards.pdf)  R – [Geoboard Task Cards](http://www.k-5mathteachingresources.com/support-files/areaonthegeobaord.pdf)  A – [Developing the Formula](http://www.k-5mathteachingresources.com/support-files/developingaformulafortheareaofarectangle.pdf)  A – [The Pasture and the Fence](http://www.uen.org/Lessonplan/preview?LPid=14856)  A – [Giant Museum Extension Activity](http://mixinginmath.terc.edu/activities/giantmuseum.cfm)  A – [Shape Builder](http://www.shodor.org/interactivate/activities/ShapeBuilder/)  ML – [Length, Perimeter, and Area](http://www.shodor.org/interactivate/lessons/LengthPerimeterArea/) |
| **Cluster:** Geometric measurement: recognize perimeter as an attribute of plane figures and distinguish between linear and area measures. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 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. | ML - [Shape Explorer](http://www.shodor.org/interactivate/activities/ShapeExplorer/)  ML – [Fixed Areas – Connection between Area and Perimeter](http://www.teachervision.fen.com/measuring-space/printable/56871.html)  ML – [Junior Architects Unit](http://illuminations.nctm.org/LessonDetail.aspx?ID=U172) |
| **Grade 4** | | |
| **Cluster:** Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 4.MD.1  4.MD.2  4.MD.3 | 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), ...*  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.  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.* | V – [Measurement Video Series](http://www.learner.org/courses/learningmath/measurement/index.html)  PL – [Measurement Course](http://www.learner.org/courses/learningmath/measurement/index.html) |
| **Cluster:** Represent and interpret data. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 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.* |  |
| **Cluster:** Geometric measurement: understand concepts of angle and measure angles. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 4.MD.5  4.MD.6  4.MD.7 | Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement:  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.  b. An angle that turns through *n* one-degree angles is said to have an angle measure of *n* degrees.  Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure.  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. | PL – [Measurement Course](http://www.learner.org/courses/learningmath/measurement/index.html) |
| **Grade 5** | | |
| **Cluster:** Convert like measurement units within a given measurement system. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 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. | V – [Measurement Video Series](http://www.learner.org/courses/learningmath/measurement/index.html) |
| **Cluster:** Represent and interpret data. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 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.* |  |
| **Cluster:** Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 5.MD.3  5.MD.4  5.MD.5 | Recognize volume as an attribute of solid figures and understand concepts of volume measurement.  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.  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.  Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units.  Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume.  a. 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.  b. 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.  c. 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. | PL – [Measurement Course](http://www.learner.org/courses/learningmath/measurement/index.html) |

**Domain: Geometry**

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| **Kindergarten** | | |
| **Cluster:** Identify and describe shapes (squares, circles, triangles, rectangles, hexagons, cubes, cones, cylinders, and spheres). | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| K.G.1  K.G.2  K.G.3 | 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*.  Correctly name shapes regardless of their orientations or overall size.  Identify shapes as two-dimensional (lying in a plane, “flat”) or three-dimensional (“solid”). |  |
| **Cluster:** Analyze, compare, create, and compose shapes. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| K.G.4  K.G.5  K.G.6 | 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).  Model shapes in the world by building shapes from components (e.g., sticks and clay balls) and drawing shapes.  Compose simple shapes to form larger shapes. *For example, “Can you join these two triangles with full sides touching to make a rectangle?”* |  |
| **Grade 1** | | |
| **Cluster:** Reason with shapes and their attributes. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 1.G.1  1.G.2  1.G.3 | 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.  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 shapes from the composite shape. (Note: Students do not need to learn formal names such as “right rectangular prism.”)  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 decomposing into more equal shares creates smaller shares. |  |
| **Grade 2** | | |
| **Cluster:** Reason with shapes and their attributes. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 2.G.1  2.G.2  2.G.3 | Recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces. (Note: Sizes are compared directly or visually, not compared by measuring.) Identify triangles, quadrilaterals, pentagons, hexagons, and cubes.  Partition a rectangle into rows and columns of same-size squares and count to find the total number of them.  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. |  |
| **Grade 3** | | |
| **Cluster:** Reason with shapes and their attributes. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 3.G.1  3.G.2 | 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 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.  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.* |  |
| **Grade 4** | | |
| **Cluster:** Draw and identify lines and angles, and classify shapes by properties of their lines and angles. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 4.G.1  4.G.2  4.G.3 | Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.  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.  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. |  |
| **Grade 5** | | |
| **Cluster:** Graph points on the coordinate plane to solve real-world and mathematical problems. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 5.G.1  5.G.2 | 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).  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. |  |
| **Cluster:** Classify two-dimensional figures into categories based on their properties. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 5.G.3  5.G.4 | 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.*  Classify two-dimensional figures in a hierarchy based on properties. |  |

Kentucky Core Academic Progression of Standards and Related Intervention Supports

MATHEMATICS- Middle School

R-Resources S- Strategy A- Activities V- Video ML- Model Lesson PL- Professional Learning

**Domain: Ratios and Proportional Relationships**

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| **Grade 6** | | |
| **Cluster:** Understand ratio concepts and use ratio reasoning to solve problems. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 6.RP.1  6.RP.2  6.RP.3 | 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.”  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.” (Note: Expectations for unit rates in this grade are limited to non-complex fractions.)  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.   1. 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. 2. 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? 3. 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. 4. Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities. | [https://njctl.org/courses/math/6th-grade-math/ratios-proportions-percents/ratios-proportions-percents-2/#](https://njctl.org/courses/math/6th-grade-math/ratios-proportions-percents/ratios-proportions-percents-2/)  Ratios & Proportions (Grade 6/7 focus)  <https://secondarymathcommoncore.wikispaces.hcpss.org/MS+After+School+Intervention> |
| **Grade 7** | | |
| **Cluster:** Analyze proportional relationships and use them to solve real-world and mathematical problems. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 7.RP.1  7.RP.2  7.RP.3 | 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.*  Recognize and represent proportional relationships between quantities.  a. 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.  b. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.  c. 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*.  d. 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.  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.* | [https://njctl.org/courses/math/7th-grade/ratios-proportions/ratios-proportions-7th-grade-2/#](https://njctl.org/courses/math/7th-grade/ratios-proportions/ratios-proportions-7th-grade-2/)  Ratios & Proportions (Grade 6/7 focus)  <https://secondarymathcommoncore.wikispaces.hcpss.org/MS+After+School+Intervention>  Unit Plan  <http://secmathcurriculum.wikispaces.com/file/detail/10.28.11_MCCSC.Unit+Plan_7.RP.1-3.docx> |

**Domain: The Number System**

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| **Grade 6** | | |
| **Cluster:** Apply and extend previous understandings of multiplication and division to divide fractions by fractions. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 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? How wide is a rectangular strip of* *land with length 3/4 mi and area 1/2 square mi?* | Video – eSpark Learning: Dividing Fractions  <http://www.youtube.com/watch?v=ASc1QQ-nHbk>  Foldable  <http://www.teacherspayteachers.com/Product/Rules-of-Divisibility-Differentiated-Interactive-Notes-and-Worksheets-327778>  Lesson Plan Ideas  <http://kuna6th.weebly.com/number-system-part-1.html>  Models for dividing fractions  <http://dnet01.ode.state.oh.us/ims.itemdetails/lessondetail.aspx?id=0907f84c80530aea> |
| **Cluster:** Compute fluently with multi-digit numbers and find common factors and multiples. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 6.NS.2  6.NS.3  6.NS.4 | Fluently divide multi-digit numbers using the standard algorithm.  Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation.  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).* |  |
| **Cluster:** Apply and extend previous understandings of numbers to the system of rational numbers. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 6.NS.5  6.NS.6  6.NS.7  6.NS.8 | 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.  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.   1. 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. 2. 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. 3. 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.   Understand ordering and absolute value of rational numbers.   1. 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. 2. Write, interpret, and explain statements of order for rational numbers in real-world contexts. For example, write –3° C > –7° C to express the fact that –3° C is warmer than –7° C. 3. 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. 4. 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.   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. |  |
| **Grade 7** | | |
| **Cluster:** Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 7.NS.1  7.NS.2  7.NS.3 | 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.   1. 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.* 2. 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. 3. 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. 4. Apply properties of operations as strategies to add and subtract rational numbers.   Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers.   1. 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. 2. 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. 3. Apply properties of operations as strategies to multiply and divide rational numbers. 4. 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.   Solve real-world and mathematical problems involving the four operations with rational numbers. (NOTE: Computations with rational numbers extend the rules for manipulating fractions to complex fractions.) |  |
| **Grade 8** | | |
| **Cluster:** Know that there are numbers that are not rational, and approximate them by rational numbers. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 8.NS.1  8.NS.2 | Understand informally that every number has a decimal expansion; the rational numbers are those with decimal expansions that terminate in 0s or eventually repeat. Know that other numbers are called irrational.  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., π2). *For example,* *by truncating the decimal expansion of* *, show that is between 1 and* *2, then between 1.4 and 1.5, and explain how to continue on to get better* *approximations.* |  |

**Domain: Expressions and Equations**

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| **Grade 6** | | |
| **Cluster:** Apply and extend previous understandings of arithmetic to algebraic expressions. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 6.EE.1  6.EE.2  6.EE.3  6.EE.4 | Write and evaluate numerical expressions involving whole-number exponents.  Write, read, and evaluate expressions in which letters stand for numbers.   1. 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. 2. 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. 3. Evaluate expressions at specific values of their variables. Include expressions that arise from formulas 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 = s3 and A = 6s2 to find the volume and surface area of a cube with sides of length s = 1/2.   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.  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. | V: Several videos on writing expressions.  <https://learnzillion.com/lessons/460-write-numerical-expressions-involving-wholenumber-exponents>  V/R: Videos and examples on parts of expressions.  <https://www.khanacademy.org/math/cc-sixth-grade-math/cc-6th-expressions-and-variables/cc-6th-writing-expressions/e/identifying-parts-of-expressions>  A: A visual representation of order of operations and how expressions are organized.  <https://mathematicsteachingcommunity.math.uga.edu/index.php/448/interpreting-algebraic-expressions>  R: Provides a clear step-by-step process for evaluating expressions. <http://math.com/school/subject2/lessons/S2U2L3GL.html>  R: Graphic organizers on order of operations.  <http://www.kidzucation.com/math/what-is-the-order-of-operations-in-math/>  R: Several graphic organizers and charts on expressions.  <http://passyworldofmathematics.com/algebra-expressions/>  A: An activity on equivalent expressions.  <https://www.engageny.org/sites/default/files/resource/attachments/math-g7-m3-student-materials.pdf>  V: Videos on equivalent expressions.  <http://www.onlinemathlearning.com/equivalent-expressions-6ee3.html> |
| **Cluster:** Reason about and solve one-variable equations and inequalities. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 6.EE.5  6.EE.6  6.EE.7  6.EE.8 | 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.  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.  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.  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. | ML: A lesson on solving basic equations.  [http://www.cpalms.org/Public/PreviewResource/Preview/39090#/#standards-toggle](http://www.cpalms.org/Public/PreviewResource/Preview/39090#/)  ML: A real world lesson on equations.  [http://www.cpalms.org/Public/PreviewResource/Preview/47447#/#standards-toggle](http://www.cpalms.org/Public/PreviewResource/Preview/47447#/)  V: Videos on equations.  <http://www.virtualnerd.com/common-core/grade-6/6_EE-expression-equations/B/6>  V/R: Several videos and resources on equations.  <http://hr6math.com/2013/11/20/6-ee-7-solve-problems-by-writing-and-solving-equations-of-the-form-x-p-q-and-px-q-adv/>  ML: Lesson on expressions, equations, and inequalities.  <http://www.beaconlearningcenter.com/Lessons/Lesson.asp?ID=1323>  ML: Lesson on inequalities.  <http://www.cpalms.org/Public/PreviewResource/Preview/27913> |
| **Cluster:** Represent and analyze quantitative relationships between dependent and independent variables. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 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 equation d = 65t to represent the relationship between distance and time. | ML: Real-world lesson on equations.  <http://illuminations.nctm.org/Lesson.aspx?id=2099>  ML: Lesson involving independent and dependent variables.  <http://www.cpalms.org/Public/PreviewResource/Preview/31597> |
| **Grade 7** | | |
| **Cluster:** Use properties of operations to generate equivalent expressions. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 7.EE.1  7.EE.2 | Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.  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.” | V: A video on the distributive property.  <https://learnzillion.com/lessons/1126-expand-linear-expressions-using-the-distributive-property>  V/R: Videos and examples on expressions.  <http://www.onlinemathlearning.com/rewrite-expressions.7ee2.html>  ML: Lesson on expressions.  <http://www.cpalms.org/Public/PreviewResource/Preview/55124> |
| **Cluster:** Solve real-life and mathematical problems using numerical and algebraic expressions and equations. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 7.EE.3  7.EE.4 | Solve multi-step real-life and mathematical 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.  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.   1. 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? 2. 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. | ML: A collaborative lesson on equations.  <http://www.cpalms.org/Public/PreviewResource/Preview/53890>  ML: A hands on activity with equations.  <http://www.cpalms.org/Public/PreviewResource/Preview/39102>  V/R: Examples and a video on variables, expressions and equations.  [http://www.learner.org/workshops/algebra/workshop1/index.html#](http://www.learner.org/workshops/algebra/workshop1/index.html)  V/R: Videos and examples on equations.  <https://www.khanacademy.org/math/cc-seventh-grade-math/cc-7th-variables-expressions/cc-7th-2-step-equations/v/why-we-do-the-same--thing-to-both-sides--simple-equations>  R: Several examples on inequalities.  <http://www.algebra-class.com/solving-word-problems-in-algebra.html> |
| **Grade 8** | | |
| **Cluster:** Work with radicals and integer exponents. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 8.EE.1  8.EE.2  8.EE.3  8.EE.4 | Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, 32 × 3–5 = 3–3 = 1/33 = 1/27.  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 is irrational.  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 × 108 and the population of the world as 7 × 109, and determine that the world population is more than 20 times larger.  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. | R: Provides several examples on exponents.  <http://www.purplemath.com/modules/exponent2.htm>  R: Examples on negative exponents.  <http://www.themathpage.com/alg/negative-exponents.htm>  R: Examples on square roots.  <http://www.mathblaster.com/coolmath/articles/using-square-root-and-cube-root-to-represent-solutions-to-equations>  V: Videos on square roots.  <http://www.virtualnerd.com/common-core/grade-8/8_EE-expressions-equations/A/2>  R: Several examples on scientific notation.  <http://www.mathsisfun.com/numbers/scientific-notation.html>  V: Videos on scientific notation.  <https://learnzillion.com/lessonsets/276-perform-operations-with-numbers-expressed-in-scientific-notation-including-decimals> |
| **Cluster:** Analyze and solve linear equations and pairs of simultaneous linear equations. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 8.EE.5  8.EE.6 | 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 two moving objects has greater speed.  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. | ML: Lesson on slope.  <http://betterlesson.com/community/lesson/307561/slope-and-rate-of-change#/community/document/1358584/8th-grade-slope-and-rate-of-change-lesson-plan2-doc?&_suid=1408645848877008058534582923815>  ML: Lesson on slope.  <http://www.cpalms.org/Public/PreviewResource/Preview/56777>  V: Videos on slope.  <http://www.virtualnerd.com/common-core/grade-8/8_EE-expressions-equations/B/6>  V: Video on slope-intercept form.  <https://learnzillion.com/lessons/1473-derive-ymxb-using-similar-triangles> |
| **Cluster:** Understand the connections between proportional relationships, lines, and linear equations. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 8.EE.7  8.EE.8 | Solve linear equations in one variable.   1. 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). 2. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.   Analyze and solve pairs of simultaneous linear equations.   1. 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. 2. 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. 3. 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. | V: Funny video on solving equations.  <http://www.shmoop.com/video/solving-rational-equations-with-one-variable/>  R: Provides a set of steps for solving equations  <http://cstl.syr.edu/fipse/Algebra/Unit3/steps.htm>  R: Examples with explanations on solving equations.  <https://www.illustrativemathematics.org/illustrations/550>  ML: A full lesson on solving equations using the “Party Method.” Includes a full length PowerPoint presentation.  <http://alex.state.al.us/lesson_view.php?id=23865>  R: Shows how to solve system of equations multiple ways.  <http://www.mathsisfun.com/algebra/systems-linear-equations.html>  R: Lists several activities to review/enhance student understanding of system of equations.  <http://www.ilovemath.org/index.php?option=com_docman&task=cat_view&gid=53>  V: Several videos on system of equations.  <https://www.khanacademy.org/math/algebra/systems-of-eq-and-ineq/fast-systems-of-equations/e/systems_of_equations> |

**Domain: Functions**

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| **Grade 8 only** | | |
| **Cluster:** Define, evaluate, and compare functions. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 8.F.1  8.F.2  8.F.3 | 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. (Note: Function notation is not required in Grade 8.)  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.*  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 = s2 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* | V: Several videos on functions.  <http://www.virtualnerd.com/common-core/grade-8/8_F-functions/A/1>  ML: Lesson on functions and perimeter.  <http://alex.state.al.us/lesson_view.php?id=32177>  R: Discusses how to graph several kinds of functions.  <http://math.tutorvista.com/calculus/graphing-functions.html>  V: Several videos on comparing functions.  <https://learnzillion.com/lessons/1194-compare-two-functions-by-analyzing-an-equation-and-a-verbal-description>  ML: Lesson on linear and non-linear functions.  <http://www.cpalms.org/Public/PreviewResource/Preview/48283> |
| **Cluster:** Use functions to model relationships between quantities. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 8.F.4  8.F.5 | 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.  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. | ML: Lesson on graphing functions.  <http://illuminations.nctm.org/Lesson.aspx?id=2858>  ML: Lesson on graph interpretations.  <http://map.mathshell.org.uk/materials/lessons.php?taskid=208&subpage=concept>  ML: An activity on writing functions.  [http://www.cpalms.org/Public/PreviewResource/Preview/48744#/#standards-toggle](http://www.cpalms.org/Public/PreviewResource/Preview/48744#/) |

**Domain: Geometry**

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| **Grade 6** | | | |
| **Cluster:** Solve real-world and mathematical problems involving area, surface area, and volume. | | | |
| **Standards** | **Key ideas and Details** | | **Intervention Supports** |
| 6.G.1  6.G.2  6.G.3  6.G.4 | 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.  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.  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.  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. | | V: Several videos on area.  <http://www.virtualnerd.com/middle-math/geometry-measurement/area-parallelogram-triangle-trapezoid>  ML: An activity connecting area to the real-world.  <http://www.cpalms.org/Public/PreviewResource/Preview/39341>  ML: Real world activity on area.  <http://map.mathshell.org/materials/lessons.php?taskid=482&subpage=problem>  ML: Activity connecting volume to the real-world.  <http://www.beaconlearningcenter.com/Lessons/Lesson.asp?ID=913>  ML: Lesson relating volume and money.  <http://www.cpalms.org/Public/PreviewResource/Preview/47371>  V: Several videos on finding volume.  <http://www.onlinemathlearning.com/volume-formula.html>  V: Video on polygons in the coordinate plane.  <https://learnzillion.com/lessons/1065-draw-polygons-using-given-coordinates-as-vertices>  A: Game involving polygons on the coordinate plane.  <http://www.beaconlearningcenter.com/Lessons/Lesson.asp?ID=1037>  ML: Activity on surface area.  <http://www.cpalms.org/Public/PreviewResource/Preview/26225>  V/R: Videos and examples on surface area.  <https://www.khanacademy.org/math/geometry/basic-geometry/volume_tutorial/e/surface-area> |
| **Grade 7** | | | |
| **Cluster:** Draw, construct, and describe geometrical figures and describe the relationships between them. | | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** | |
| 7.G.1  7.G.2  7.G.3 | 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.  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.  Describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids. | V: Videos on scale drawings.  <http://www.onlinemathlearning.com/scale-drawings-7g1.html>  ML: Lesson on quadrilaterals.  <http://illuminations.nctm.org/Lesson.aspx?id=2189>  A: Activity relating polygons to amusement parks.  <http://www.cpalms.org/Public/PreviewResource/Preview/26834>  V: Video on 3D figures.  <http://www.pbslearningmedia.org/resource/muen-math-g-slicing-3d-figures/slicing-three-dimensional-figures/>  A: Activity on 3D figures involving Play-Doh.  <http://7thgrademathteacherextraordinaire.blogspot.com/2013/04/slicing-three-dimensional-figures-cc-7g3.html> | |
| **Cluster:** Solve real-life and mathematical problems involving angle measure, area, surface area, and volume. | | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** | |
| 7.G.4  7.G.5  7.G.6 | 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.  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.  Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms. | ML: Lesson on circles.  <http://www.beaconlearningcenter.com/Lessons/Lesson.asp?ID=2447>  ML: Activity on Pi.  <http://illuminations.nctm.org/Lesson.aspx?id=2407>  R: Shows examples on circumference and area of a circle.  <http://www.mathgoodies.com/lessons/vol2/circumference.html>  R: PowerPoint on types of angles.  [http://star.spsk12.net/math/8/**AdjacentAngles**.ppt](http://star.spsk12.net/math/8/AdjacentAngles.ppt)  R: Examples on types of angles.  <http://www.algebralab.org/lessons/lesson.aspx?file=Geometry_AnglesComplementarySupplementaryVertical.xml>  V: Several videos on area.  <http://www.virtualnerd.com/middle-math/geometry-measurement/area-parallelogram-triangle-trapezoid>  ML: An activity connecting area to the real-world.  <http://illuminations.nctm.org/Lesson.aspx?id=2769> | |
| **Grade 8** | | | |
| **Cluster:** Understand congruence and similarity using physical models, transparencies, or geometry software. | | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** | |
| 8.G.1  8.G.2  8.G.3  8.G.4  8.G.5 | Verify experimentally the properties of rotations, reflections, and translations:   1. Lines are taken to lines, and line segments to line segments of the same length. 2. Angles are taken to angles of the same measure. 3. Parallel lines are taken to parallel lines.   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.  Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.  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.  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.* | V: Videos on transformations.  <https://learnzillion.com/lessonsets/422-verify-the-properties-of-rotations-reflections-and-translations>  ML: A guided lesson on transformations.  <http://alex.state.al.us/lesson_view.php?id=30033>  ML: Activity on transformations.  <http://www.cpalms.org/Public/PreviewResource/Preview/48156>  V: Videos on transformations.  <http://www.virtualnerd.com/common-core/grade-8/8_G-geometry/A/3>  ML: Activity on transformations.  <http://www.cpalms.org/Public/PreviewResource/Preview/40868>  V: Videos connecting congruence/similarity and transformations.  <https://learnzillion.com/lessonsets/289>  R: Shows examples on types of angles formed by parallel lines and a transversal.  <http://www.mathwarehouse.com/geometry/angle/parallel-lines-cut-transversal.php>  R: Shows examples on the exterior angle theorem of triangles.  <http://regentsprep.org/Regents/math/geometry/GP5/LExtAng.htm>  R: Shows examples on the exterior angle theorem of triangles.  <http://www.mathwarehouse.com/geometry/triangles/>  V/R: Videos and examples on parallel lines cut by a transversal.  <http://www.khanacademy.org/math/geometry/parallel-and-perpendicular-lines/old_angles/v/angles-formed-between-transversals-and-parallel-lines> | |
| **Cluster:** Understand and apply the Pythagorean Theorem. | | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** | |
| 8.G.6  8.G.7  8.G.8 | Explain a proof of the Pythagorean Theorem and its converse.  Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.  Apply the Pythagorean Theorem to find the distance between two points in a coordinate system. | V/R: Videos and examples on the Pythagorean Theorem.  <http://www.khanacademy.org/math/geometry/right_triangles_topic/pyth_theor/v/the-pythagorean-theorem>  V: Video on the converse of the Pythagorean Theorem.  <http://www.onlinemathlearning.com/pythagorean-theorem-converse.html>  ML: Lesson on discovering the Pythagorean Theorem.  <http://www.nsa.gov/academia/_files/collected_learning/high_school/geometry/pythagorean_theorem.pdf>  ML: Activity connecting the Pythagorean Theorem to the real-world.  <http://www.cpalms.org/Public/PreviewResource/Preview/35738>  V: Videos on Pythagorean Theorem and distance.  <https://learnzillion.com/lessonsets/287-apply-the-pythagorean-theorem-to-find-the-distance-between-two-points-in-a-coordinate-system>  ML: Activity connecting Pythagorean Theorem to the real world.  <http://www.cpalms.org/Public/PreviewResource/Preview/43471> | |
| **Cluster:** Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres. | | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** | |
| 8.G.9 | Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems. | R: Provides a visual display of the volume formulas.  <http://www.math.com/tables/geometry/volumes.htm>  R: A visual display of the volume formulas.  <http://www.mathexpression.com/volume-formulas.html>    ML: Activity connecting volume to the real-world.  <http://www.learnnc.org/lp/pages/3497>  ML: Activity connecting volume to the real-world.  <http://www.cpalms.org/Public/PreviewResource/Preview/30345> | |

**Domain: Statistics and Probability**

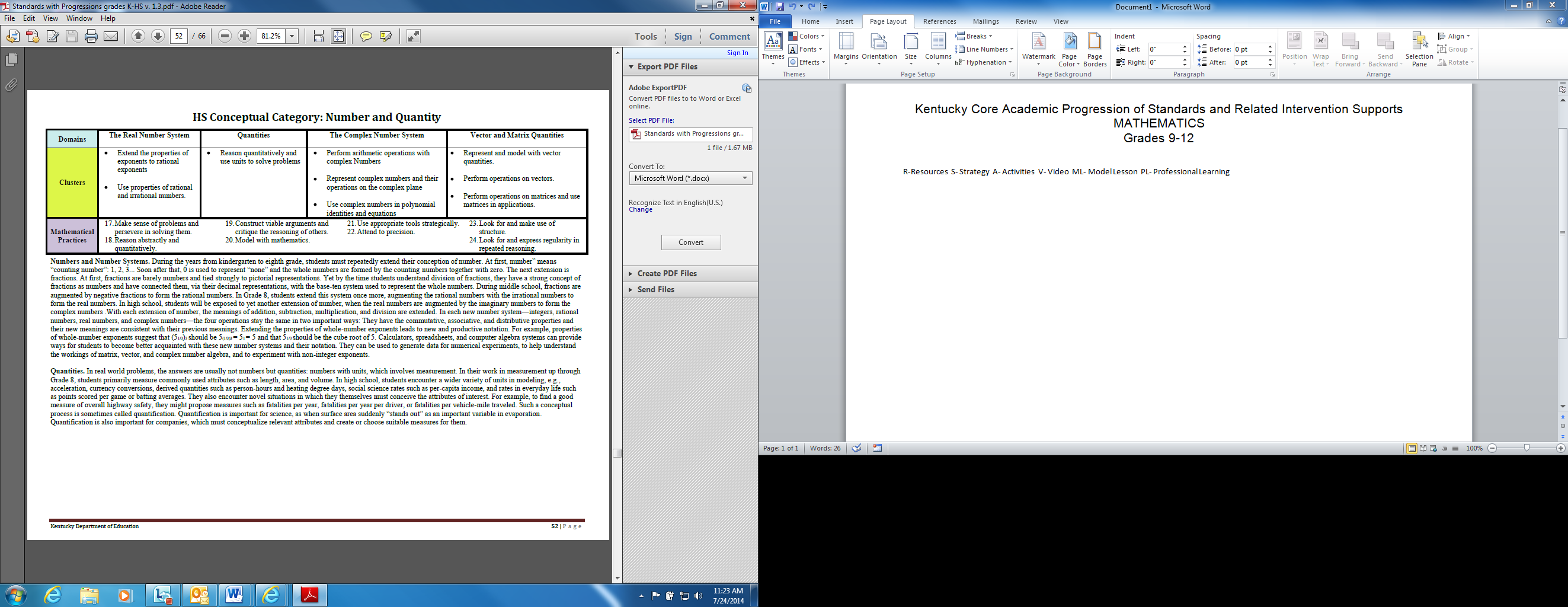
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| **Grade 6** | | |
| **Cluster:** Develop understanding of statistical variability. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 6.SP.1  6.SP.2  6.SP.3 | Recognize a statistical question as one that anticipates 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.*  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.  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. |  |
| **Cluster:** Summarize and describe distributions. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 6.SP.4  6.SP.5 | Display numerical data in plots on a number line, including dot plots, histograms, and box plots.  Summarize numerical data sets in relation to their context, such as by:   1. Reporting the number of observations. 2. Describing the nature of the attribute under investigation, including how it was measured and its units of measurement. 3. 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. 4. 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. |  |
| **Grade 7** | | |
| **Cluster:** Use random sampling to draw inferences about a population. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 7.SP.1  7.SP.2 | 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.  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.* |  |
| **Cluster:** Draw informal comparative inferences about two populations. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 7.SP.3  7.SP.4 | 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.*  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.* |  |
| **Cluster:** Investigate chance processes and develop, use, and evaluate probability models. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 7.SP.5  7.SP.6  7.SP.7  7.SP.8 | 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.  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.*  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.   1. 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.* 2. 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?*   Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.   1. 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. 2. 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. 3. 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?* |  |
| **Grade 8** | | |
| **Cluster:** Investigate patterns of association in bivariate data. | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 8.SP.1  8.SP.2  8.SP.3  8.SP.4 | 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.  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.  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.*  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?* |  |

Kentucky Core Academic Progression of Standards and Related Intervention Supports

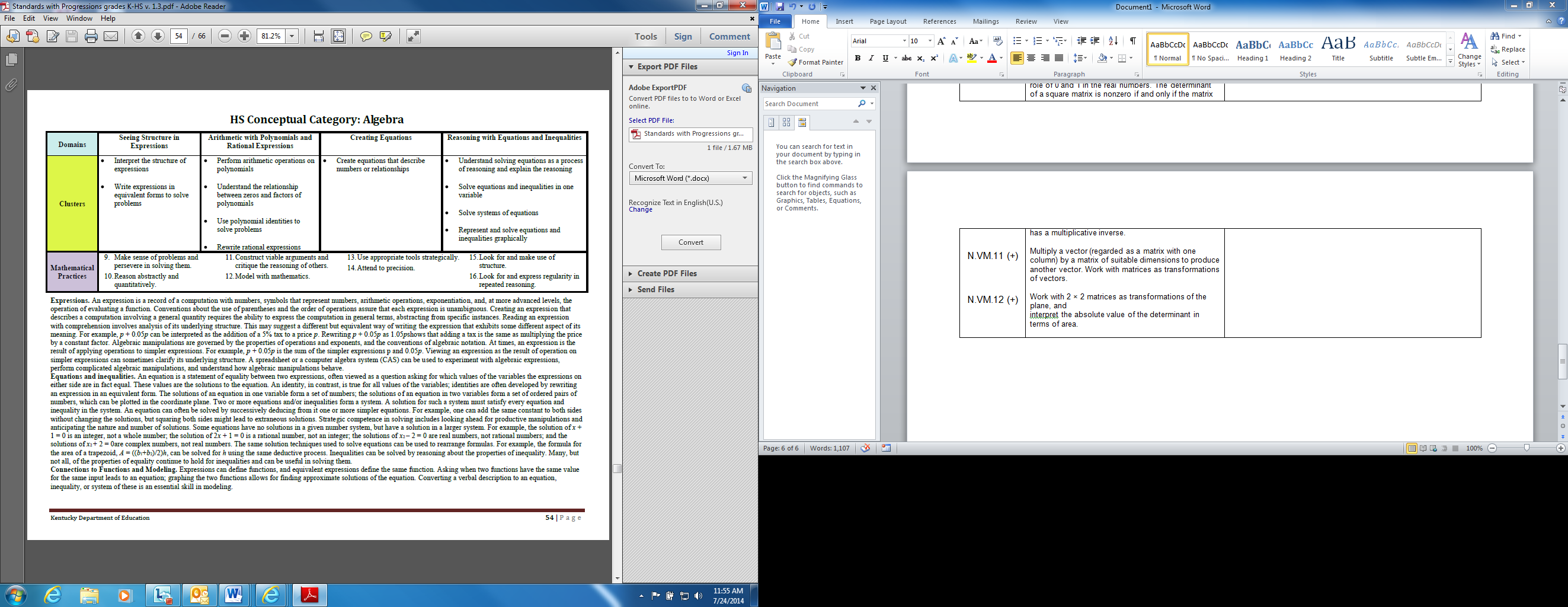
MATHEMATICS

Grades 9-12

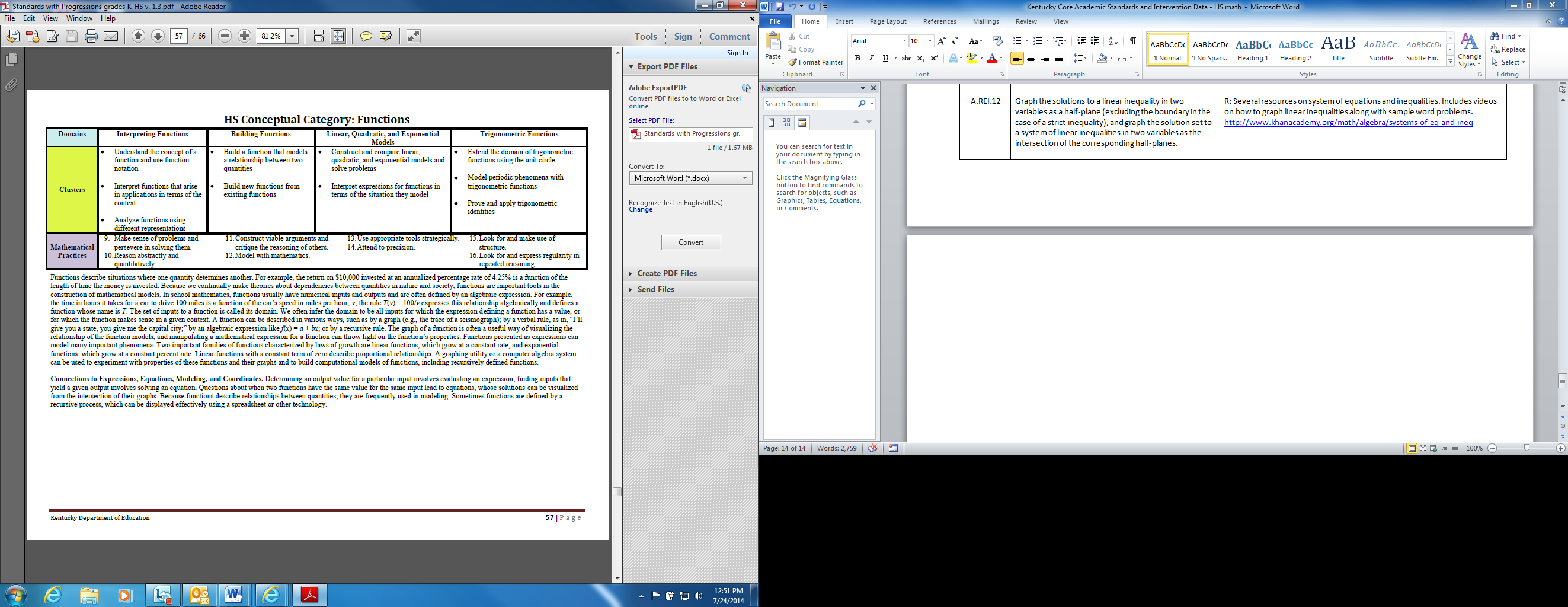
R-Resources S- Strategy A- Activities V- Video ML- Model Lesson PL- Professional Learning



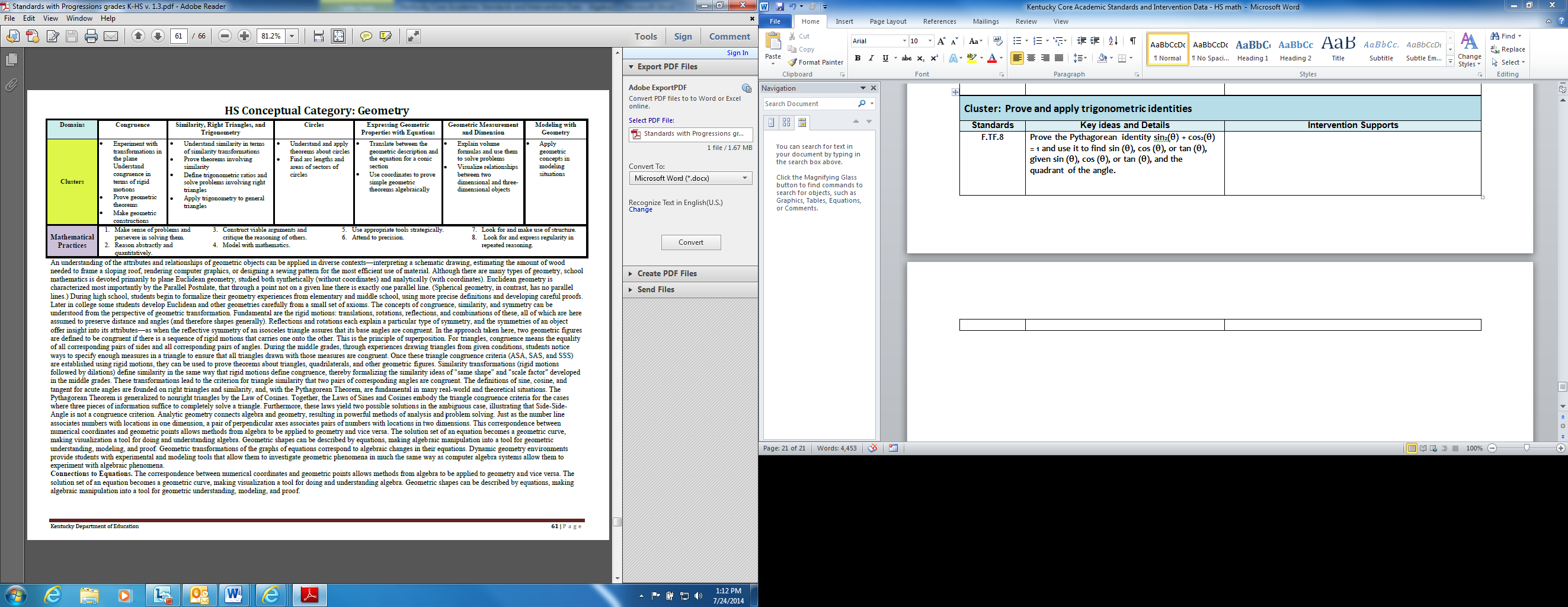
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| **Domain: The Real Number System**  **Cluster: Extend the properties of exponents to rational exponents** | | | | |
| **Standards** | **Key ideas and Details** | | | **Intervention Supports** |
| N.RN.1  N.RN.2 | Explain how the definition of the 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.*  Rewrite expressions involving radicals and rational exponents using the properties of exponents. | | | R: Shows the connection between rational and integer exponents.  <http://tutorial.math.lamar.edu/Classes/Alg/RationalExponents.aspx>  R: Provides an overview of rational exponents including several examples of how to write them in radical form. <http://www.montereyinstitute.org/courses/DevelopmentalMath/COURSE_TEXT2_RESOURCE/U16_L1_T3_text_final.html> |
| **Cluster: Use properties of rational and irrational numbers** | | | | | |
| **Standards** | **Key ideas and Details** | | **Intervention Supports** | | |
| 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. | | R/V: Provides a full explanation of this standard and includes a funny video for students.  <http://www.shmoop.com/common-core-standards/ccss-hs-n-rn-3.html> | | |
| **Domain: Quantities**  **Cluster: Reason quantitatively and use units to solve problems.** | | | | | |
| **Standards** | **Key ideas and Details** | | **Intervention Supports** | | |
| N.Q.1  N.Q.2  N.Q.3 | 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.  Define appropriate quantities for the purpose of descriptive modeling.  Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. | | A: Shows students how to choose a scale for their graph.  <http://view.officeapps.live.com/op/view.aspx?src=http%3A%2F%2Fwww.tacomacc.edu%2FUserFiles%2FServers%2FServer_6%2FFile%2FScale%2520handout.doc>  R: A full website dedicated to each type of unit. The units are broken down into categories: mass, length, area, volume, etc.  <http://www.mathsisfun.com/measure/index.html>  V: Helps students determine the accuracy of a math problem.  <https://learnzillion.com/lessons/3370-determine-appropriate-level-of-accuracy> | | |
| **Domain: The Complex Number System**  **Cluster: Perform arithmetic operations with complex numbers** | | | | | |
| **Standards** | | **Key ideas and Details** | **Intervention Supports** | | |
| N.CN.1  N.CN.2  N.CN.3 (+) | | Know there is a complex number *i* such that *i*² = -1, and every complex number has the form a + b*i* with a and b real numbers.  Use the relation *i*2 = -1 and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.  Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers. | R: Shows examples involving complex numbers.  <http://www.purplemath.com/modules/complex.htm>  R: Provides examples of operations with complex numbers.  <http://www.mathsisfun.com/numbers/complex-numbers.html>  V: Videos of operations with complex numbers.  [http://www.khanacademy.org/math/algebra2/complex-numbers-a2/complex\_numbers/v/adding-complex-numbers#](http://www.khanacademy.org/math/algebra2/complex-numbers-a2/complex_numbers/v/adding-complex-numbers)!  R: Examples on conjugates.  <http://www.suitcaseofdreams.net/Complex_conjugate.htm> | | |
| **Cluster: Represent complex numbers and their operations on the complex plane.** | | | | | |
| **Standards** | | **Key ideas and Details** | **Intervention Supports** | | |
| N.CN.4 (+)  N.CN.5 (+)  N.CN.6 (+) | | 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.  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°.    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. | R: Examples on rectangular and polar form.  <http://www.allaboutcircuits.com/vol_2/chpt_2/5.html>  V: Videos on rectangular and polar form.  <http://www.khanacademy.org/math/precalculus/imaginary_complex_precalc/complex_analysis/e/rectangular-and-polar-forms-of-complex-numbers>  V: Videos demonstrating standard N.CN.5.  <http://www.onlinemathlearning.com/complex-plane-operations-hsn-cn5.html>  ML: Lesson on distance involving the complex plane.  <http://www.cpalms.org/Public/PreviewResource/Preview/46414> | | |
| **Cluster: Use complex numbers in polynomial identities and equations** | | | | | |
| **Standards** | **Key ideas and Details** | | **Intervention Supports** | | |
| N.CN.7  N.CN.8 (+)  N.CN.9 (+) | Solve quadratic equations with real coefficients that have complex solutions.  Extend polynomial identities to the complex numbers. *For example, rewrite x*2 + 4 *as*  (*x* + 2*i*)(*x* – 2*i*).  Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials. | | R: Several examples on quadratics.  <http://regentsprep.org/Regents/math/algtrig/ATE3/quadcomlesson.htm>  V: Videos on quadratics.  <https://learnzillion.com/lessonsets/674-solve-quadratic-equations-with-real-coefficients-that-have-complex-solutions>  R: Several handouts and examples on polynomial identities.  <http://www.mathworksheetsland.com/hsnumbersquan/15poly.html>  R: Explains on the Fundamental Theorem of Algebra.  <http://www.mathsisfun.com/algebra/fundamental-theorem-algebra.html> | | |
| **Domain: Vector and Matrix Quantities**  **Cluster: Represent and model with vector quantities** | | | | | |
| **Standards** | | **Key ideas and Details** | **Intervention Supports** | | |
| N.VM.1 (+)  N.VM.2 (+)  N.VM.3 (+) | | 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., *v*, |*v*|, ||*v*||, *v*).  Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.  Solve problems involving velocity and other quantities that can be represented by vectors. | V: Video lesson on vectors.  <https://www.youtube.com/watch?v=nKIrNxXcTwY&list=PLtXf78zN40CIcNugs9j908FZFHlu8jdnC&index=2>  V: Videos on vectors.  <http://www.onlinemathlearning.com/vector-quantities-hsn.vm1.html>  R: Discusses vectors with examples.  <http://algebralab.org/lessons/lesson.aspx?file=Trigonometry_TrigVectorIntro.xml>  ML: Lesson involving velocity.  <http://www.cpalms.org/Public/PreviewResource/Preview/51224>  R: Examples involving velocity.  <http://www.tutorvista.com/content/science/science-i/motion/question-answers-3.php> | | |
| **Cluster: Perform operations on vectors** | | | | | |
| **Standards** | | **Key ideas and Details** | **Intervention Supports** | | |
| N.VM.4a (+)  N.VM.4b (+)  N.VM.4c (+)  N.VM.5a (+)  N.VM.5b (+) | | Add and subtract vectors.  a. 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.  b. Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.  c. 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.    Multiply a vector by a scalar.  a. 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).  b. Compute the magnitude of a scalar multiple *cv* using ||*cv*|| = |*c*|*v*. Compute the direction of *cv* knowing that when |*c*|*v* 0, the direction of *cv* is either along *v* (for *c* > 0) or against *v* (for *c* < 0). | R/V: Several examples on adding vectors along with a video.  <https://www.khanacademy.org/math/linearalgebra/vectors_and_spaces/vectors/v/adding-vectors>  R: Examples on magnitude and direction.  <http://www.mathwarehouse.com/vectors/>  ML: Lesson on vectors.  <http://www.cpalms.org/Public/PreviewResource/Preview/30164>  A: Activity on vectors.  <http://alex.state.al.us/lesson_view.php?id=32217>  V/R: Examples and videos on vector subtraction.  <http://www.onlinemathlearning.com/vector-subtraction.html>  V: Videos on multiplying vectors.  [https://www.khanacademy.org/math/linear-algebra/vectors\_and\_spaces/vectors/v/multiplying-vector-by-scalar#](https://www.khanacademy.org/math/linear-algebra/vectors_and_spaces/vectors/v/multiplying-vector-by-scalar) | | |
| **Cluster: Perform operations on matrices and use matrices in applications.** | | | | | |
| **Standards** | | **Key ideas and Details** | **Intervention Supports** | | |
| N.VM.6 (+)  N.VM.7 (+)  N.VM.8 (+)  N.VM.9 (+)  N.VM.10 (+)  N.VM.11 (+)  N.VM.12 (+) | | Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.  Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled.  Add, subtract, and multiply matrices of appropriate dimensions.  Understand that, unlike multiplication of #’s, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties.  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.  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.  Work with 2 × 2 matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of area. | R/V: Examples and a video on matrices.  <http://www.shmoop.com/common-core-standards/ccss-hs-n-vm-6.html>  R: Examples on matrices.  <http://www.purplemath.com/modules/mtrxmult.htm>  R: Several handouts on adding, subtracting, and multiplying matrices.  <http://www.mathworksheetsland.com/hsnumbersquan/27matrixaddsub.html>  R/V: Examples on standard N.VM.9 and a funny video.  <http://www.shmoop.com/common-core-standards/ccss-hs-n-vm-9.html>  R/V: Examples on standard N.VM.10 and a funny video.  <http://www.shmoop.com/common-core-standards/ccss-hs-n-vm-10.html>  R: Examples on vectors and matrices.  <http://www.facstaff.bucknell.edu/mastascu/eLessonsHTML/Circuit/MatVecMultiply.htm>  V: Videos on vectors and matrices.  <http://www.onlinemathlearning.com/multiply-vector-matrix-hsn-vm11.html>  V: Video on standard N.VM.12.  <http://www.virtualnerd.com/common-core/hsn-number-quantity/HSN-VM-vector-matrix/C/12> | | |



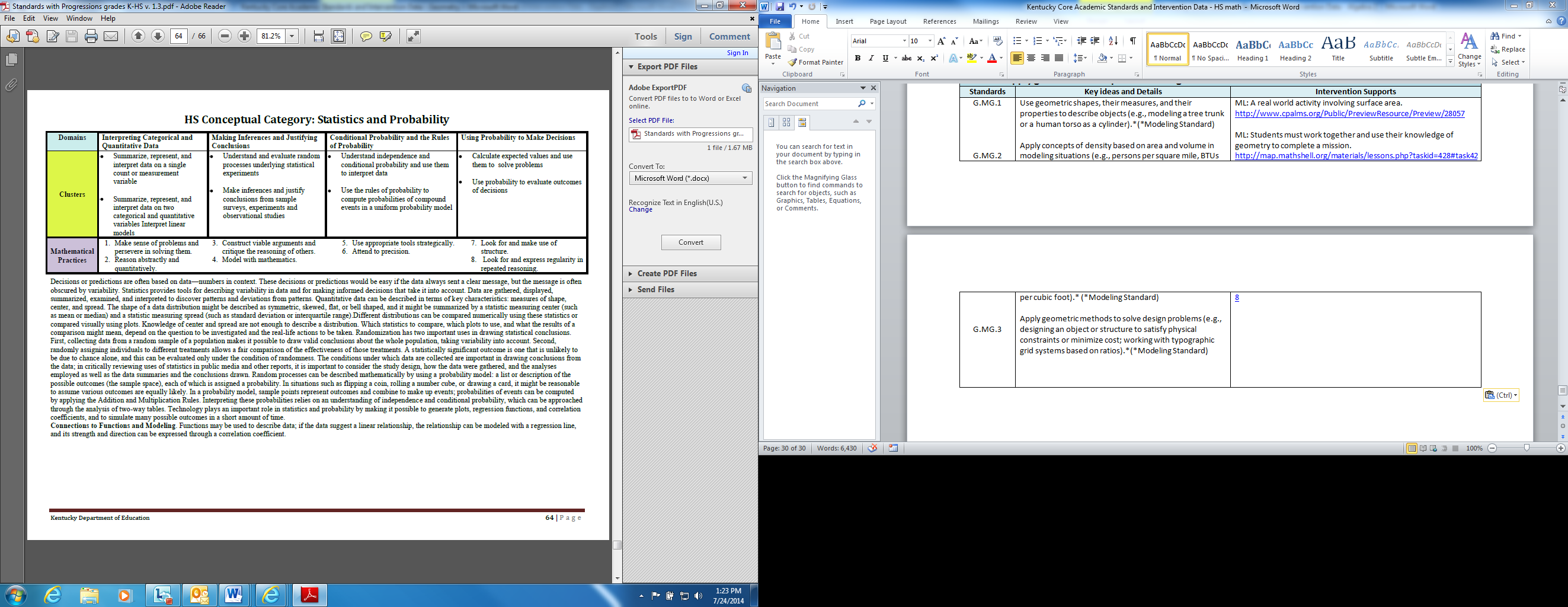
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| **Domain: Seeing Structure in Expressions**  **Cluster: Interpret the structure of expressions** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| A.SSE.1a  A.SSE.1b  A.SSE.2 | Interpret expressions that represent a quantity in terms of its context.\* (\*Modeling standard)  a. Interpret parts of an expression, such as terms, factors, and coefficients.  b. Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret P(1 + r)n* as the product of P and a factor not depending on P.  Use the structure of an expression to identify ways to rewrite it. *For example, see x4 – y4 as (x2)2 – (y2)2, thus recognizing it as a difference of squares that can be factored as (x2 – y2)(x2 + y2).* | ML: Shows students how to determine the meaning of expressions.  <http://map.mathshell.org/materials/lessons.php?taskid=221>  A: A visual representation of order of operations and how expressions are organized.  <https://mathematicsteachingcommunity.math.uga.edu/index.php/448/interpreting-algebraic-expressions>  V/R: Funny videos discussing standard A.SSE.2.  <http://www.shmoop.com/common-core-standards/ccss-hs-a-sse-2.html> |
| **Cluster: Write expressions in equivalent forms to solve problems** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| A.SSE.3a  A.SSE.3b  A.SSE.3c  A.SSE.4 | Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.  a. Factor a quadratic expression to reveal the zeros of the function it defines.  b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.  c. Use the properties of exponents to transform expressions for exponential functions. *For example the expression 1.15t can be rewritten as (1.151/12)12t* ≈ *1.01212t to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.*  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.*\*(Modeling standard) | R: Discusses the process of finding zeros.  <http://www.shmoop.com/common-core-standards/ccss-hs-a-sse-3a.html>  R: Provides several useful handouts for finding the zeros.  <http://www.mathworksheetsland.com/algebra/4solve.html>  V: A video on completing the square.  <https://www.youtube.com/watch?v=dpeI6gonxPk>  ML: A complete lesson on quadratics.  <http://map.mathshell.org/materials/lessons.php?taskid=224>  R: Provides an example of how to present standard A.SSE.3c to your students.  <http://www.shmoop.com/common-core-standards/ccss-hs-a-sse-3c.html>  R/V: Discusses standard A.SSE.4 and includes funny videos for students.  <http://www.shmoop.com/common-core-standards/ccss-hs-a-sse-4.html> |
| **Domain: Arithmetic with Polynomial and Rational Expressions**  **Cluster: Perform arithmetic operations on polynomials** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 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. | V: Includes several video examples on adding, subtracting, and multiplying polynomials.  <http://www.khanacademy.org/math/algebra/multiplying-factoring-expression/polynomial_basics/v/adding-and-subtracting-polynomials-1>    V: Includes several video examples on adding, subtracting, and multiplying polynomials.  <http://www.khanacademy.org/math/algebra/multiplying-factoring-expression/multiplying_polynomials/v/multiplying-polynomials> |
| **Cluster: Understand the relationship between zeros and factors of polynomials** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| A.APR. 2  A.APR.3 | 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*).  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. | R: Shows examples of the Remainder Theorem.  <https://www.khanacademy.org/computing/computer-science/cryptography/modarithmetic/a/the-quotient-remainder-theorem>  R: Shows examples of the Remainder Theorem.  <http://www.mathsisfun.com/algebra/polynomials-remainder-factor.html>  ML: Lesson on polynomials.  <http://illuminations.nctm.org/Lesson.aspx?id=1091>  ML: Activity on polynomials.  <http://map.mathshell.org/materials/lessons.php?taskid=436#task436> |
| **Cluster: Use polynomial identities to solve problems** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| A.APR.4  A.APR.5 (+) | 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 + (2*xy*)2 *can be used to generate Pythagorean triples.*  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. | V/R: Provides examples and videos on polynomial identities.  <http://www.onlinemathlearning.com/polynomial-identities-hsa-apr4.html>  ML: Lesson on Pascal’s Triangle  <http://www.cpalms.org/Public/PreviewResource/Preview/47838>  V: Video on the Binomial Theorem.  <http://www.virtualnerd.com/common-core/hsa-algebra/HSA-APR-polynomial-rational-expressions-arithmetic/C/5> |
| **Cluster: Rewrite rational expressions** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| A.APR.6  A.APR.7 (+) | 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.  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. | V: Video on rational expressions.  <http://www.lessonpaths.com/learn/i/rewriting-simple-rational-expressions-in-different-forms/rewrite-simple-rational-expressions-using-inspection>  V/R: Examples and videos on rational expressions.  <http://www.onlinemathlearning.com/rewrite-rational-expressions-synthetic-division-hsa-apr6.html>  V: Several videos on operations with rational expressions.  <https://www.khanacademy.org/math/algebra2/rational-expressions/rational_expressions/e/adding_and_subtracting_rational_expressions_0.5>  ML: Lessons on rational expressions.  [www.doe.virginia.gov/testing/solsearch/sol/math/AII/m\_ess\_a2-1a.pdf](http://www.doe.virginia.gov/testing/solsearch/sol/math/AII/m_ess_a2-1a.pdf) |
| **Domain: Creating Equations\* (\*Modeling Domain)**  **Cluster: Create equations that describe numbers or relationships** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| A.CED.1  A.CED.2  A.CED.3  A.CED.4 | 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.*  Create equations in two or more variables to represent relationships between quantities, graph equations on a coordinate axes with labels and scales.  Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*  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.* | R: Shows the steps for writing an equation from a word problem.  <http://algebralab.org/lessons/lesson.aspx?file=Algebra_OneVariableWritingEquations.xml>  ML: Shows students how to write and solve linear equations for a specific value.  <http://www.mathworksheetsgo.com/sheets/algebra/linear-equation/linear-equation-word-problems-worksheet.php>  V: A set of videos that show how to determine constraints of equations and inequalities.  <https://learnzillion.com/lessonsets/516-represent-constraints-by-linear-equations-inequalities-and-systems-interpret-solutions-as-viable-and-nonviable>  V: Shows the process of solving an equation for a specific variable  <http://www.khanacademy.org/math/algebra/solving-linear-equations-and-inequalities/solving_for_variable/v/rearrange-formulas-to-isolate-specific-variables> |
| **Domain: Reasoning with equations and inequalities**  **Cluster: Understand solving equations as a process of reasoning and explain reasoning** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| A.REI.1  A.REI.2 | 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.  Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise. | R: Provides a set of steps for solving equations  <http://cstl.syr.edu/fipse/Algebra/Unit3/steps.htm>  R: Examples of rational and radical equations.  <http://www.mathworksheetsland.com/algebra/23solve.html> |
| **Cluster: Solve equations and inequalities in one variable** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| A.REI.3  A.REI.4a  A.REI.4b | Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.  Solve quadratic equations in one variable.  a. 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.  b. Solve quadratic equations by inspection (e.g., for *x2 =* 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 ± bi* for real numbers *a* and *b*. | ML: A full lesson on solving equations using the “Party Method.” Includes a full length PowerPoint presentation. <http://alex.state.al.us/lesson_view.php?id=23865>  V: Shows how the quadratic formula results from completing the square.  <https://www.youtube.com/watch?v=SCfHulybCH8>  V: Song on the quadratic formula  <https://www.youtube.com/watch?v=j-hrP_9vx5o>  ML: Lesson on factoring.  <http://alex.state.al.us/lesson_view.php?id=24082>  V: Multiple videos on how to solve quadratics.  <https://learnzillion.com/lessons/744-solve-a-quadratic-equation-by-taking-a-square-root> |
| |  | | --- | | **Cluster: Solve system of equations** | | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| A.REI.5  A.REI.6  A.REI.7  A.REI.8 (+)  A.REI.9 (+) | Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and multiple of the other produces a system with the same solutions.  Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.  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 x2 + y2 = 3*.  Represent a system of linear equations as a single matrix equation in a vector variable.  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 × 3 or greater). | V: A set of videos showing why a solution to a system of equations matches the sum.  <https://learnzillion.com/lessons/3755-find-commonalities-between-equations-in-a-system-and-their-sum>  R: Shows how to solve system of equations multiple ways.  <http://www.mathsisfun.com/algebra/systems-linear-equations.html>  R: Lists several activities to review/enhance student understanding of system of equations.  <http://www.ilovemath.org/index.php?option=com_docman&task=cat_view&gid=53>  R: Explains standard A.REI.7 and shows examples.  <http://www.shmoop.com/common-core-standards/ccss-hs-a-rei-7.html>  R: Provides several examples and videos on system of equations involving quadratics.  <http://www.khanacademy.org/math/algebra2/systems_eq_ineq/non-linear-systems-tutorial/e/systems-of-nonlinear-equations>  V/R: Videos on matrices.  <http://www.onlinemathlearning.com/systems-equation-matrices-hsa-rei8.html>  R: Examples on inverses of matrices.  <http://www.mathsisfun.com/algebra/matrix-inverse.html>  V: Video on inverses of matrices.  <https://www.youtube.com/watch?v=iUQR0enP7RQ> |
| **Cluster: Represent and solve equations and inequalities graphically** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| A.REI.10  A.REI.11  A.REI.12 | 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).  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.\* (Modeling standard)  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. | R: Resource page with multiple lessons.  <http://ccssmath.org/?page_id=2147>  R: Resource page with multiple lessons.  <http://ccssmath.org/?page_id=2149>  R: Several resources on system of equations and inequalities. Includes videos on how to graph linear inequalities along with sample word problems.  <http://www.khanacademy.org/math/algebra/systems-of-eq-and-ineq> |



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| **Domain: Interpreting Functions**  **Cluster: Understand the concept of a function and use function notation** | | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** | |
| F.IF.1  F.IF.2  F.IF.3 | 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*).  Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.  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.* | R: Provides several examples, definitions, and a video on relations, functions, domain and range.  <http://www.mathwarehouse.com/algebra/relation/math-function.php>  R: Shows several examples and explanations on function notation.  <http://www.onemathematicalcat.org/algebra_book/online_problems/function_notation.htm>  V: Includes several videos about function notation.  <http://www.onlinemathlearning.com/function-equation.html>  R: A quick demonstration showing how arithmetic sequences are connected to linear functions.  <http://mathandmultimedia.com/2010/04/28/arithmetic-sequence-and-linear-function/> | |
| **Cluster: Interpret functions that arise in applications in terms of the context** | | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** | |
| F.IF.4  F.IF.5  F.IF.6 | 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.\**(\*Modeling standard)  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.*\*(\*Modeling standard)  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.\*(Modeling standard) | ML: A lesson that requires students to identify parts of distance/time graphs.  <http://map.mathshell.org/materials/lessons.php?taskid=208>  V: Features several videos to help students identify parts of functions.  <https://www.khanacademy.org/math/algebra2/functions_and_graphs/analyzing_functions/e/recog-features-func-2>  V: Provides several videos on finding the domain and range of functions.  <https://www.khanacademy.org/math/algebra/algebrafunctions/domain_and_range/v/domain-and-range-1>  A: A lesson showing how slope is related to ramps.  <http://alex.state.al.us/lesson_view.php?id=23830>  R: Provides several examples on slope and how it is connected to the real world.  <http://www.learner.org/courses/learningmath/algebra/session5/index.html> | |
| **Cluster: Analyze functions using different representations** | | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** | |
| F.IF.7a  F.IF.7b  F.IF.7c  F.IF.7d(+)  F.IF.7e  F.IF.8a  F.IF.8b  F.IF.9 | Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.\*(Modeling standard)  a. Graph linear and quadratic functions and show intercepts, maxima, and minima.  b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.  c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.  d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.  e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.  Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.  a. 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.  b. 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=(.97)t, y=(1.01)12t, y=(1.2)t/10, and classify them as representing exponential growth or decay.*  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.* | V: Features several videos on graphing parabolas.  <http://www.khanacademy.org/math/algebra/quadratics/solving_graphing_quadratics/e/graphing_parabolas_1>  R: Shows the steps for graphing linear equations.  <http://www.basic-mathematics.com/graphing-linear-equations.html>  ML: A lesson helping students to identify parts of quadratic functions.  <http://map.mathshell.org/materials/lessons.php?taskid=224>  V: Multiple videos on graphing.  <http://www.virtualnerd.com/common-core/hsf-functions/HSF-IF-interpreting-functions/C/7>  R: Shows examples of graphing.  <http://www.shmoop.com/common-core-standards/ccss-hs-f-if-7b.html>  V: Multiple videos and examples on graphing.  <http://www.khanacademy.org/math/pre-algebra/exponents-radicals>  R: Shows the process for graphing exponential functions.  <http://www.purplemath.com/modules/graphexp.htm>  R: Discusses how to graph logarithmic functions.  <http://www.purplemath.com/modules/graphlog.htm>  R: Discusses how to graph several kinds of functions.  <http://math.tutorvista.com/calculus/graphing-functions.html>  V: Video on graphing logarithmic functions.  <http://www.khanacademy.org/math/algebra2/exponential_and_logarithmic_func/log_functions/v/graphing-logarithmic-functions>  R: Discusses the process of finding zeros.  <http://www.shmoop.com/common-core-standards/ccss-hs-a-sse-3a.html>  R: Provides several useful handouts for finding the zeros.  <http://www.mathworksheetsland.com/algebra/4solve.html>  ML: A complete lesson on quadratics.  <http://map.mathshell.org/materials/lessons.php?taskid=224>  R: Provides a full explanation of standard F.IF.8b along with examples.  <http://www.shmoop.com/common-core-standards/ccss-hs-f-if-8b.html>  A: An activity relating exponential growth and decay to real life.  <http://alex.state.al.us/lesson_view.php?id=24092>  V: Features several short video lessons on how to make connections between functions.  <https://learnzillion.com/lessons/1194-compare-two-functions-by-analyzing-an-equation-and-a-verbal-description>  R: Discusses standard F.IF.9 and provides examples.  <http://www.shmoop.com/common-core-standards/ccss-hs-f-if-9.html> | |
| **Domain: Building Functions**  **Cluster: Build a function that models a relationship between two quantities** | | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** | |
| F.BF.1a  F.BF.1b  F.BF.1c(+)  F.BF.2 | Write a function that describes a relationship between two quantities.\*(Modeling standard)  a. Determine an explicit expression, a recursive process, or steps for calculation from a context.    b. 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.*  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.*  Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.\*(\*Modeling standard) | ML: Students write equations based on patterns.  <http://map.mathshell.org/materials/lessons.php?taskid=215>  ML: Students write equations based on patterns.  <http://map.mathshell.org/materials/tasks.php?taskid=286&subpage=expert>  V: A video showing how to write equations based on sequences.  <https://www.youtube.com/watch?v=V02nV_qR_xQ>  R: Examples on functions.  <http://www.purplemath.com/modules/fcncomp3.htm>  V: Video on functions.  <http://education-portal.com/academy/lesson/how-to-compose-functions.html#lesson>  R: Guided notes on geometric sequences.  <http://images.pcmac.org/SiSFiles/Schools/GA/DouglasCounty/DouglasCountyHigh/Uploads/DocumentsCategories/Documents/Geometric%20Sequences%20Notes.pdf> | |
| **Cluster: Build new functions from existing functions** | | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** | |
| F.BF.3  F.BF.4a  F.BF.4b(+)  F.BF.4c(+)  F.BF.4d(+)  F.BF.5(+) | 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.*  Find the inverse functions.  a. 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) = 2x3* or f(x) = (x+1)/(x - 1) for x ≠ 1.  b. (+) Verify by composition that one function is the inverse of another.  c. (+) Read values of an inverse function from a graph or a table, given that the function has an inverse.  d. (+) Produce an invertible function from a non-invertible function by restricting the domain.  Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents. | ML: A guided lesson on transformations.  <http://alex.state.al.us/lesson_view.php?id=30033>  R: Explains the process of finding the inverse of a function.  <http://www.purplemath.com/modules/invrsfcn3.htm>  R: Discusses composition.  <http://www.purplemath.com/modules/fcncomp6.htm>  R: Explains standard F.BF.4c and shows examples.  <http://www.shmoop.com/common-core-standards/ccss-hs-f-bf-4c.html>  V: Videos on inverse functions.  <http://www.onlinemathlearning.com/inverse-function-restrict-domain-hsf-bf4.html>  R: Shows several examples of logarithms and exponentials.  <http://www.mathsisfun.com/algebra/exponents-logarithms.html>  V: Videos on logarithms and exponentials.  <http://www.virtualnerd.com/common-core/hsf-functions/HSF-BF-building-functions/B/5> | |
| **Domain: Linear, Quadratic, and Exponential Models\* (\*Modeling Domain)**  **Cluster: Construct and compare linear, quadratic, and exponential models and solve problems** | | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** | |
| F.LE.1a  F.LE.1b  F.LE.1c  F.LE.2  F.LE.3  F.LE.4 | Distinguish between situations that can be modeled with linear functions and with exponential functions.  a. Prove that linear functions grow by equal differences over equal intervals; and that exponential functions grow by equal factors over equal intervals.  b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.  c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.  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).  Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.  For exponential models, express as a logarithm the solution to abct, where a, b, and d are numbers and the base is 2, 10, or *e*; evaluate the logarithm using technology. | V: Two videos on linear and exponentials functions.  <https://learnzillion.com/lessons/300-prove-that-linear-functions-grow-by-equal-differences-over-equal-intervals>  A: Has students decide which situations are linear or exponential  <http://map.mathshell.org/materials/tasks.php?taskid=296&subpage=novice>  R: A PowerPoint introducing exponential growth and decay.  <http://view.officeapps.live.com/op/view.aspx?src=http%3A%2F%2Fwww.mathisnothard.com%2Fpages%2Fnotes%2Falgebra%2Fpowerpoints%2Fexpgrowthdecay.ppt>  V: A video that shows how to graph an exponential function.  <http://www.khanacademy.org/math/algebra/algebrafunctions/graphing_functions/v/graphing-exponential-functions>  V: Features several videos on graphing exponential functions and how they relate to linear functions.  <https://learnzillion.com/lessons/298-determine-which-of-2-growing-quantities-will-eventually-exceed-the-other>  R: Discusses standard F.LE.4 and provides examples.  <http://www.shmoop.com/common-core-standards/ccss-hs-f-le-4.html>  V: Several videos on logarithms.  <https://learnzillion.com/lessonsets/438-express-solutions-to-exponential-models-as-logarithms-evaluate-using-technology> | |
| **Cluster: Interpret expressions for functions in terms of the situation they model** | | | |
| **Standards** | **Key ideas and Details** | | **Intervention Supports** |
| F.LE.5 | Interpret the parameters in a linear or exponential function in terms of a context. | | V: A series of videos on exponentials and how they relate to this standard.  <http://www.virtualnerd.com/common-core/hsf-functions/HSF-LE-linear-quadratic-exponential-models/B/5> |
| **Domain: Trigonometric Functions**  **Cluster: Extend the domain of trigonometric functions using the unit circle** | | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** | |
| F.TF.1  F.TF.2  F.TF.3(+)  F.TF.4(+) | Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.  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.  Use special triangles to determine geometrically the values of sine, cosine, tangent for /3, /4 and /6, and use the unit circle to express the values of sine, cosine, and tangent for –*x*, +*x*, and 2–*x* in terms of their values for *x*, where *x* is any real number.  Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions. | R/V: Discusses standard F.TF.1 and includes a funny video.  <http://www.shmoop.com/common-core-standards/ccss-hs-f-tf-1.html>  R/V: Discusses standard F.TF.2 and includes a funny video.  <http://www.shmoop.com/common-core-standards/ccss-hs-f-tf-2.html>  V/R: Several examples on the unit circle.  [http://www.khanacademy.org/math/trigonometry/unit-circle-trig-func/Trig-unit-circle/v/unit-circle-manipulative#](http://www.khanacademy.org/math/trigonometry/unit-circle-trig-func/Trig-unit-circle/v/unit-circle-manipulative)  V: Video on trigonometry.  <https://www.teachingchannel.org/videos/introduction-to-trigonometry?fd=1>  A: Activity on trigonometry.  <http://illuminations.nctm.org/Lesson.aspx?id=1435>  R: Examples on standard F.TF.3  <http://www.shmoop.com/common-core-standards/ccss-hs-f-tf-3.html>  A: Lesson on the unit circle.  <http://illuminations.nctm.org/Lesson.aspx?id=2870>  V: Videos on the unit circle and symmetry.  <http://illuminations.nctm.org/Lesson.aspx?id=2870> | |
| **Cluster: Model periodic phenomena with trigonometric functions** | | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** | |
| F.TF.5  F.TF.6(+)  F.TF.7(+) | Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.\*(\*Modeling standard)  Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.    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. | V: Video on trigonometric functions.  <https://learnzillion.com/lessons/2770-model-periodic-phenomena-using-trigonometric-functions>  V: Videos on trigonometric functions and its inverse.  [https://www.khanacademy.org/math/trigonometry/unit-circle-trig-func/inverse\_trig\_functions/v/restricting-trig-function-domain#](https://www.khanacademy.org/math/trigonometry/unit-circle-trig-func/inverse_trig_functions/v/restricting-trig-function-domain)!  V: Video on trigonometric equations.  <http://education-portal.com/academy/lesson/how-to-solve-trigonometric-equations-for-x.html#lesson> | |
| **Cluster: Prove and apply trigonometric identities** | | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** | |
| F.TF.8  F.TF.9(+) | Prove the Pythagorean identity sin2(θ) + cos2(θ) = 1 and use it to find sin (θ), cos (θ), or tan (θ), given sin (θ), cos (θ), or tan (θ), and the quadrant of the angle.  Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems. | V: Video on Pythagorean Identity.  <https://learnzillion.com/lessons/2352-find-trigonometric-values-using-the-pythagorean-identity>  R/V: Discusses standard F.TF.9 and includes a funny video.  <http://www.shmoop.com/common-core-standards/ccss-hs-f-tf-9.html> | |



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| **Domain: Congruence**  **Cluster: Experiment with transformations in the plane.** | | | | | | |
| **Standards** | **Key ideas and Details** | | | | | **Intervention Supports** |
| G.CO.1  G.CO.2  G.CO.3  G.CO.4  G.CO.5 | Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment based on the undefined notions of a point, line, distance along a line and distance around a circular arc.  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)  Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.  Develop definitions of rotations, reflections and translations in terms of angles, circles, perpendicular lines, parallel lines and line segments.  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. | | | | | V: A series of videos that define the basic terms of geometry.  <http://www.virtualnerd.com/common-core/hsf-geometry/HSG-CO-congruence/A/1>  V/R: Features several videos on transformations.  <http://www.onlinemathlearning.com/transformation-hsg-co2.html>  R: Discusses standard G.OC.3 and includes examples.  <http://www.shmoop.com/common-core-standards/ccss-hs-g-co-3.html>  A: An activity on transformations.  <http://illuminations.nctm.org/Lesson.aspx?id=2591>  A: A graphing calculator activity featuring transformations.  <http://education.ti.com/en/us/activity/detail?id=B7CBCEE88FBC486886D9A270295AF80C>  R: Includes several practice games on transformations.  <http://www.onlinemathlearning.com/transformation-games.html>  A: Students have to complete several transformations.  <http://mathsteaching.wordpress.com/2008/07/11/shape-transformations/> |
| **Cluster: Understand congruence in terms of rigid motions** | | | | | | |
| **Standards** | | **Key ideas and Details** | | | | **Intervention Supports** |
| G.CO.6  G.CO.7  G.CO.8 | | Use geometric descriptions as 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.  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.  Explain how the criteria for triangle congruence (ASA, SAS, SSS) follow from the definition of congruence in terms of rigid motions. | | | | ML: A lesson on triangle congruence.  <http://map.mathshell.org/materials/lessons.php?taskid=452#task452>  V: Features videos and interactive examples of triangle congruence.  <https://www.khanacademy.org/math/geometry/congruent-triangles/cong_triangle/e/congruency_postulates>  R: An interactive site on triangle congruence.  <http://illuminations.nctm.org/Activity.aspx?id=3504>  R: Discusses each method to prove congruent triangles.  <http://www.mathwarehouse.com/geometry/congruent_triangles/> |
| **Cluster: Prove Geometric Theorems** | | | | | | |
| **Standards** | | **Key ideas and Details** | | | | **Intervention Supports** |
| G.CO.9  G.CO.10  G.CO.11. | | 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.*  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.*  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.* | | | | R: Provides several examples of proofs.  <http://excellup.com/classnine/mathnine/lineangletheorem.aspx>  V: Offers several videos on proofs.  <http://www.virtualnerd.com/common-core/hsf-geometry/HSG-CO-congruence/C/9>  R: Discusses standard G.CO.10 and includes examples.  <http://www.shmoop.com/common-core-standards/ccss-hs-g-co-10.html>  R: Provides several handouts on parallelogram theorems.  <http://www.mathworksheetsland.com/geometry/11parallelproofset.html> |
| **Cluster: Make geometric constructions** | | | | | | |
| **Standards** | | **Key ideas and Details** | | | | **Intervention Supports** |
| G.CO.12  G.CO.13 | | 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.*  Construct an equilateral triangle, a square and a regular hexagon inscribed in a circle. | | | | R: A “How To” list on constructions.  <http://www.mathsisfun.com/geometry/constructions.html>  R: An interactive “How To” lesson on constructions.  <http://www.mathopenref.com/constinhexagon.html> |
| **Domain: Similarity, Right Triangles, and Trigonometry**  **Cluster: Understand similarity in terms of similarity transformations** | | | | | | |
| **Standards** | | **Key ideas and Details** | | | | **Intervention Supports** |
| G.SRT.1a  G.SRT.1b  G.SRT.2  G.SRT.3 | | Verify experimentally the properties of dilations given by a center and a scale factor.  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.  b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.  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.  Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar. | | | | R: Discusses dilations and similarity transformations.  <http://math.tutorvista.com/geometry/similarity-transformation.html>  A: A short activity on dilations.  <http://www.regentsprep.org/Regents/math/geometry/GT3/DActiv.htm>  A: Sample problems on dilations.  [www.mathworksheetsland.com/geometry/16dilation/ip.pdf](http://www.mathworksheetsland.com/geometry/16dilation/ip.pdf)  V: Video on similarity transformations.  <http://www.virtualnerd.com/geometry/transformations/similarity-congruence/identify-similarity-transformation> |
| **Cluster: Prove theorems involving similarity.** | | | | | | |
| **Standards** | | | **Key ideas and Details** | | | **Intervention Supports** |
| G.SRT.4  G.SRT.5 | | | 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.*  Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. | | | R/V: Discusses standard G.SRT.4 and includes a funny video for students.  <http://www.shmoop.com/common-core-standards/ccss-hs-g-srt-4.html>  R: Discusses standard G.SRT.5 and includes a real life example to present to students.  <https://www.illustrativemathematics.org/illustrations/651> |
| **Cluster: Define trigonometric ratios and solve problems involving right triangles** | | | | | | |
| **Standards** | | | **Key ideas and Details** | | | **Intervention Supports** |
| G.SRT.6  G.SRT.7  G.SRT.8 | | | 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.  Explain and use the relationship between the sine and cosine of complementary angles.  Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. \* | | | R: A graphic organizer on trigonometric ratios.  <http://exchange.smarttech.com/details.html?id=cdbb7c21-85b7-4646-a51d-f7ae27d4e8aa>  V/R: Features several videos and examples of trigonometry.  <http://www.khanacademy.org/math/trigonometry/basic-trigonometry>  V: Provides several videos on standard G.SRT.7.  <https://learnzillion.com/lessonsets/619-understand-the-relationship-between-the-sine-and-cosine-of-complementary-angles>  A: A real world activity on trigonometry.  <http://alex.state.al.us/lesson_view.php?id=6943>  A: A real world activity on trigonometry.  <http://alex.state.al.us/lesson_view.php?id=1669> |
| **Cluster: Apply trigonometry to general triangles** | | | | | | |
| **Standards** | | | | **Key ideas and Details** | | **Intervention Supports** |
| G.SRT.9 (+)  G.SRT.10 (+)  G.SRT.11 (+) | | | | 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.  Prove the Laws of Sines and Cosines and use them to solve problems.  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). | | V: A “How To” video on the derivation of *A=1/2absin(c).*  <http://www.virtualnerd.com/common-core/hsf-geometry/HSG-SRT-right-triangle-similarity-trigonometry/D/9>  R: Shows examples of Law of Sines and Cosines.  <http://www.mathwarehouse.com/trigonometry/law-of-sines/formula-and-practice-problems.php>  R: Shows examples of Law of Sines and Cosines.  <http://www.mathcaptain.com/trigonometry/law-of-sines-and-cosines.html>  A: An activity helping students prove the Law of Cosines.  <http://illuminations.nctm.org/Lesson.aspx?id=2441>  A: An activity helping students prove the Law of Sines.  <http://illuminations.nctm.org/Lesson.aspx?id=2433> |
| **Domain: Circles**  **Cluster: Understand and apply theorems about circles** | | | | | | |
| **Standards** | | | | **Key ideas and Details** | | **Intervention Supports** |
| G.C.1  G.C.2  G.C.3  G.C. 4 (+) | | | | Prove that all circles are similar.  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.  Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.  Construct a tangent line from a point outside a given circle to the circle. | | V: Several videos showing how to prove circles are similar.  <http://www.onlinemathlearning.com/prove-circles-similar-hsg-c1.html>  R: A handout with examples on how to prove circles are similar.  [www.cpm.org/pdfs/state\_supplements/**Similar**\_**Circles**.pdf](http://www.cpm.org/pdfs/state_supplements/Similar_Circles.pdf)  V/R: Discusses standard C.C.2 and includes two funny videos for students.  <http://www.shmoop.com/common-core-standards/ccss-hs-g-c-2.html>  ML: Lesson involving chords, secant, and tangents.  <http://www.cpalms.org/Public/PreviewResource/Preview/51284>  V/R: Discusses standard C.C.3 and includes two funny videos for students.  <http://www.shmoop.com/common-core-standards/ccss-hs-g-c-3.html>  A: An activity connecting inscribed angles to real life.  <http://secondaryiiinutah.wikispaces.com/Inscribed+and+Circumscribed+Circles>’  ML: Lesson connecting tangents to real life.  <http://www.cpalms.org/Public/PreviewResource/Preview/46386> |
| **Cluster: Find arc lengths and areas of sectors of circles** | | | | | | |
| **Standards** | | | | **Key ideas and Details** | | **Intervention Supports** |
| 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. | | ML: Lesson connecting sectors to the real world.  <http://www.cpalms.org/Public/PreviewResource/Preview/49299>  V: Multiple videos on sectors.  <http://www.onlinemathlearning.com/area-sector.html> |
| **Domain: Expressing Geometric Properties with Equations**  **Cluster: Translate between the geometric description and the equation for a conic section** | | | | | | |
| **Standards** | | | | **Key ideas and Details** | | **Intervention Supports** |
| G.GPE.1  G.GPE.2  G.GPE.3(+) | | | | 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.  Derive the equation of a parabola given a focus and directrix.  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. | | V: Several videos on the equation of a circle.  <https://learnzillion.com/lessonsets/763-derive-the-equation-of-a-circle-using-the-pythagorean-theorem>  ML: An activity on equations of circles.  <http://map.mathshell.org/materials/lessons.php?taskid=425#task425>  R: Shows several examples of standard G.GPE.2.  <http://www.algebralab.org/lessons/lesson.aspx?file=Algebra_conics_directrix.xml>  V: Contains videos on parabolas.  <http://www.virtualnerd.com/common-core/hsf-geometry/HSG-GPE-geometric-properties-equations/A/2>  V: Videos on ellipses and hyperbolas.  <http://www.virtualnerd.com/common-core/hsf-geometry/HSG-GPE-geometric-properties-equations/A/3> |
| **Cluster: Use coordinates to prove simple geometric theorems algebraically** | | | | | | |
| **Standards** | | | | **Key ideas and Details** | | **Intervention Supports** |
| G.GPE.4  G.GPE.5  G.GPE.6  G.GPE.7 | | | | 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).  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).  Find the point on a directed line segment between two given points that partitions the segment in a given ratio.  Use coordinates to compute perimeters of polygons and area of triangles and rectangles, e.g., using the distance formula.\*(\*Modeling Standard) | | V: Videos on proofs involving the coordinate plane.  <https://learnzillion.com/lessons/285-prove-whether-a-figure-is-a-rectangle-in-the-coordinate-plane>  V: Features several videos on parallel and perpendicular lines.  <http://www.showme.com/topic/g.gpe.5>  R: Shows several examples on writing equations of parallel and perpendicular lines.  <http://www.mathsisfun.com/algebra/line-parallel-perpendicular.html>  R: A PowerPoint on line segments.  <http://view.officeapps.live.com/op/view.aspx?src=http%3A%2F%2Fsamgierlessons.wikispaces.com%2Ffile%2Fview%2FCONGRUENT%2BSEGMENTS%2B%2526%2BMIDPOINT%2BOF%2BA%2BSEGMENT.ppt>  V: Provides several videos on computations involving polygons.  <http://www.onlinemathlearning.com/coordinates-perimeters-areas-hsg-gpe7.html>  V: Provides several videos on computations involving polygons.  <http://www.virtualnerd.com/common-core/hsf-geometry/HSG-GPE-geometric-properties-equations/B/7> |
| **Domain: Geometric Measurement and Dimension**  **Cluster: Explain volume formulas and use them to solve problems** | | | | | | |
| **Standards** | | | | **Key ideas and Details** | | **Intervention Supports** |
| G.GMD.1  G.GMD.2(+)  G.GMD.3 | | | | 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.*  Give an informal argument using Cavalieri’s principle for the formulas for the volume of a sphere and other solid figures.   |  | | --- | | Use volume formulas for cylinders,  pyramids, cones, and spheres to solve  problems.\*(\*Modeling Standard) | | | ML: Introductory lesson on volume.  <http://www.cpalms.org/Public/PreviewResource/Preview/45410>  ML: Lesson on volume.  <http://map.mathshell.org/materials/lessons.php?taskid=213>  V: Videos on each component of standard G.GMD.3.  <https://learnzillion.com/lessonsets/535-use-volume-formulas-for-cylinders-pyramids-cones-and-spheres-to-solve-problems>  ML: Complete lesson on cylinders.  <http://www.constructioncenterofexcellence.com/wp-content/uploads/2013/05/MathToolbox4.pdf>  ML: Students will find the volume of irregular shapes.  <http://map.mathshell.org/materials/lessons.php?taskid=216#task216> |
| **Cluster: Visualize relationships between two-dimensional and three-dimensional objects** | | | | | | |
| **Standards** | | | | **Key ideas and Details** | | **Intervention Supports** |
| 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. | | | R/V: Discusses this standard and includes a funny video for students.  <http://www.shmoop.com/common-core-standards/ccss-hs-g-gmd-4.html> |
| **Domain: Modeling with Geometry**  **Cluster: Apply geometric concepts in modeling situations** | | | | | | |
| **Standards** | | | | | **Key ideas and Details** | **Intervention Supports** |
| G.MG.1  G.MG.2  G.MG.3 | | | | | Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).\*(\*Modeling Standard)  Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).\* (\*Modeling Standard)  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).\*(\*Modeling Standard) | ML: A real world activity involving surface area.  <http://www.cpalms.org/Public/PreviewResource/Preview/28057>  ML: Students must work together and use their knowledge of geometry to complete a mission.  <http://map.mathshell.org/materials/lessons.php?taskid=428#task428>  ML: A lesson connecting geometry to the real world.  <http://www.cpalms.org/Public/PreviewResource/Preview/28057>  ML: A lesson connecting geometry to the real world.  <http://www.cpalms.org/Public/PreviewResource/Preview/49160> |



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| **Domain: Interpreting Categorical and Quantitative Data**  **Cluster: Summarize, represent, and interpret data on a single count or measurement variable** | | | | |
| **Standards** | **Key ideas and Details** | | **Intervention Supports** | |
| S.ID.1  S.ID.2  S.ID.3  S.ID.4 | Represent data with plots on the real number line (dot plots, histograms, and box plots).  (Statistics and Probability is a Modeling Conceptual Category.)  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.  (Statistics and Probability is a Modeling Conceptual Category.)  Interpret differences in shape, center and spread in the context of data sets, accounting for possible effects of extreme data points (outliers).  (Statistics and Probability is a Modeling Conceptual Category.)  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. \*Statistics and Probability is a Modeling Conceptual Category | | A: Students will model data using various displays.  <http://alex.state.al.us/lesson_view.php?id=26258>  A: Students will create a data display.  <http://www.prb.org/Publications/Lesson-Plans/PyramidBuilding.aspx>  A: Students will make various calculations with a set of data including mean, median, and mode.  <http://alex.state.al.us/lesson_view.php?id=14515>  V: Provides several videos on how to understand the meaning of data.  <http://www.khanacademy.org/math/pre-algebra/applying-math-reasoning-topic/reading_data/v/histograms>  V: Videos on statistics and the Empirical Rule.  <https://learnzillion.com/lessonsets/458-use-mean-and-standard-deviation-to-fit-a-data-set-to-a-normal-distribution-when-appropriate-estimate-population-percentages-using-tools>  <https://learnzillion.com/lessonsets/433-use-mean-and-standard-deviation-to-fit-to-normal-distribution-and-estimate-population-percentages-when-appropriate-use-tools-to-estimate-areas-under-the-normal-curve> | |
| **Cluster: Summarize, represent, and interpret data on two categorical and quantitative variables** | | | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** | | |
| S.ID.5  S.ID.6a  S.ID.6b  S.ID.6c | 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.  (Statistics and Probability is a Modeling Conceptual Category.)  Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.  a. 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 and exponential models.*  (Statistics and Probability is a Modeling Conceptual Category.)  b. Informally assess the fit of a function by plotting and analyzing residuals.  c. Fit a linear function for a scatter plot that suggests a linear association.  (Statistics and Probability is a Modeling Conceptual Category.) | V: A video showing how to interpret frequency tables.  <http://www.teachertube.com/video/sid5-summarize-data-in-two-way-frequency-290006>  V: Video series on scatter plots.  <http://www.onlinemathlearning.com/scatter-plot.html>  A: An activity involving the line of best fit and exponential functions.  <http://alex.state.al.us/lesson_view.php?id=21153>  R: An interactive line of best fit.  <http://illuminations.nctm.org/Activity.aspx?id=4186>  A: A graphing calculator activity on scatter plots, line of best fit, and regression.  <http://illuminations.nctm.org/Lesson.aspx?id=2551> | | |
| **Cluster: Interpret linear models** | | | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** | | |
| S.ID.7  S.ID.8  S.ID.9 | Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.  (Statistics and Probability is a Modeling Conceptual Category.)  Compute (using technology) and interpret the correlation coefficient of a linear fit.  (Statistics and Probability is a Modeling Conceptual Category.)  Distinguish between correlation and causation.  (Statistics and Probability is a Modeling Conceptual Category.) | A: An interactive activity that shows how bungee jumping relates to scatter plots and line of best fit.  <http://illuminations.nctm.org/Lesson.aspx?id=2157>  R: Discusses the meaning of a correlation coefficient.  <http://mathbits.com/MathBits/TISection/Statistics2/correlation.htm>  R: Provides a clear explanation of causation and correlation.  <http://www.differencebetween.net/science/difference-between-causation-and-correlation/> | | |
| **Domain: Making Inferences and Justifying Conclusions\*(Modeling Conceptual Category)**  **Cluster: Understand and evaluate random processes underlying statistical experiments** | | | | |
| **Standards** | **Key ideas and Details** | | | **Intervention Supports** |
| S.IC.1  S.IC.2 | Understand statistics as a process for making inferences about population parameters based on a random sample from that population. \*Statistics and Probability is a Modeling Conceptual Category  Decide if a specified model is consistent with results from a given data-generating process, eg., 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?* \*Statistics and Probability is a Modeling Conceptual Category | | | V/R: Shows several examples on standard S.IC.1 and has a funny video.  <http://www.shmoop.com/common-core-standards/ccss-hs-s-ic-1.html>  V/R: Provides several examples and videos on statistics.  <http://www.onlinemathlearning.com/understand-statistics-ic1.html>  V: Video on collecting data.  <http://www.virtualnerd.com/common-core/hss-statistics-probability/HSS-IC-inferences-conclusions/A/2>  V: Videos on collecting data.  <https://learnzillion.com/lessonsets/512-decide-if-a-model-is-consistent-with-results> |
| **Cluster: Make inferences and justify conclusions from sample surveys, experiments, and observational studies** | | | | |
| **Standards** | **Key ideas and Details** | | | **Intervention Supports** |
| S.IC.3  S.IC.4  S.IC.5  S.IC.6 | Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.  \*Statistics and Probability is a Modeling Conceptual Category  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.  \*Statistics and Probability is a Modeling Conceptual Category  Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between two parameters are significant.  \*Statistics and Probability is a Modeling Conceptual Category  Evaluate reports based on data.\*  \*Statistics and Probability is a Modeling Conceptual Category | | | ML: Lesson plan discussing sample surveys, experiments, and observational studies.  <http://www.cpalms.org/Public/PreviewResource/Preview/48326>  ML: Lesson plan discussing sample surveys, experiments, and observational studies.  <http://www.cpalms.org/Public/PreviewResource/Preview/50602>  V: Videos on sample surveys, experiments, and observational studies.  <http://www.onlinemathlearning.com/surveys-experiments-ic2.html>  V: Video from MIT about statistics.  <http://blossoms.mit.edu/videos/lessons/bigger_better_look_selection_bias_all_around_us>  V: Videos on standards S.IC.4 and S.IC.6.  <https://learnzillion.com/lessonsets/531-use-survey-data-to-estimate-means-and-proportions-develop-a-margin-of-error-through-simulation-models-and-evaluate-reports-based-on-data>  A: Activity on a randomized experiment.  <http://www.laurussoft.com/CommonCore/LevelThree/PDF/S-IC.B.5-ques1.pdf>  A: Activity on data reports.  <http://www.laurussoft.com/CommonCore/LevelThree/PDF/S-IC.B.6-ques2.pdf> |

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| **Domain: Conditional Probability and the Rules of Probability**  **Cluster: Understand independence and conditional probability and use them to interpret data** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| S.CP.1  S.CP 2  S.CP 3  S.CP. 4  S.CP.5 | 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”).  \*Statistics and Probability is a Modeling Conceptual Category.  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. \*Statistics and Probability is a Modeling Conceptual Category.  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*. \*Statistics and Probability is a Modeling Conceptual Category.  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 10th grade. Do the same for other subjects and compare the results.* Statistics and Probability is a Modeling Conceptual Category.  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.* Statistics and Probability is a Modeling Conceptual Category. | V: Several videos on probability.  <http://www.virtualnerd.com/common-core/hss-statistics-probability/HSS-CP-conditional-probability-rules/A/1\>  ML: Lesson on probability.  <http://map.mathshell.org/materials/lessons.php?taskid=225>  ML: A lesson connecting probability to the real world.  <http://map.mathshell.org/materials/lessons.php?taskid=438#task438>  A: A short activity relating probability to the Titanic.  <http://www.cpalms.org/Public/PreviewResource/Preview/44654>  V: A video on conditional probability.  <https://www.youtube.com/watch?v=xw6utjoyMi4>  ML: Lesson on independent and dependent events.  <http://www.cpalms.org/Public/PreviewResource/Preview/71619>  R: Information on probability.  <http://www.wyzant.com/resources/lessons/math/statistics_and_probability/probability/further_concepts_in_probability>  A: An activity involving pennies and probability.  <http://alex.state.al.us/lesson_view.php?id=23814>  R: Information on two-way frequency tables.  <http://www.stattrek.com/statistics/two-way-table.aspx>  A: A short activity on independent events.  <http://www.cpalms.org/Public/PreviewResource/Preview/44646> |
| **Cluster: Use rules of probability to compute probabilities of compound events in a uniform probability model** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| S.CP.6  S.CP.7  S.CP.8 (+)  S.CP.9 (+) | 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.  \*Statistics and Probability is a Modeling Conceptual Category.  Apply the Additional Rule, P(A or B) = P(A) + P(B) – P(A and B) and interpret the answer in terms of the model. \*Statistics and Probability is a Modeling Conceptual Category.  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. \*Statistics and Probability is a Modeling Conceptual Category.  Use permutations and combinations to compute probabilities of compound events and solve problems. \*Statistics and Probability is a Modeling Conceptual Category. | V: Videos on conditional probability.  <http://www.onlinemathlearning.com/compound-conditional-probability-cp6.html>  R: Discusses standard S.CP.6 and provides examples.  <http://www.shmoop.com/common-core-standards/ccss-hs-s-cp-6.html>  V: Video on the addition rule.  [http://www.khanacademy.org/math/precalculus/prob\_comb/ addition\_rule\_prob\_precalc/v/addition-rule-for-probability](http://www.khanacademy.org/math/precalculus/prob_comb/%20addition_rule_prob_precalc/v/addition-rule-for-probability)  R: Discusses standard S.CP.8 and provides examples.  <http://www.shmoop.com/common-core-standards/ccss-hs-s-cp-8.html>  V: Several videos on the multiplication rule.  <http://www.onlinemathlearning.com/multiplication-rule-probability-cp8.html>  R: Shows examples of permutations and combinations.  <http://www.mathsisfun.com/combinatorics/combinations-permutations.html>  V: Several videos and examples on permutations and combinations.  <http://www.khanacademy.org/math/precalculus/prob_comb/combinatorics_precalc/v/combinations> |
| **Domain: Using Probability to Make Decisions**  **Cluster: Calculate expected values and use them to solve problems** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| S.MD.1 (+)  S.MD.2 (+)  S.MD.3 (+)  S.MD.4(+) | 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.  Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.  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.*    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?* | ML: Lesson on expected values.  [http://www.cpalms.org/Public/PreviewResource/Preview/50618#/#standards-toggle](http://www.cpalms.org/Public/PreviewResource/Preview/50618#/)  R: Discusses standard S.MD.3.  <http://www.stattrek.com/probability-distributions/probability-distribution.aspx>  V: Videos on probability.  <http://education-portal.com/academy/topic/common-core-hs-statistics-probability-random-variables.html>  V: Videos on random variables.  <http://www.khanacademy.org/math/probability/random-variables-topic/random_variables_prob_dist/v/discrete-probability-distribution> |
| **Cluster: Use probability to evaluate outcomes of decisions** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| S.MD.5a (+)  S.MD.5b (+)  S.MD.6 (+)  S.MD.7 (+) | Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.  a. 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.*  b. Evaluate and compare strategies on the basis of expected values. *For example, compare a high-deductible vs. a low-deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident.*  Use probabilities to make fair decisions (e.g. drawing by lots, using a random number generator.)  Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game.) Statistics and Probability is a Modeling Conceptual Category. | R: An example of how probability is used to make decisions.  <https://www.khanacademy.org/math/probability/probability-and-combinatorics-topic/decisions-with-probability/e/using-probability-to-make-fair-decisions>  R: Several lessons and examples on how probability is used to make decisions.  <http://www.mathworksheetsland.com/stats/28fairdecset.html>  ML: Activity connecting probability to the real world.  <http://www.cpalms.org/Public/PreviewResource/Preview/50626>  R: Discusses standard S.MD.7 and includes examples.  <http://www.shmoop.com/common-core-standards/ccss-hs-s-md-7.html> |

Kentucky Core Academic Progression of Standards and Related Intervention Supports

MATHEMATICS- Geometry

R-Resources S- Strategy A- Activities V- Video ML- Model Lesson PL- Professional Learning

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| **Geometry Unit 1** | | |
| **Domain: Congruence**  **Cluster: Experiment with transformations in the plane.** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| G.CO.1  G.CO.2  G.CO.3  G.CO.4  G.CO.5 | Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment based on the undefined notions of a point, line, distance along a line and distance around a circular arc.  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)  Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.  Develop definitions of rotations, reflections and translations in terms of angles, circles, perpendicular lines, parallel lines and line segments.  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. | V: A series of videos that define the basic terms of geometry.  <http://www.virtualnerd.com/common-core/hsf-geometry/HSG-CO-congruence/A/1>  V/R: Features several videos on transformations.  <http://www.onlinemathlearning.com/transformation-hsg-co2.html>  R: Discusses standard G.OC.3 and includes examples.  <http://www.shmoop.com/common-core-standards/ccss-hs-g-co-3.html>  A: An activity on transformations.  <http://illuminations.nctm.org/Lesson.aspx?id=2591>  A: A graphing calculator activity featuring transformations.  <http://education.ti.com/en/us/activity/detail?id=B7CBCEE88FBC486886D9A270295AF80C>  R: Includes several practice games on transformations.  <http://www.onlinemathlearning.com/transformation-games.html>  A: Students have to complete several transformations.  <http://mathsteaching.wordpress.com/2008/07/11/shape-transformations/> |
| **Cluster: Understand congruence in terms of rigid motions** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| G.CO.6  G.CO.7  G.CO.8 | Use geometric descriptions as 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.  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.  Explain how the criteria for triangle congruence (ASA, SAS, SSS) follow from the definition of congruence in terms of rigid motions. | ML: A lesson on triangle congruence.  <http://map.mathshell.org/materials/lessons.php?taskid=452#task452>  V: Features videos and interactive examples of triangle congruence.  <https://www.khanacademy.org/math/geometry/congruent-triangles/cong_triangle/e/congruency_postulates>  R: An interactive site on triangle congruence.  <http://illuminations.nctm.org/Activity.aspx?id=3504>  R: Discusses each method to prove congruent triangles.  <http://www.mathwarehouse.com/geometry/congruent_triangles/> |
| **Cluster: Prove Geometric Theorems** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| G.CO.9  G.CO.10  G.CO.11. | 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.*  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.*  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.* | R: Provides several examples of proofs.  <http://excellup.com/classnine/mathnine/lineangletheorem.aspx>  V: Offers several videos on proofs.  <http://www.virtualnerd.com/common-core/hsf-geometry/HSG-CO-congruence/C/9>  R: Discusses standard G.CO.10 and includes examples.  <http://www.shmoop.com/common-core-standards/ccss-hs-g-co-10.html>  R: Provides several handouts on parallelogram theorems.  <http://www.mathworksheetsland.com/geometry/11parallelproofset.html> |
| **Cluster: Make geometric constructions** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| G.CO.12  G.CO.13 | 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.*  Construct an equilateral triangle, a square and a regular hexagon inscribed in a circle. | R: A “How To” list on constructions.  <http://www.mathsisfun.com/geometry/constructions.html>  R: An interactive “How To” lesson on constructions.  <http://www.mathopenref.com/constinhexagon.html> |

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| **Geometry Unit 2** | | | |
| **Domain: Similarity, Right Triangles, and Trigonometry**  **Cluster: Understand similarity in terms of similarity transformations** | | | |
| **Standards** | **Key ideas and Details** | | **Intervention Supports** |
| G.SRT.1a  G.SRT.1b  G.SRT.2  G.SRT.3 | Verify experimentally the properties of dilations given by a center and a scale factor.  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.  Verify experimentally the properties of dilations given by a center and a scale factor.  b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.  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.  Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar. | | R: Discusses dilations and similarity transformations.  <http://math.tutorvista.com/geometry/similarity-transformation.html>  A: A short activity on dilations.  <http://www.regentsprep.org/Regents/math/geometry/GT3/DActiv.htm>  A: Sample problems on dilations.  [www.mathworksheetsland.com/geometry/16dilation/ip.pdf](http://www.mathworksheetsland.com/geometry/16dilation/ip.pdf)  V: Video on similarity transformations.  <http://www.virtualnerd.com/geometry/transformations/similarity-congruence/identify-similarity-transformation> |
| **Cluster: Prove theorems involving similarity.** | | | |
| **Standards** | **Key ideas and Details** | | **Intervention Supports** |
| G.SRT.4  G.SRT.5 | 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.*  Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. | | R/V: Discusses standard G.SRT.4 and includes a funny video for students.  <http://www.shmoop.com/common-core-standards/ccss-hs-g-srt-4.html>  R: Discusses standard G.SRT.5 and includes a real life example to present to students.  <https://www.illustrativemathematics.org/illustrations/651> |
| **Cluster: Define trigonometric ratios and solve problems involving right triangles** | | | |
| **Standards** | | **Key ideas and Details** | **Intervention Supports** |
| G.SRT.6  G.SRT.7  G.SRT.8 | | 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.  Explain and use the relationship between the sine and cosine of complementary angles.  Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. \* | R: A graphic organizer on trigonometric ratios.  <http://exchange.smarttech.com/details.html?id=cdbb7c21-85b7-4646-a51d-f7ae27d4e8aa>  V/R: Features several videos and examples of trigonometry.  <http://www.khanacademy.org/math/trigonometry/basic-trigonometry>  V: Provides several videos on standard G.SRT.7.  <https://learnzillion.com/lessonsets/619-understand-the-relationship-between-the-sine-and-cosine-of-complementary-angles>  A: A real world activity on trigonometry.  <http://alex.state.al.us/lesson_view.php?id=6943>  A: A real world activity on trigonometry.  <http://alex.state.al.us/lesson_view.php?id=1669> |
| **Cluster: Apply trigonometry to general triangles** | | | |
| **Standards** | | **Key ideas and Details** | **Intervention Supports** |
| G.SRT.9 (+)  G.SRT.10 (+)  G.SRT.11 (+) | | 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.  Prove the Laws of Sines and Cosines and use them to solve problems.  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). | V: A “How To” video on the derivation of *A=1/2absin(c).*  <http://www.virtualnerd.com/common-core/hsf-geometry/HSG-SRT-right-triangle-similarity-trigonometry/D/9>  R: Shows examples of Law of Sines and Cosines.  <http://www.mathwarehouse.com/trigonometry/law-of-sines/formula-and-practice-problems.php>  R: Shows examples of Law of Sines and Cosines.  <http://www.mathcaptain.com/trigonometry/law-of-sines-and-cosines.html>  A: An activity helping students prove the Law of Cosines.  <http://illuminations.nctm.org/Lesson.aspx?id=2441>  A: An activity helping students prove the Law of Sines.  <http://illuminations.nctm.org/Lesson.aspx?id=2433> |
| **Domain: Modeling with Geometry**  **Cluster: Apply geometric concepts in modeling situations** | | | |
| **Standards** | | **Key ideas and Details** | **Intervention Supports** |
| G.MG.1  G.MG.2  G.MG.3 | | Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).\*(\*Modeling Standard)  Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).\* (\*Modeling Standard)  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).\*(\*Modeling Standard) | ML: A real world activity involving surface area.  <http://www.cpalms.org/Public/PreviewResource/Preview/28057>  ML: Students must work together and use their knowledge of geometry to complete a mission.  <http://map.mathshell.org/materials/lessons.php?taskid=428#task428> |

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| **Geometry Unit 3** | | |
| **Domain: Geometric Measurement and Dimension**  **Cluster: Explain volume formulas and use them to solve problems** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| G.GMD.3 | |  | | --- | | Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.\*(\*Modeling Standard) | | ML: Introductory lesson on volume.  <http://www.cpalms.org/Public/PreviewResource/Preview/45410>  V: Videos on each component of this standard.  <https://learnzillion.com/lessonsets/535-use-volume-formulas-for-cylinders-pyramids-cones-and-spheres-to-solve-problems>  ML: Complete lesson on cylinders.  <http://www.constructioncenterofexcellence.com/wp-content/uploads/2013/05/MathToolbox4.pdf>  ML: Students will find the volume of irregular shapes.  <http://map.mathshell.org/materials/lessons.php?taskid=216#task216> |
| **Cluster: Visualize relationships between two-dimensional and three-dimensional objects** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 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. | | R/V: Discusses this standard and includes a funny video for students.  <http://www.shmoop.com/common-core-standards/ccss-hs-g-gmd-4.html> |
| **Domain: Modeling with Geometry**  **Cluster: Apply geometric concepts in modeling situations** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 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).\*(\*Modeling Standard) | ML: A real world activity involving surface area.  <http://www.cpalms.org/Public/PreviewResource/Preview/28057>  ML: Students must work together and use their knowledge of geometry to complete a mission.  <http://map.mathshell.org/materials/lessons.php?taskid=428#task428> |

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| **Geometry Unit 4** | | |
| **Domain: Expressing Geometric Properties with Equations**  **Cluster: Use coordinates to prove simple geometric theorems algebraically** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| G.GPE.4  G.GPE.5  G.GPE.6  G.GPE.7 | 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).  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).  Find the point on a directed line segment between two given points that partitions the segment in a given ratio.  Use coordinates to compute perimeters of polygons and area of triangles and rectangles, e.g., using the distance formula.\*(\*Modeling Standard) | V: Videos on proofs involving the coordinate plane.  <https://learnzillion.com/lessons/285-prove-whether-a-figure-is-a-rectangle-in-the-coordinate-plane>  V: Features several videos on parallel and perpendicular lines.  <http://www.showme.com/topic/g.gpe.5>  R: Shows several examples on writing equations of parallel and perpendicular lines.  <http://www.mathsisfun.com/algebra/line-parallel-perpendicular.html>  R: A PowerPoint on line segments.  <http://view.officeapps.live.com/op/view.aspx?src=http%3A%2F%2Fsamgierlessons.wikispaces.com%2Ffile%2Fview%2FCONGRUENT%2BSEGMENTS%2B%2526%2BMIDPOINT%2BOF%2BA%2BSEGMENT.ppt>  V: Provides several videos on computations involving polygons.  <http://www.onlinemathlearning.com/coordinates-perimeters-areas-hsg-gpe7.html>  V: Provides several videos on computations involving polygons.  <http://www.virtualnerd.com/common-core/hsf-geometry/HSG-GPE-geometric-properties-equations/B/7> |
| **Cluster: Translate between the geometric description and the equation for a conic section** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| G.GPE.2 | Derive the equation of a parabola given a focus and directrix. | R: Shows several examples of this standard.  <http://www.algebralab.org/lessons/lesson.aspx?file=Algebra_conics_directrix.xml>  V: Contains videos on parabolas.  <http://www.virtualnerd.com/common-core/hsf-geometry/HSG-GPE-geometric-properties-equations/A/2> |

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| **Geometry Unit 5** | | |
| **Domain: Circles**  **Cluster: Understand and apply theorems about circles** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| G.C.1  G.C.2  G.C.3  G.C. 4 (+) | Prove that all circles are similar.  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.  Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.  Construct a tangent line from a point outside a given circle to the circle. | V: Several videos showing how to prove circles are similar.  <http://www.onlinemathlearning.com/prove-circles-similar-hsg-c1.html>  R: A handout with examples on how to prove circles are similar.  [www.cpm.org/pdfs/state\_supplements/**Similar**\_**Circles**.pdf](http://www.cpm.org/pdfs/state_supplements/Similar_Circles.pdf)  V/R: Discusses standard C.C.2 and includes two funny videos for students.  <http://www.shmoop.com/common-core-standards/ccss-hs-g-c-2.html>  ML: Lesson involving chords, secant, and tangents.  <http://www.cpalms.org/Public/PreviewResource/Preview/51284>  V/R: Discusses standard C.C.3 and includes two funny videos for students.  <http://www.shmoop.com/common-core-standards/ccss-hs-g-c-3.html>  A: An activity connecting inscribed angles to real life.  <http://secondaryiiinutah.wikispaces.com/Inscribed+and+Circumscribed+Circles>’  ML: Lesson connecting tangents to real life.  <http://www.cpalms.org/Public/PreviewResource/Preview/46386> |
| **Cluster: Find arc lengths and areas of sectors of circles** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 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. | ML: Lesson connecting sectors to the real world.  <http://www.cpalms.org/Public/PreviewResource/Preview/49299>  V: Multiple videos on sectors.  <http://www.onlinemathlearning.com/area-sector.html> |
| **Domain: Expressing Geometric Properties with Equations**  **Cluster: Translate between the geometric description and the equation for a conic section** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 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. | V: Several videos on the equation of a circle.  <https://learnzillion.com/lessonsets/763-derive-the-equation-of-a-circle-using-the-pythagorean-theorem>  ML: An activity on equations of circles.  <http://map.mathshell.org/materials/lessons.php?taskid=425#task425> |
| **Cluster: Use coordinate to prove simple geometric theorems algebraically** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 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).* | V: Videos on proofs involving the coordinate plane.  <https://learnzillion.com/lessons/285-prove-whether-a-figure-is-a-rectangle-in-the-coordinate-plane> |
| **Domain: Modeling with Geometry**  **Cluster: Apply geometric concepts in modeling situations** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 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).\*(\*Modeling Standard) | ML: A real world activity involving surface area.  <http://www.cpalms.org/Public/PreviewResource/Preview/28057>  ML: Students must work together and use their knowledge of geometry to complete a mission.  <http://map.mathshell.org/materials/lessons.php?taskid=428#task428> |

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| **Geometry Unit 6** | | | | |
| **Domain: Conditional Probability and the Rules of Probability**  **Cluster: Understand independence and conditional probability and use them to interpret data** | | | | |
| **Standards** | | **Key ideas and Details** | **Intervention Supports** | |
| S.CP.1  S.CP 2  S.CP 3  S.CP. 4  S.CP.5 | | 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”).  Statistics and Probability is a Modeling Conceptual Category.  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.  Statistics and Probability is a Modeling Conceptual Category.  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*.\* Statistics and Probability is a Modeling Conceptual Category.  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 10th grade. Do the same for other subjects and compare the results.* Statistics and Probability is a Modeling Conceptual Category.  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.* Statistics and Probability is a Modeling Conceptual Category. | V: Several videos on probability.  <http://www.virtualnerd.com/common-core/hss-statistics-probability/HSS-CP-conditional-probability-rules/A/1\>  ML: Lesson on probability.  <http://map.mathshell.org/materials/lessons.php?taskid=225>  ML: A lesson connecting probability to the real world.  <http://map.mathshell.org/materials/lessons.php?taskid=438#task438>  A: A short activity relating probability to the Titanic.  <http://www.cpalms.org/Public/PreviewResource/Preview/44654>  V: A video on conditional probability.  <https://www.youtube.com/watch?v=xw6utjoyMi4>  ML: Lesson on independent and dependent events.  <http://www.cpalms.org/Public/PreviewResource/Preview/71619>  R: Information on probability.  <http://www.wyzant.com/resources/lessons/math/statistics_and_probability/probability/further_concepts_in_probability>  A: An activity involving pennies and probability.  <http://alex.state.al.us/lesson_view.php?id=23814>  R: Information on two-way frequency tables.  <http://www.stattrek.com/statistics/two-way-table.aspx>  A: A short activity on independent events.  <http://www.cpalms.org/Public/PreviewResource/Preview/44646> | |
| **Cluster: Use rules of probability to compute probabilities of compound events in a uniform probability model** | | | | |
| **Standards** | | **Key ideas and Details** | **Intervention Supports** | |
| S.CP.6  S.CP.7  S.CP.8 (+)  S.CP.9 (+) | | 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.  Apply the Additional Rule, P(A or B) = P(A) + P(B) – P(A and B) and interpret the answer in terms of the model.  Statistics and Probability is a Modeling Conceptual Category.  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.  Statistics and Probability is a Modeling Conceptual Category.  Use permutations and combinations to compute probabilities of compound events and solve problems.  Statistics and Probability is a Modeling Conceptual Category. | V: Videos on conditional probability.  <http://www.onlinemathlearning.com/compound-conditional-probability-cp6.html>  R: Discusses standard S.CP.6 and provides examples.  <http://www.shmoop.com/common-core-standards/ccss-hs-s-cp-6.html>  V: Video on the addition rule.  [http://www.khanacademy.org/math/precalculus/prob\_comb/ addition\_rule\_prob\_precalc/v/addition-rule-for-probability](http://www.khanacademy.org/math/precalculus/prob_comb/%20addition_rule_prob_precalc/v/addition-rule-for-probability)  R: Discusses standard S.CP.8 and provides examples.  <http://www.shmoop.com/common-core-standards/ccss-hs-s-cp-8.html>  V: Several videos on the multiplication rule.  <http://www.onlinemathlearning.com/multiplication-rule-probability-cp8.html>  R: Shows examples of permutations and combinations.  <http://www.mathsisfun.com/combinatorics/combinations-permutations.html>  V: Several videos and examples of permutations and combinations.  <http://www.khanacademy.org/math/precalculus/prob_comb/combinatorics_precalc/v/combinations> | |
| **Domain: Using Probability to Make Decisions**  **Cluster: Use probability to evaluate outcomes of decisions** | | | | |
| **Standards** | **Key ideas and Details** | | | **Intervention Supports** |
| S.MD.6 (+)  S.MD.7 (+) | Use probabilities to make fair decisions (e.g. drawing by lots, using a random number generator.)  *This unit sets the stage for work in Algebra II, where the ideas of statistical inference are introduced. Evaluating the risks associated with conclusions drawn from sample data (i.e. incomplete information) requires an understanding of probability concepts.* Statistics and Probability is a Modeling Conceptual Category.  Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game.) Statistics and Probability is a Modeling Conceptual Category. | | | R: An example of how probability is used to make decisions.  <https://www.khanacademy.org/math/probability/probability-and-combinatorics-topic/decisions-with-probability/e/using-probability-to-make-fair-decisions>  R: Several lessons and examples on how probability is used to make decisions.  <http://www.mathworksheetsland.com/stats/28fairdecset.html>  ML: Activity connecting probability to the real world.  <http://www.cpalms.org/Public/PreviewResource/Preview/50626>  R: Discusses the standard and includes examples.  <http://www.shmoop.com/common-core-standards/ccss-hs-s-md-7.html> |

Kentucky Core Academic Progression of Standards and Related Intervention Supports

MATHEMATICS- Algebra 1

R-Resources S- Strategy A- Activities V- Video ML- Model Lesson PL- Professional Learning

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| **Algebra 1 Unit 1** | | |
| **Domain: Quantities**  **Cluster: Reason quantitatively and use units to solve problems.** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| N.Q.1  N.Q.2  N.Q.3 | 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.  Define appropriate quantities for the purpose of descriptive modeling.  Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. | A: Shows students how to choose a scale for their graph.  <http://view.officeapps.live.com/op/view.aspx?src=http%3A%2F%2Fwww.tacomacc.edu%2FUserFiles%2FServers%2FServer_6%2FFile%2FScale%2520handout.doc>  R: A full website dedicated to each type of unit. The units are broken down into categories: mass, length, area, volume, etc.  <http://www.mathsisfun.com/measure/index.html>  V: Helps students determine the accuracy of a math problem.  <https://learnzillion.com/lessons/3370-determine-appropriate-level-of-accuracy> |
| **Domain: Seeing Structure in Expressions**  **Cluster: Interpret the structure of expressions** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| A.SSE.1a  A.SSE.1b | Interpret expressions that represent a quantity in terms of its context.\*(\*Modeling standard)  a. Interpret parts of an expression, such as terms, factors, and coefficients.  Interpret expressions that represent a quantity in terms of its context.\* (Modeling standard)  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. | ML: Shows students how to determine the meaning of expressions.  <http://map.mathshell.org/materials/lessons.php?taskid=221>  A: A visual representation of order of operations and how expressions are organized.  <https://mathematicsteachingcommunity.math.uga.edu/index.php/448/interpreting-algebraic-expressions> |
| **Domain: Creating Equations\* (\*Modeling Domain)**  **Cluster: Create equations that describe numbers or relationships** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| A.CED.1  A.CED.2  A.CED.3  A.CED.4 | 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.*    Create equations in two or more variables to represent relationships between quantities, graph equations on a coordinate axes with labels and scales.  Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*  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.* | R: Shows the steps for writing an equation from a word problem.  <http://algebralab.org/lessons/lesson.aspx?file=Algebra_OneVariableWritingEquations.xml>  ML: Shows students how to write and solve linear equations for a specific value.  <http://www.mathworksheetsgo.com/sheets/algebra/linear-equation/linear-equation-word-problems-worksheet.php>  V: A set of videos that show how to determine constraints of equations and inequalities.  <https://learnzillion.com/lessonsets/516-represent-constraints-by-linear-equations-inequalities-and-systems-interpret-solutions-as-viable-and-nonviable>  V: Shows the process of solving an equation for a specific variable  <http://www.khanacademy.org/math/algebra/solving-linear-equations-and-inequalities/solving_for_variable/v/rearrange-formulas-to-isolate-specific-variables> |
| **Domain: Reasoning with equations and inequalities**  **Cluster: Understand solving equations as a process of reasoning and explain reasoning** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 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. | R: Provides a set of steps for solving equations  <http://cstl.syr.edu/fipse/Algebra/Unit3/steps.htm> |
| **Cluster: Solve equations and inequalities in one variable** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| A.REI.3 | Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. | ML: A full lesson on solving equations using the “Party Method.” Includes a full length PowerPoint presentation. <http://alex.state.al.us/lesson_view.php?id=23865> |

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| **Algebra 1 Unit 2** | | | |
| **Domain: The Real Number System**  **Cluster: Extend the properties of exponents to rational exponents** | | | |
| **Standards** | | **Key ideas and Details** | **Intervention Supports** |
| N.RN.1  N.RN.2 | | 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.*  Rewrite expressions involving radicals and rational exponents using the properties of exponents. | R: Shows the connection between rational and integer exponents.  <http://tutorial.math.lamar.edu/Classes/Alg/RationalExponents.aspx>  R: Provides an overview of rational exponents including several examples of how to write them in radical form. <http://www.montereyinstitute.org/courses/DevelopmentalMath/COURSE_TEXT2_RESOURCE/U16_L1_T3_text_final.html> |
| |  | | --- | | **Domain: Reasoning with Equations and Inequalities**  **Cluster: Solve system of equations** | | | | |
| **Standards** | | **Key ideas and Details** | **Intervention Supports** |
| A.REI.5  A.REI.6 | | Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and multiple of the other produces a system with the same solutions.  Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. | V: A set of videos showing why a solution to a system of equations matches the sum.  <https://learnzillion.com/lessons/3755-find-commonalities-between-equations-in-a-system-and-their-sum>  R: Shows how to solve system of equations multiple ways.  <http://www.mathsisfun.com/algebra/systems-linear-equations.html>  R: Lists several activities to review/enhance student understanding of system of equations.  <http://www.ilovemath.org/index.php?option=com_docman&task=cat_view&gid=53> |
| **Cluster: Represent and solve equations and inequalities graphically** | | | |
| **Standards** | **Key ideas and Details** | | **Intervention Supports** |
| A.REI.10  A.REI.11  A.REI.12 | 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).  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.\* (Modeling standard)  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. | | R: Resource page with multiple lessons.  <http://ccssmath.org/?page_id=2147>  R: Resource page with multiple lessons.  <http://ccssmath.org/?page_id=2149>  R: Several resources on system of equations and inequalities. Includes videos on how to graph linear inequalities along with sample word problems.  <http://www.khanacademy.org/math/algebra/systems-of-eq-and-ineq> |
| **Domain: Interpreting Functions**  **Cluster: Understand the concept of a function and use function notation** | | | |
| **Standards** | **Key ideas and Details** | | **Intervention Supports** |
| F.IF.1  F.IF.2  F.IF.3 | 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*).  Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.  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.* | | R: Provides several examples, definitions, and a video on relations, functions, domain and range.  <http://www.mathwarehouse.com/algebra/relation/math-function.php>  R: Shows several examples and explanations on function notation.  <http://www.onemathematicalcat.org/algebra_book/online_problems/function_notation.htm>  V: Includes several videos about function notation.  <http://www.onlinemathlearning.com/function-equation.html>  R: A quick demonstration showing how arithmetic sequences are connected to linear functions.  <http://mathandmultimedia.com/2010/04/28/arithmetic-sequence-and-linear-function/> |
| **Cluster: Interpret functions that arise in applications in terms of the context** | | | |
| **Standards** | **Key ideas and Details** | | **Intervention Supports** |
| F.IF.4  F.IF.5  F.IF.6 | 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.\**(\*Modeling standard)  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.*\*(\*Modeling standard)  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.\*(Modeling standard) | | ML: A lesson that requires students to identify parts of distance/time graphs.  <http://map.mathshell.org/materials/lessons.php?taskid=208>  V: Features several videos to help students identify parts of functions.  <https://www.khanacademy.org/math/algebra2/functions_and_graphs/analyzing_functions/e/recog-features-func-2>  V: Provides several videos on finding the domain and range of functions.  <https://www.khanacademy.org/math/algebra/algebrafunctions/domain_and_range/v/domain-and-range-1>  A: A lesson showing how slope is related to ramps.  <http://alex.state.al.us/lesson_view.php?id=23830>  R: Provides several examples on slope and how it is connected to the real world.  <http://www.learner.org/courses/learningmath/algebra/session5/index.html> |
| **Cluster: Analyze functions using different representations** | | | |
| **Standards** | **Key ideas and Details** | | **Intervention Supports** |
| F.IF.7a  F.IF.7e  F.IF.9 | Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.\*(Modeling standard)  a. Graph linear and quadratic functions and show intercepts, maxima, and minima.  Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.\*(Modeling standard)  e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.  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.* | | V: Features several videos on graphing parabolas.  <http://www.khanacademy.org/math/algebra/quadratics/solving_graphing_quadratics/e/graphing_parabolas_1>  R: Shows the steps for graphing linear equations.  <http://www.basic-mathematics.com/graphing-linear-equations.html>  ML: A lesson helping students to identify parts of quadratic functions.  <http://map.mathshell.org/materials/lessons.php?taskid=224>  A: An activity relating exponential growth and decay to real life.  <http://alex.state.al.us/lesson_view.php?id=24092>  R: Shows the process for graphing exponential functions.  <http://www.purplemath.com/modules/graphexp.htm>  R: Discusses how to graph several kinds of functions.  <http://math.tutorvista.com/calculus/graphing-functions.html>  V: Features several short video lessons on how to make connections between functions.  <https://learnzillion.com/lessons/1194-compare-two-functions-by-analyzing-an-equation-and-a-verbal-description>  R: Discusses standard F.IF.9 and provides examples.  <http://www.shmoop.com/common-core-standards/ccss-hs-f-if-9.html> |
| **Domain: Building Functions**  **Cluster: Build a function that models a relationship between two quantities** | | | |
| **Standards** | **Key ideas and Details** | | **Intervention Supports** |
| F.BF.1a  F.BF.1b  F.BF.2 | Write a function that describes a relationship between two quantities.\*(Modeling standard)  a. Determine an explicit expression, a recursive process, or steps for calculation from a context.  Write a function that describes a relationship between two quantities.\*(Modeling standard)  b. 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.*  Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.\*(\*Modeling standard) | | ML: Students write equations based on patterns.  <http://map.mathshell.org/materials/lessons.php?taskid=215>  ML: Students write equations based on patterns.  <http://map.mathshell.org/materials/tasks.php?taskid=286&subpage=expert>  V: A video showing how to write equations based on sequences.  <https://www.youtube.com/watch?v=V02nV_qR_xQ>  R: Guided notes on geometric sequences.  <http://images.pcmac.org/SiSFiles/Schools/GA/DouglasCounty/DouglasCountyHigh/Uploads/DocumentsCategories/Documents/Geometric%20Sequences%20Notes.pdf> |
| **Cluster: Build new functions from existing functions** | | | |
| **Standards** | **Key ideas and Details** | | **Intervention Supports** |
| 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.* | | ML: A guided lesson on transformations.  <http://alex.state.al.us/lesson_view.php?id=30033> |
| **Domain: Linear, Quadratic, and Exponential Models\* (\*Modeling Domain)**  **Cluster: Cluster: Construct and compare linear, quadratic, and exponential models and solve problems** | | | |
| **Standards** | **Key ideas and Details** | | **Intervention Supports** |
| F.LE.1a  F.LE.1b  F.LE.1c  F.LE.2  F.LE.3 | Distinguish between situations that can be modeled with linear functions and with exponential functions.  a. Prove that linear functions grow by equal differences over equal intervals; and that exponential functions grow by equal factors over equal intervals.  Distinguish between situations that can be modeled with linear functions and with exponential functions.  b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.  Distinguish between situations that can be modeled with linear functions and with exponential functions.  c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.  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).  Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function. | | V: Two videos on linear and exponentials functions.  <https://learnzillion.com/lessons/300-prove-that-linear-functions-grow-by-equal-differences-over-equal-intervals>  A: Has students decide which situations are linear or exponential  <http://map.mathshell.org/materials/tasks.php?taskid=296&subpage=novice>  R: A PowerPoint introducing exponential growth and decay  <http://view.officeapps.live.com/op/view.aspx?src=http%3A%2F%2Fwww.mathisnothard.com%2Fpages%2Fnotes%2Falgebra%2Fpowerpoints%2Fexpgrowthdecay.ppt>  V: A video that shows how to graph an exponential function.  <http://www.khanacademy.org/math/algebra/algebrafunctions/graphing_functions/v/graphing-exponential-functions>  V: Features several videos on graphing exponential functions and how they relate to linear functions.  <https://learnzillion.com/lessons/298-determine-which-of-2-growing-quantities-will-eventually-exceed-the-other> |
| **Cluster: Interpret expressions for functions in terms of the situation they model** | | | |
| **Standards** | **Key ideas and Details** | | **Intervention Supports** |
| F.LE.5 | Interpret the parameters in a linear or exponential function in terms of a context. | | V: A series of videos on exponentials and how they relate to this standard.  <http://www.virtualnerd.com/common-core/hsf-functions/HSF-LE-linear-quadratic-exponential-models/B/5> |

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| **Algebra 1 Unit 3** | | |
| **Domain: Interpreting Categorical and Quantitative Data**  **Cluster: Summarize, represent, and interpret data on a single count or measurement variable** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| S.ID.1  S.ID.2  S.ID.3 | Represent data with plots on the real number line (dot plots, histograms, and box plots).  (Statistics and Probability is a Modeling Conceptual Category.)  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.  (Statistics and Probability is a Modeling Conceptual Category.)  Interpret differences in shape, center and spread in the context of data sets, accounting for possible effects of extreme data points (outliers).  (Statistics and Probability is a Modeling Conceptual Category.) | A: Students will model data using various displays.  <http://alex.state.al.us/lesson_view.php?id=26258>  A: Students will create a data display.  <http://www.prb.org/Publications/Lesson-Plans/PyramidBuilding.aspx>  A: Students will make various calculations with a set of data including mean, median, and mode.  <http://alex.state.al.us/lesson_view.php?id=14515>  V: Provides several videos on how to understand the meaning of data.  <http://www.khanacademy.org/math/pre-algebra/applying-math-reasoning-topic/reading_data/v/histograms> |
| **Cluster: Summarize, represent, and interpret data on two categorical and quantitative variables** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| S.ID.5  S.ID.6a  S.ID.6b  S.ID.6c | 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. (Statistics and Probability is a Modeling Conceptual Category.)  Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. a. 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 and exponential models.*  Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. b. Informally assess the fit of a function by plotting and analyzing residuals.  Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. c. Fit a linear function for a scatter plot that suggests a linear association. (Statistics and Probability is a Modeling Conceptual Category.) | V: A video showing how to interpret frequency tables.  <http://www.teachertube.com/video/sid5-summarize-data-in-two-way-frequency-290006>  V: Video series on scatter plots.  <http://www.onlinemathlearning.com/scatter-plot.html>  A: An activity involving the line of best fit and exponential functions.  <http://alex.state.al.us/lesson_view.php?id=21153>  R: An interactive line of best fit.  <http://illuminations.nctm.org/Activity.aspx?id=4186>  A: A graphing calculator activity on scatter plots, line of best fit, and regression.  <http://illuminations.nctm.org/Lesson.aspx?id=2551> |
| **Cluster: Interpret linear models** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| S.ID.7  S.ID.8  S.ID.9 | Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.  (Statistics and Probability is a Modeling Conceptual Category.)  Compute (using technology) and interpret the correlation coefficient of a linear fit.  (Statistics and Probability is a Modeling Conceptual Category.)  Distinguish between correlation and causation.  (Statistics and Probability is a Modeling Conceptual Category.) | A: An interactive activity that shows how bungee jumping relates to scatter plots and line of best fit. <http://illuminations.nctm.org/Lesson.aspx?id=2157>  R: Discusses the meaning of a correlation coefficient.  <http://mathbits.com/MathBits/TISection/Statistics2/correlation.htm>  R: Provides a clear explanation of causation and correlation.  <http://www.differencebetween.net/science/difference-between-causation-and-correlation/> |

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| **Algebra 1 Unit 4** | | |
| **Domain: Seeing Structure in Expressions**  **Cluster: Interpret the structure of expressions** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| A.SSE.1a  A.SSE.1b  A.SSE.2 | Interpret expressions that represent a quantity in terms of its context.\* (\*Modeling standard)  a. Interpret parts of an expression, such as terms, factors, and coefficients.  Interpret expressions that represent a quantity in terms of its context.\* (Modeling standard)  b. 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.  Use the structure of an expression to identify ways to rewrite it. *For example, see x4 – y4 as (x2)2 – (y2)2, thus recognizing it as a difference of squares that can be factored as (x2 – y2)(x2 + y2).* | ML: Shows students how to determine the meaning of expressions.  <http://map.mathshell.org/materials/lessons.php?taskid=221>  A: A visual representation of order of operations and how expressions are organized.  <https://mathematicsteachingcommunity.math.uga.edu/index.php/448/interpreting-algebraic-expressions>  V/R: Discusses standard A.SS.E.2, provides examples, and includes funny videos for students.  <http://www.shmoop.com/common-core-standards/ccss-hs-a-sse-2.html> |
| **Cluster: Write expressions in equivalent forms to solve problems** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| A.SSE.3a  A.SSE.3b  A.SSE.3c | Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.\*(Modeling standard) a. Factor a quadratic expression to reveal the zeros of the function it defines.  Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.\* (Modeling standard) b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.  Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.\* (\*Modeling standard) c. Use the properties of exponents to transform expressions for exponential functions. *For example the expression 1.15t can be rewritten as (1.151/12)12t* ≈ *1.01212t to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.* | R: Discusses the process of finding zeros.  <http://www.shmoop.com/common-core-standards/ccss-hs-a-sse-3a.html>  R: Provides several useful handouts for finding the zeros.  <http://www.mathworksheetsland.com/algebra/4solve.html>  V: A video on completing the square.  <https://www.youtube.com/watch?v=dpeI6gonxPk>  ML: A complete lesson on quadratics.  <http://map.mathshell.org/materials/lessons.php?taskid=224>  R: Provides an example of how to present standard A.SSE.3c to your students.  <http://www.shmoop.com/common-core-standards/ccss-hs-a-sse-3c.html> |
| **Domain: Arithmetic with Polynomial and Rational Expressions**  **Cluster: Perform arithmetic operations on polynomials** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 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. | V: Includes several video examples on adding, subtracting, and multiplying polynomials.  <http://www.khanacademy.org/math/algebra/multiplying-factoring-expression/polynomial_basics/v/adding-and-subtracting-polynomials-1>  <http://www.khanacademy.org/math/algebra/multiplying-factoring-expression/multiplying_polynomials/v/multiplying-polynomials> |
| **Domain: Create Equations and Describe\***  **Cluster: Create equations that describe numbers or relationships** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| A.CED.2 | Create equations in two or more variables to represent relationships between quantities, graph equations on a coordinate axes with labels and scales. | ML: Shows students how to write and solve linear equations for a specific value.  <http://www.mathworksheetsgo.com/sheets/algebra/linear-equation/linear-equation-word-problems-worksheet.php> |
| **Domain: Create Equations\* (\*Modeling Domain)**  **Cluster: Create equations that describe numbers or relationships** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 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.* | V: Shows the process of solving an equation for a specific variable.  <http://www.khanacademy.org/math/algebra/solving-linear-equations-and-inequalities/solving_for_variable/v/rearrange-formulas-to-isolate-specific-variables> |
| **Domain: Reasoning with Equations and Inequalities**  **Cluster: Solve equations and inequalities in one variable** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| A.REI.4a  A.REI.4b | Solve quadratic equations in one variable. a. 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.  Solve quadratic equations in one variable.  b. Solve quadratic equations by inspection (e.g., for *x2 =* 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 ± bi* for real numbers *a* and *b*. | V: Shows how the quadratic formula results from completing the square.  <https://www.youtube.com/watch?v=SCfHulybCH8>  V: Song on the quadratic formula.  <https://www.youtube.com/watch?v=j-hrP_9vx5o>  ML: Lesson on factoring.  <http://alex.state.al.us/lesson_view.php?id=24082>  V: Multiple videos on how to solve quadratics.  <https://learnzillion.com/lessons/744-solve-a-quadratic-equation-by-taking-a-square-root> |
| **Cluster: Solve systems of equations** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| 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 x2 + y2 = 3*. | R: Explains the standard and shows examples.  <http://www.shmoop.com/common-core-standards/ccss-hs-a-rei-7.html>  R: Provides several examples and videos on system of equations involving quadratics.  <http://www.khanacademy.org/math/algebra2/systems_eq_ineq/non-linear-systems-tutorial/e/systems-of-nonlinear-equations> |

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| **Algebra 1 Unit 5** | | | |
| **Domain: The Real Number System**  **Cluster: Use properties of rational and irrational numbers** | | | |
| **Standards** | | **Key ideas and Details** | **Intervention Supports** |
| 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. | R/V: Provides a full explanation of this standard and includes a funny video for students.  <http://www.shmoop.com/common-core-standards/ccss-hs-n-rn-3.html> |
| **Domain: Interpreting Functions**  **Cluster: Interpret functions that arise in applications in terms of the context** | | | |
| **Standards** | | **Key ideas and Details** | **Intervention Supports** |
| F.IF.4  F.IF.5  F.IF.6 | | 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.\**(Modeling standard)  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.*\*(Modeling standard)  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.\*(Modeling standard) | ML: A lesson that requires students to identify parts of distance/time graphs.  <http://map.mathshell.org/materials/lessons.php?taskid=208>  V: Features several videos helping students identify parts of functions.  <https://www.khanacademy.org/math/algebra2/functions_and_graphs/analyzing_functions/e/recog-features-func-2>  V: Provides several videos on finding the domain and range of functions.  <https://www.khanacademy.org/math/algebra/algebrafunctions/domain_and_range/v/domain-and-range-1>  A: A lesson showing how slope is related to ramps.  <http://alex.state.al.us/lesson_view.php?id=23830>  R: Provides several examples on slope and how it is connected to the real world.  <http://www.learner.org/courses/learningmath/algebra/session5/index.html> |
| **Cluster: Analyze functions using different representations** | | | |
| **Standards** | | **Key ideas and Details** | **Intervention Supports** |
| F.IF.7a  F.IF.7b  F.IF.8a  F.IF.8b  F.IF.9 | | Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.  a. Graph linear and quadratic functions and show intercepts, maxima, and minima.  Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.\*(Modeling standard)  b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.  Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.  a. 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.  Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function:  b. 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=(.97)t, y=(1.01)12t, y=(1.2)t/10, and classify them as representing exponential growth or decay.*  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.* | V: Features several videos on graphing parabolas.  <http://www.khanacademy.org/math/algebra/quadratics/solving_graphing_quadratics/e/graphing_parabolas_1>  R: Shows the steps for graphing linear equations.  <http://www.basic-mathematics.com/graphing-linear-equations.html>  ML: A lesson helping students to identify parts of quadratic functions.  <http://map.mathshell.org/materials/lessons.php?taskid=224>  R: Shows examples of graphing.  <http://www.shmoop.com/common-core-standards/ccss-hs-f-if-7b.html>  V: Multiple videos and examples on graphing.  <http://www.khanacademy.org/math/pre-algebra/exponents-radicals>  R: Discusses the process of finding zeros.  <http://www.shmoop.com/common-core-standards/ccss-hs-a-sse-3a.html>  R: Provides several useful handouts for finding the zeros.  <http://www.mathworksheetsland.com/algebra/4solve.html>  V: Features several videos on graphing parabolas.  <http://www.khanacademy.org/math/algebra/quadratics/solving_graphing_quadratics/e/graphing_parabolas_1>  ML: A complete lesson on quadratics.  <http://map.mathshell.org/materials/lessons.php?taskid=224>  R: Provides a full explanation of standard F.IF.8b along with examples.  <http://www.shmoop.com/common-core-standards/ccss-hs-f-if-8b.html>  V: Features several short video lessons on how to make connections between functions.  <https://learnzillion.com/lessons/1194-compare-two-functions-by-analyzing-an-equation-and-a-verbal-description> |
| **Domain: Building Functions**  **Cluster: Build a function that models a relationship between two quantities** | | | |
| **Standards** | **Key ideas and Details** | | **Intervention Supports** |
| F.BF.1a  F.BF.1b | Write a function that describes a relationship between two quantities.\*(Modeling standard)  a. Determine an explicit expression, a recursive process, or steps for calculation from a context.  Write a function that describes a relationship between two quantities.\*(Modeling standard)  b. 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.* | | ML: Students write equations based on patterns.  <http://map.mathshell.org/materials/lessons.php?taskid=215>  ML: Students write equations based on patterns.  <http://map.mathshell.org/materials/tasks.php?taskid=286&subpage=expert>  V: A video showing how to write equations based on sequences.  <https://www.youtube.com/watch?v=V02nV_qR_xQ> |
| **Domain: Building Functions**  **Cluster: Build new functions from existing functions** | | | |
| **Standards** | **Key ideas and Details** | | **Intervention Supports** |
| F.BF.3  F.BF.4a | 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.*  Find the inverse functions.  a. 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) = 2x3* or f(x) = (x+1)/(x - 1) for x ≠ 1. | | ML: A guided lesson on transformations.  <http://alex.state.al.us/lesson_view.php?id=30033>  R: Explains the process of finding the inverse of a function.  <http://www.purplemath.com/modules/invrsfcn3.htm> |
| **Domain: Linear, Quadratic, and Exponential Models\*(Modeling Domain)**  **Cluster: Construct and compare linear, quadratic, and exponential models and solve problems** | | | |
| **Standards** | **Key ideas and Details** | | **Intervention Supports** |
| 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. | | V: Features several videos on graphing exponential functions and how they relate to linear functions.  <https://learnzillion.com/lessons/298-determine-which-of-2-growing-quantities-will-eventually-exceed-the-other> |

Kentucky Core Academic Progression of Standards and Related Intervention Supports

MATHEMATICS- Algebra 2

R-Resources S- Strategy A- Activities V- Video ML- Model Lesson PL- Professional Learning

QC: Quality Core Standards

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| **Algebra 2 Unit 1** | | |
| **Domain: The Complex Number System**  **Cluster: Perform arithmetic operations with complex numbers** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| **N.CN.1**  QC: C.1.a  **N.CN.2**  QC: C.1.b | Know there is a complex number *i* such that *i*² = -1, and every complex number has the form a + b*i* with a and b real numbers.  Use the relation *i*2 = -1 and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. | R: Shows examples involving complex numbers.  <http://www.purplemath.com/modules/complex.htm>  R: Provides examples of operations with complex numbers.  <http://www.mathsisfun.com/numbers/complex-numbers.html>  V: Videos of operations with complex numbers.  [http://www.khanacademy.org/math/algebra2/complex-numbers-a2/complex\_numbers/v/adding-complex-numbers#](http://www.khanacademy.org/math/algebra2/complex-numbers-a2/complex_numbers/v/adding-complex-numbers)! |
| |  | | --- | |  |   **Cluster: Use complex numbers in polynomial identities and equations** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| **N.CN.7**  QC: E.1.c  **N.CN.8 (+)**  **N.CN.9 (+)** | Solve quadratic equations with real coefficients that have complex solutions.  Extend polynomial identities to the complex numbers. *For example, rewrite x2 + 4 as (x + 2i)(x – 2i).*  Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials. | R: Several examples of quadratics.  <http://regentsprep.org/Regents/math/algtrig/ATE3/quadcomlesson.htm>  V: Videos on quadratics.  <https://learnzillion.com/lessonsets/674-solve-quadratic-equations-with-real-coefficients-that-have-complex-solutions>  R: Several handouts and examples on polynomial identities.  <http://www.mathworksheetsland.com/hsnumbersquan/15poly.html>  R: Explains on the Fundamental Theorem of Algebra.  <http://www.mathsisfun.com/algebra/fundamental-theorem-algebra.html> |
| **Domain: Seeing Structure in Expressions**  **Cluster: Interpret the structure of expressions** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| **A.SSE.1a**  QC: F.1.a, F.1.b, G.1.c  **A.SSE.1b**  QC: F.1.a, F.1.b, G.1.c  **A.SSE.2**  QC: C.1.b, C.1.c, F.1.a, F.1.b, G.1.c, G.1.e | Interpret expressions that represent a quantity in terms of its context.\*( \*Modeling standard)  a. Interpret parts of an expression, such as terms, factors, and coefficients.  Interpret expressions that represent a quantity in terms of its context.\*(Modeling standard)  b. 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.  Use the structure of an expression to identify ways to rewrite it. *For example, see x4 – y4 as (x2)2 – (y2)2, thus recognizing it as a difference of squares that can be factored as (x2 – y2)(x2 + y2).* | ML: Shows students how to determine the meaning of expressions.  <http://map.mathshell.org/materials/lessons.php?taskid=221>  A: A visual representation of order of operations and how expressions are organized.  <https://mathematicsteachingcommunity.math.uga.edu/index.php/448/interpreting-algebraic-expressions>  V/R: Discusses standard A.SSE.2, provides examples, and includes funny videos for students.  <http://www.shmoop.com/common-core-standards/ccss-hs-a-sse-2.html> |
| **Cluster: Write expressions in equivalent forms to solve problems** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| **A.SSE.4**  QC: F.1.a, H.2.c, H.2.d, H.2.e | 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.*\*(Modeling standard) | R/V: Discusses this standard and includes funny videos for students.  <http://www.shmoop.com/common-core-standards/ccss-hs-a-sse-4.html> |
| **Domain: Arithmetic with Polynomial and Rational Expressions**  **Cluster: Perform arithmetic operations on polynomials** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| **A.APR.1**  QC: F.1.a, F.1.b | 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. | V: Includes several video examples on adding, subtracting, and multiplying polynomials.  <http://www.khanacademy.org/math/algebra/multiplying-factoring-expression/polynomial_basics/v/adding-and-subtracting-polynomials-1>  <http://www.khanacademy.org/math/algebra/multiplying-factoring-expression/multiplying_polynomials/v/multiplying-polynomials> |
| **Cluster: Understand the relationship between zeros and factors of polynomials** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| **A.APR. 2**  QC: F.1.a, F.1.b, F.2.a, F.2.b, F.2.c  **A.APR.3**  QC: F.1.b, F.2.a, F.2.b, F.2.c, F.2.d | 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*).  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. | R: Shows examples of the Remainder Theorem.  <https://www.khanacademy.org/computing/computer-science/cryptography/modarithmetic/a/the-quotient-remainder-theorem>  R: Shows examples of the Remainder Theorem.  <http://www.mathsisfun.com/algebra/polynomials-remainder-factor.html>  ML: Lesson on polynomials.  <http://illuminations.nctm.org/Lesson.aspx?id=1091>  ML: Activity on polynomials.  <http://map.mathshell.org/materials/lessons.php?taskid=436#task436> |
| **Cluster: Use polynomial identities to solve problems** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| **A.APR.4**  QC: F.1.a  **A.APR.5 (+)**  QC: F.1.a | 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 + (2*xy*)2 *can be used to generate Pythagorean triples.*  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. | V/R: Provides examples and videos on polynomial identities.  <http://www.onlinemathlearning.com/polynomial-identities-hsa-apr4.html>  ML: Lesson on Pascal’s Triangle  <http://www.cpalms.org/Public/PreviewResource/Preview/47838>  V: Video on the Binomial Theorem.  <http://www.virtualnerd.com/common-core/hsa-algebra/HSA-APR-polynomial-rational-expressions-arithmetic/C/5> |
| **Cluster: Rewrite rational expressions** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| **A.APR.6**  QC: F.1.b, G.1.e  **A.APR.7 (+)**  QC: G.1.a, G.1.e | 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.  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. | V: Video on rational expressions.  <http://www.lessonpaths.com/learn/i/rewriting-simple-rational-expressions-in-different-forms/rewrite-simple-rational-expressions-using-inspection>  V/R: Examples and videos on rational expressions.  <http://www.onlinemathlearning.com/rewrite-rational-expressions-synthetic-division-hsa-apr6.html>  V: Several videos on operations with rational expressions.  <https://www.khanacademy.org/math/algebra2/rational-expressions/rational_expressions/e/adding_and_subtracting_rational_expressions_0.5>  ML: Lessons on rational expressions.  [www.doe.virginia.gov/testing/solsearch/sol/math/AII/m\_ess\_a2-1a.pdf](http://www.doe.virginia.gov/testing/solsearch/sol/math/AII/m_ess_a2-1a.pdf) |
| **Domain: Reasoning with Equations and Inequalities**  **Cluster: Understand solving equations as a process of reasoning and explain the reasoning** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| **A.REI.2**  QC: G.1.a, G.1.b, G.1.c, G.1.d, G.1.e, G.1.f, G.1.g | Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise. | R: Examples of rational and radical equations.  <http://www.mathworksheetsland.com/algebra/23solve.html> |
| **Cluster: Represent and solve equations and inequalities graphically** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| **A.REI.11**  QC: E.1.d, F.2.a, F.2.b, F.2.d, | 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.\*(\*Modeling standard) | R: Resource page with multiple lessons.  <http://ccssmath.org/?page_id=2149> |
| **Domain: Interpreting Functions**  **Cluster: Analyze functions using different representations** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| **F.IF.7c**  QC: F.2.c, F.2.d | Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.\*(Modeling standard)  c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. | V: Multiple videos on graphing.  <http://www.virtualnerd.com/common-core/hsf-functions/HSF-IF-interpreting-functions/C/7> |
| **Algebra 2 Unit 2** | | |
| **Domain: Trigonometric Functions**  **Cluster: Extend the domain of trigonometric functions using the unit circle** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| **F.TF.1**  QC:G.3.b,G.3.c G.3.g  **F.TF.2**  QC: G.3.b, G.3.c, G.3.g | Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.  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. | R/V: Discusses standard F.TF.1 and includes a funny video.  <http://www.shmoop.com/common-core-standards/ccss-hs-f-tf-1.html>  R/V: Discusses standard F.TF.2 and includes a funny video.  <http://www.shmoop.com/common-core-standards/ccss-hs-f-tf-2.html>  V/R: Several examples on the unit circle.  [http://www.khanacademy.org/math/trigonometry/unit-circle-trig-func/Trig-unit-circle/v/unit-circle-manipulative#](http://www.khanacademy.org/math/trigonometry/unit-circle-trig-func/Trig-unit-circle/v/unit-circle-manipulative) |
| **Cluster: Model periodic phenomena with trigonometric functions** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| **F.TF.5**  QC: G.3.c, G.3.d, G.3.g | Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.\*(\*Modeling standard) | V: Video on trigonometric functions.  <https://learnzillion.com/lessons/2770-model-periodic-phenomena-using-trigonometric-functions> |
| **Cluster: Prove and apply trigonometric identities** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| **F.TF.8** | Prove the Pythagorean identity sin2(θ) + cos2(θ) = 1 and use it to find sin (θ), cos (θ), or tan (θ), given sin (θ), cos (θ), or tan (θ), and the quadrant of the angle. | V: Video on Pythagorean Identity.  <https://learnzillion.com/lessons/2352-find-trigonometric-values-using-the-pythagorean-identity> |

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| **Algebra 2 Unit 3** | | |
| **Domain: Creating Equations\* (\*Modeling Domain)**  **Cluster: Create equations that describes numbers or relationships** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| **A.CED.1**  QC: E.1.a, G.3.g, H.2.d, H.2.e  **A.CED.2**  QC: E.1.a, G.3.g, H.2.d, H.2.e  **A.CED.3**  QC: D.1.b, D.1.c, D.2.a, E.1.d, E.2.c, G.3.g  **A.CED.4**  QC: F.1.a, G.1.a, G.1.g | 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.  Create equations in two or more variables to represent relationships between quantities, graph equations on a coordinate axes with labels and scales.  Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.  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. | R: Shows the steps for writing an equation from a word problem.  <http://algebralab.org/lessons/lesson.aspx?file=Algebra_OneVariableWritingEquations.xml>  ML: Shows students how to write and solve linear equations for a specific value.  <http://www.mathworksheetsgo.com/sheets/algebra/linear-equation/linear-equation-word-problems-worksheet.php>  V: A set of videos that show how to determine constraints of equations and inequalities.  <https://learnzillion.com/lessonsets/516-represent-constraints-by-linear-equations-inequalities-and-systems-interpret-solutions-as-viable-and-nonviable>  V: Shows the process of solving an equation for a specific variable  <http://www.khanacademy.org/math/algebra/solving-linear-equations-and-inequalities/solving_for_variable/v/rearrange-formulas-to-isolate-specific-variables> |
| **Domain: Interpreting Functions**  **Cluster: Interpret functions that arise in applications in terms of the context** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| **F.IF.4**  QC: G.3.e, G.3.f, G.3.g  **F.IF.5**  QC: C.1.d,E.2.a, F.2.d, G.3.e  **F.IF.6** | 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. \**(Modeling standard)  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.\**(\*Modeling standard)  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.\*(Modeling standard)   |  | | --- | |  | | ML: A lesson that requires students to identify parts of distance/time graphs.  <http://map.mathshell.org/materials/lessons.php?taskid=208>  V: Features several videos to help students identify parts of functions.  <https://www.khanacademy.org/math/algebra2/functions_and_graphs/analyzing_functions/e/recog-features-func-2>  V: Provides several videos on finding the domain and range of functions.  <https://www.khanacademy.org/math/algebra/algebrafunctions/domain_and_range/v/domain-and-range-1>  A: A lesson showing how slope is related to ramps.  <http://alex.state.al.us/lesson_view.php?id=23830>  R: Provides several examples on slope and how it is connected to the real world.  <http://www.learner.org/courses/learningmath/algebra/session5/index.html> |
| **Cluster: Analyze functions using different representations** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| **F.IF.7b**  QC: E.2.b, F.2.b  **F.IF.7e**  QC: E.2.b, G.2.a, G.3.d, G.3.e, G.3.f  **F.IF.8a**  QC: E.1.a, F.1.b, G.1.b, G.1.c  **F.IF.8b**  QC: E.1.a, F.1.b, G.1.b, G.1.c, G.1.e  **F.IF.9** | Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.\*(Modeling standard)  b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.  Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.\*(Modeling standard)  e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.  Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.  a. 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.  Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function:  b. 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=(.97)t, y=(1.01)12t, y=(1.2)t/10, and classify them as representing exponential growth or decay.*  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.* | R: Shows examples of graphing.  <http://www.shmoop.com/common-core-standards/ccss-hs-f-if-7b.html>  V: Multiple videos and examples on graphing.  <http://www.khanacademy.org/math/pre-algebra/exponents-radicals>  R: Shows the process for graphing exponential functions.  <http://www.purplemath.com/modules/graphexp.htm>  R: Discusses how to graph logarithmic functions.  <http://www.purplemath.com/modules/graphlog.htm>  R: Discusses how to graph several kinds of functions.  <http://math.tutorvista.com/calculus/graphing-functions.html>  V: Video on graphing logarithmic functions.  <http://www.khanacademy.org/math/algebra2/exponential_and_logarithmic_func/log_functions/v/graphing-logarithmic-functions>  R: Discusses the process of finding zeros.  <http://www.shmoop.com/common-core-standards/ccss-hs-a-sse-3a.html>  R: Provides several useful handouts for finding the zeros.  <http://www.mathworksheetsland.com/algebra/4solve.html>  V: Features several videos on graphing parabolas.  <http://www.khanacademy.org/math/algebra/quadratics/solving_graphing_quadratics/e/graphing_parabolas_1>  ML: A complete lesson on quadratics.  <http://map.mathshell.org/materials/lessons.php?taskid=224>  R: Provides a full explanation of standard F.IF.8b along with examples.  <http://www.shmoop.com/common-core-standards/ccss-hs-f-if-8b.html>  V: Features several short video lessons on how to make connections between functions.  <https://learnzillion.com/lessons/1194-compare-two-functions-by-analyzing-an-equation-and-a-verbal-description>  R: Discusses standard F.IF.9 and provides examples.  <http://www.shmoop.com/common-core-standards/ccss-hs-f-if-9.html> |
| **Domain: Building Functions**  **Cluster: Build a function that models a relationship between two quantities** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| **F.BF.1b**  QC: C.1.d, E.2.a | Write a function that describes a relationship between two quantities.\*(Modeling standard)  b. 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.* | ML: Students write equations based on patterns.  <http://map.mathshell.org/materials/lessons.php?taskid=215>  ML: Students write equations based on patterns.  <http://map.mathshell.org/materials/tasks.php?taskid=286&subpage=expert>  V: A video showing how to write equations based on sequences.  <https://www.youtube.com/watch?v=V02nV_qR_xQ> |
| **Cluster: Build new functions from existing functions** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| **F.BF.3**  QC: E.2.b, E.3.b  **F.BF. 4a**  QC: G.2.b, H.2.b, H.2.d | 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.*  Find the inverse functions  a. 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) = 2x3 or f(x) = (x+1)/(x-1)* for x ≠ 1. | ML: A guided lesson on transformations.  <http://alex.state.al.us/lesson_view.php?id=30033>  R: Explains the process of finding the inverse of a function.  <http://www.purplemath.com/modules/invrsfcn3.htm> |
| **Domain: Linear and Exponential Models\***  **Cluster: Construct and compare linear, quadratic, and exponential models and solve problems** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| **F.LE.4**  QC: G.2.b | For exponential models, express as a logarithm the solution to abct , where a, b, and d are numbers and the base is 2, 10, or *e*; evaluate the logarithm using technology. | R: Discusses standard and provides examples.  <http://www.shmoop.com/common-core-standards/ccss-hs-f-le-4.html>  V: Several videos on logarithms.  <https://learnzillion.com/lessonsets/438-express-solutions-to-exponential-models-as-logarithms-evaluate-using-technology> |

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| **Algebra Unit 4** | | |
| **Domain: Interpreting Categorical and Quantitative Data\*(Modeling Conceptual Category)**  **Cluster: Summarize, represent, and interpret data on a single count or measurement variable** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| **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. \*Statistics and Probability is a Modeling Conceptual Category | V: Videos on statistics and the Empirical Rule.  <https://learnzillion.com/lessonsets/458-use-mean-and-standard-deviation-to-fit-a-data-set-to-a-normal-distribution-when-appropriate-estimate-population-percentages-using-tools>  <https://learnzillion.com/lessonsets/433-use-mean-and-standard-deviation-to-fit-to-normal-distribution-and-estimate-population-percentages-when-appropriate-use-tools-to-estimate-areas-under-the-normal-curve> |
| **Domain: Making Inferences and Justifying Conclusions\*(Modeling Conceptual Category)**  **Cluster: Understand and evaluate random processes underlying statistical experiments** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| **S.IC.1**  **S.IC.2** | Understand statistics as a process for making inferences about population parameters based on a random sample from that population. \*Statistics and Probability is a Modeling Conceptual Category  Decide if a specified model is consistent with results from a given data-generating process, eg., 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?* \*Statistics and Probability is a Modeling Conceptual Category | V/R: Shows several examples on standard S.IC.1 and has a funny video.  <http://www.shmoop.com/common-core-standards/ccss-hs-s-ic-1.html>  V/R: Provides several examples and videos on statistics.  <http://www.onlinemathlearning.com/understand-statistics-ic1.html>  V: Video on collecting data.  <http://www.virtualnerd.com/common-core/hss-statistics-probability/HSS-IC-inferences-conclusions/A/2>  V: Videos on collecting data.  <https://learnzillion.com/lessonsets/512-decide-if-a-model-is-consistent-with-results> |
| **Cluster: Make inferences and justify conclusions from sample surveys, experiments, and observational studies** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| **S.IC.3**  **S.IC.4**  **S.IC.5**  **S.IC.6** | Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.  \*Statistics and Probability is a Modeling Conceptual Category  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.  \*Statistics and Probability is a Modeling Conceptual Category  Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between two parameters are significant.  \*Statistics and Probability is a Modeling Conceptual Category  Evaluate reports based on data. \*  \*Statistics and Probability is a Modeling Conceptual Category | ML: Lesson plan discussing sample surveys, experiments, and observational studies.  <http://www.cpalms.org/Public/PreviewResource/Preview/48326>  ML: Lesson plan discussing sample surveys, experiments, and observational studies.  <http://www.cpalms.org/Public/PreviewResource/Preview/50602>  V: Videos on sample surveys, experiments, and observational studies.  <http://www.onlinemathlearning.com/surveys-experiments-ic2.html>  V: Video from MIT about statistics.  <http://blossoms.mit.edu/videos/lessons/bigger_better_look_selection_bias_all_around_us>  V: Videos on standards S.IC.4 and S.IC.6.  <https://learnzillion.com/lessonsets/531-use-survey-data-to-estimate-means-and-proportions-develop-a-margin-of-error-through-simulation-models-and-evaluate-reports-based-on-data>  A: Activity on a randomized experiment.  <http://www.laurussoft.com/CommonCore/LevelThree/PDF/S-IC.B.5-ques1.pdf>  A: Activity on data reports.  <http://www.laurussoft.com/CommonCore/LevelThree/PDF/S-IC.B.6-ques2.pdf> |
| **Domain: Using Probability to Make Decisions\* (Modeling Conceptual Category)**  **Cluster: Use probability to evaluate outcomes of decisions** | | |
| **Standards** | **Key ideas and Details** | **Intervention Supports** |
| **S.MD.6 (+)**  QC: All of Section 8  **S.MD.7 (+)**  QC: All of Section 8 | Use probabilities to make fair decisions (e.g. drawing by lots, using a random number generator.) \*Statistics and Probability is a Modeling Conceptual Category  Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game.)  \*Statistics and Probability is a Modeling Conceptual Category | R/V: Discusses standard S.MD.6 including examples and a funny video.  <http://www.shmoop.com/common-core-standards/ccss-hs-s-md-6.html>  A: An activity on basketball and statistics.  <http://www.mathalicious.com/lessons/three-shots>  R: Discusses standard S.MD.7 and includes examples.  <http://www.shmoop.com/common-core-standards/ccss-hs-s-md-7.html> |