Ohio’s K-5 Learning Progressions

## Counting and Cardinality

### Kindergarten

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<tr>
<td><strong>Know number names and the count sequence.</strong></td>
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<tr>
<td>1. Count to 100 by ones and by tens.</td>
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<tr>
<td>2. Count forward within 100 beginning from any given</td>
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<td>number other than 1.</td>
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<tr>
<td>3. Write numerals from 0 to 20. Represent a number</td>
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<tr>
<td>of objects with a written numeral 0-20 (with 0</td>
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<tr>
<td>representing a count of no objects).</td>
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</table>

### Count to tell the number of objects.

4. Understand the relationship between numbers and quantities; connect counting to cardinality using a variety of objects including pennies.
   a. When counting objects, establish a one-to-one relationship by saying 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.

5. Count to answer “how many?” questions about as many as 20 things arranged in a line, a rectangular array, or a circle; or as many as 10 things in a scattered configuration; given a number from 1-20, count out that many objects.

### Compare numbers.

6. Orally identify (without using inequality symbols) whether the number of objects in one group is greater/more than, less/fewer than, or the same as the number of objects in another group, not to exceed 10 objects in each group.

7. Compare (without using inequality symbols) two numbers between 0 and 10 when presented as written numerals.
## Ohio’s K-5 Learning Progressions

### Number and Operations in Base Ten

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<td><strong>Number</strong></td>
<td><strong>Place</strong></td>
<td><strong>Value</strong></td>
<td><strong>Properties</strong></td>
<td><strong>Operations</strong></td>
<td><strong>Place</strong></td>
</tr>
<tr>
<td>Work with numbers 11-19 to gain foundations for place value.</td>
<td>Understand place value. Use place value understanding and properties of operations to perform multi-digit arithmetic.</td>
<td>Generalize place value understanding for operations.</td>
<td>Understand the place value system.</td>
<td>Extend the counting sequence.</td>
<td>Work with numbers 11-19 to gain foundations for place value.</td>
</tr>
<tr>
<td>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.</td>
<td>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. Use the following as special cases: a. 100 can be thought of as a bundle of ten tens — called a &quot;hundred.&quot; 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).</td>
<td>Use place value understanding and properties of operations to perform multi-digit arithmetic.</td>
<td>Understand that a digit in one place represents ten times what it represents in the place to its right and $\frac{1}{10}$ of what it represents in the place to its left.</td>
<td>Understand place value. Extend the counting sequence.</td>
<td>Understand place value. 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.</td>
</tr>
<tr>
<td>2. Understand that the two digits of a two-digit number represent amounts of tens and ones. Understand the following as special cases: a. 20 can be thought of as a bundle of two tens — called a &quot;twenties.&quot; b. The numbers 20, 30, 40, 50, 60, 70, 80, 90 refer to one, two, three, four, five, six, seven, eight, or nine tens (and 0 ones).</td>
<td>Understand place value. Count forward and backward within 1,000 by ones, tens, and hundreds starting at any number; skip-count by 5s starting at any multiple of 5.</td>
<td>Compare two multi-digit numbers based on meanings of the digits in each place, using &gt;, =, and &lt; symbols to record the results of comparisons.</td>
<td>Understand the place value system.</td>
<td>Compare two two-digit numbers based on meanings of the tens and ones digits, recording the results of comparisons with the symbols &gt;, =, and &lt;.</td>
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<tr>
<td>3. Compare two two-digit numbers based on meanings of the tens and ones digits, recording the results of comparisons with the symbols &gt;, =, and &lt;. Use place value understanding and properties of operations to add and subtract.</td>
<td>Compare two multi-digit numbers based on meanings of the digits in each place, using &gt;, =, and &lt; symbols to record the results of comparisons. Use place value understanding and properties of operations to add and subtract.</td>
<td>Use place value understanding and properties of operations to perform multi-digit arithmetic.</td>
<td>Add and subtract within 1,000 using strategies and algorithms based on place value, properties of operations, and the relationship between addition and subtraction.</td>
<td>Use place value understanding and properties of operations to perform multi-digit arithmetic. A range of strategies and algorithms may be used.</td>
<td>Use place value understanding and properties of operations to perform multi-digit arithmetic.</td>
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<tr>
<td>4. Add within 100, including adding a two-digit number and a one-digit number and adding a two-digit number and a multiple of 10, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction.</td>
<td>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.</td>
<td>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.</td>
<td>Use place value understanding for operations.</td>
<td>Multiply a whole number of up to four digits by a one-digit whole number.</td>
<td>Multiply a whole number of up to four digits by a one-digit whole number.</td>
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<tr>
<td>5. Fluently add and subtract within 100 using strategies based on place value, properties of operations, and/or the relationship between addition and subtraction.</td>
<td>Fluently add and subtract to round whole numbers to the nearest 10 or 100.</td>
<td>Fluently add and subtract within 1,000 using strategies and algorithms based on place value, properties of operations, and the relationship between addition and subtraction.</td>
<td>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. Use 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).</td>
<td>Understand place value. Count forward and backward within 1,000 by ones, tens, and hundreds starting at any number; skip-count by 5s starting at any multiple of 5.</td>
<td>Understand place value. 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.</td>
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<tr>
<td>6. Understand place value. Count forward and backward within 1,000 by ones, tens, and hundreds starting at any number; skip-count by 5s starting at any multiple of 5.</td>
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<td>Understand place value. Count forward and backward within 1,000 by ones, tens, and hundreds starting at any number; skip-count by 5s starting at any multiple of 5.</td>
<td>Compare two multi-digit numbers based on meanings of the digits in each place, using &gt;, =, and &lt; symbols to record the results of comparisons.</td>
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**February 2017**

**Ohio Department of Education**

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### Number and Operations in Base Ten

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<tr>
<td>between addition and subtraction; record the strategy with a written numerical method (drawings and, when appropriate, equations) and explain the reasoning used. Understand that when adding two-digit numbers, tens are added to tens; ones are added to ones; and sometimes it is necessary to compose a ten.</td>
<td>relationship between addition and subtraction. 6. Add up to four two-digit numbers using strategies based on place value and properties of operations. 7. Add and subtract within 1,000, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; record the strategy with a written numerical method (drawings and, when appropriate, equations) and explain the reasoning used. Understand that in adding or subtracting three-digit numbers, hundreds are added or subtracted from hundreds, tens are added or subtracted from tens, ones are added or subtracted from ones; and sometimes it is necessary to compose or decompose tens or hundreds. 8. Mentally add 10 or 100 to a given number 100-900, and mentally subtract 10 or 100 from a given number 100-900. 9. Explain why addition and subtraction strategies work, using place value and the properties of operations. Explanations may be supported by drawings or objects.</td>
<td>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. 6. Find whole-number quotients and remainders with up to four-digit dividends and one-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models. 7. Solve real-world problems by adding, subtracting, multiplying, and dividing decimals using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction, or multiplication and division; relate the strategy to a written method and explain the reasoning used. a. Add and subtract decimals, including decimals with whole numbers, (whole numbers through the hundreds place and decimals through the hundredths place). b. Multiply whole numbers by decimals (whole numbers through the hundreds place and decimals through the hundredths place). c. Divide whole numbers by decimals and decimals by whole numbers (whole numbers through the tens place and decimals less than one through the hundredths place using numbers that work well with one another). For example, 0.75 divided by 5, 18 divided by 0.6, or 0.9 divided by 3.</td>
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</table>
Number and Operations - Fractions

Grade Three

Develop understanding of fractions as numbers.

Grade 3 expectations in this domain are limited to fractions with denominators 2, 3, 4, 6, and 8.

1. Understand a fraction 1/2 as the quantity formed by 1 part when a whole is partitioned into 2 equal parts; understand a fraction 1/b as the quantity formed by 1 part of size 1/b.

2. Understand a fraction as a number on the number line; represent fractions on a number line diagram.
   a. Represent a fraction 1/2 on a number line diagram by defining the interval from 0 to 1 as the whole and partitioning it into 2 equal parts. Recognize that each part has size 1/2 and that the endpoint of the part based at 0 locates the number 1/2 on the number line.
   b. Represent a fraction 1/b (which may be greater than 1) on a number line diagram by marking off a length 1/b from 0. Recognize that the resulting interval has size 1/b and that its endpoint locates the number 1/b on the number line.

3. 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 on 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 part has size 1/2 under such circumstances.

Grade Four

Extend understanding of fraction equivalence and ordering limited to fractions with denominators 2, 3, 4, 5, 6, 8, 10, 12, and 100.

1. Explain why a fraction a/b is equivalent to a fraction (n x a)/(n x b) by using visual fraction models, with attention to how the number and size of the parts differ even though the two fractions themselves are the same number. Use this principle to recognize and generate equivalent fractions.

2. Compare two fractions with different numerators and different denominators, e.g., by creating common denominators or numerators, or by comparing to a benchmark fraction such as 1/2. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with symbols >, =, or <, and justify the conclusions, e.g., by using a visual fraction model.

3. Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers limited to fractions with denominators 2, 3, 4, 5, 6, 8, 10, 12, and 100. (Fractions need not be simplified.)

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; 2/4 = 1/4 + 1/4.
   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 like denominators, e.g., by using visual fraction models and equations to represent the problem.

Grade Five

Use equivalent fractions as a strategy to add and subtract fractions (Fractions need not be simplified.)

1. Add and subtract fractions with unlike denominators (including mixed numbers and fractions greater than 1) 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, use visual models and properties of operations to show 5/4 + 3/4 = 2/12 + 3/12 = 5/12. In general, a/b + c/d = (a x d)/(b x d) + (c x b)/(b x d) = (ad + bc)/bd.

2. Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators, e.g., by using visual fraction models or equations to represent the problem. Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers.

   a. Interpret an incorrect result 2/5 + 1/2 = 3/7, by observing that 3/7 < 1/2.
   b. Apply and extend previous understandings of multiplication and division to multiply and divide fractions. (Fractions need not be simplified.)
   c. Interpret a fraction as division of the numerator by the denominator (a/b = a ÷ b).
   d. 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?

4. Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction.
   a. Interpret the product (a/b) x q as a parts of a partition of q into b equal parts, equivalently, as the result of a sequence of operations a x q ÷ b. For example, use a visual fraction model to show (2/3) x 4 = 8/3, and create a story context for this equation.
   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.

5. Interpret multiplication as scaling (resizing).
# Ohio’s K-5 Learning Progressions

## Number and Operations - Fractions

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<tr>
<td>Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with the symbols &gt;, =, or &lt;, and justify the conclusions, e.g., by using a visual fraction model.</td>
<td>express (3 \times \left(\frac{2}{5}\right)) as (6 \times \left(\frac{1}{5}\right)), recognizing this product as (\frac{6}{5}). (In general, (n \times \left(\frac{a}{b}\right) = \frac{n \times a}{b})).</td>
<td>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.</td>
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<tr>
<td>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 (\frac{1}{3}) 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?</td>
<td>b. Explain 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 (\frac{a}{b} = \left(\frac{n \times a}{n \times b}\right)) to the effect of multiplying (\frac{n}{1}) by 1.</td>
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<tr>
<td>Understand decimal notation for fractions, and compare decimal fractions limited to fractions with denominators 2, 3, 4, 5, 6, 8, 10, 12, and 100.</td>
<td>6. Solve real-world problems involving multiplication of fractions and mixed numbers, e.g., by using visual fraction models or equations to represent the problem.</td>
<td>7. Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions. In general students able to multiply fractions can develop strategies for dividing fractions, by reasoning about the relationship between multiplication and division, but division of a fraction by a fraction is not a requirement at this grade.</td>
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<tr>
<td>5. Express a fraction with denominator 10 as an equivalent fraction with denominator 100, and use this technique to add two fractions with respective denominators 10 and 100. For example, express (\frac{3}{10}) as (\frac{30}{100}), and add (\frac{3}{10} + \frac{4}{100} = \frac{34}{100}). In general, students who can generate equivalent fractions can develop strategies for adding fractions with unlike denominators, but addition and subtraction with unlike denominators is not a requirement at this grade.</td>
<td>6. Use decimal notation for fractions with denominators 10 or 100. For example, rewrite (0.62) as (\frac{62}{100}); describe a length as 0.62 meters; locate 0.62 on a number line diagram.</td>
<td>7. Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions. In general students able to multiply fractions can develop strategies for dividing fractions, by reasoning about the relationship between multiplication and division, but division of a fraction by a fraction is not a requirement at this grade.</td>
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<td>6. Use decimal notation for fractions with denominators 10 or 100. For example, rewrite (0.62) as (\frac{62}{100}); describe a length as 0.62 meters; locate 0.62 on a number line diagram.</td>
<td>7. Compare two decimals to hundredths by reasoning about their size. Recognize that comparisons are valid only when the two decimals refer to the same whole. Record the results of comparisons with the symbols &gt;, =, or &lt;, and justify the conclusions, e.g., by using a visual model.</td>
<td>a. Interpret division of a unit fraction by a non-zero whole number, and compute such quotients. For example, create a story context for (\frac{1}{3} ÷ 4), and use a visual fraction model to show the quotient. Use the relationship between multiplication and division to explain that (\left(\frac{1}{3}\right) ÷ 4 = \left(\frac{1}{12}\right)) because (\left(\frac{1}{12}\right) × 4 = \left(\frac{1}{3}\right)).</td>
</tr>
<tr>
<td>7. Compare two decimals to hundredths by reasoning about their size. Recognize that comparisons are valid only when the two decimals refer to the same whole. Record the results of comparisons with the symbols &gt;, =, or &lt;, and justify the conclusions, e.g., by using a visual model.</td>
<td>6. Interpret division of a whole number by a unit fraction, and compute such quotients. For example, create a story context for (4 ÷ \left(\frac{1}{3}\right)), and use a visual fraction model to show the quotient. Use the relationship between multiplication and division to explain that (4 ÷ \left(\frac{1}{3}\right) = 20) because (20 × \left(\frac{1}{3}\right) = 4).</td>
<td>b. Interpret division of a whole number by a unit fraction, and compute such quotients. For example, create a story context for (4 ÷ \left(\frac{1}{3}\right)), and use a visual fraction model to show the quotient. Use the relationship between multiplication and division to explain that (4 ÷ \left(\frac{1}{3}\right) = 20) because (20 × \left(\frac{1}{3}\right) = 4).</td>
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<td>6. Interpret division of a whole number by a unit fraction, and compute such quotients. For example, create a story context for (4 ÷ \left(\frac{1}{3}\right)), and use a visual fraction model to show the quotient. Use the relationship between multiplication and division to explain that (4 ÷ \left(\frac{1}{3}\right) = 20) because (20 × \left(\frac{1}{3}\right) = 4).</td>
<td>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 (\frac{1}{2}) pound of chocolate equally? How many (\frac{1}{3}) cup servings are in 2 cups of raisins?</td>
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</table>
Ohio’s K-5 Learning Progressions

Operations and Algebraic Progressions

Kindergarten
Understand addition as putting together and adding to, and understand subtraction as taking apart and taking from.

1. Represent addition and subtraction with objects, fingers, mental images, drawings, sounds such as claps, acting out situations, verbal explanations, expressions, or equations. Drawings need not show details, but should show the mathematics in the problem. (This applies wherever drawings are mentioned in the Standards.)

2. Solve addition and subtraction problems (written or oral), and add and subtract within 10 by using objects or drawings to represent the problem.

3. Decompose numbers and record compositions for numbers less than or equal to 10 into pairs in more than one way by using objects and, when appropriate, drawings or equations.

Grade One
Represent and solve problems involving addition and subtraction.

1. Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem. See Glossary, Table 1.

2. Solve word problems that call for addition of three whole numbers whose sum is less than or equal to 20, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem. Drawings need not show details, but should show the mathematics in the problem. (This applies wherever drawings are mentioned in the Standards.)

Understand and apply properties of operations and the relationship between addition and subtraction.

2. Add and subtract within 20 using mental strategies. By end of Grade 2, know from memory all sums of two one-digit numbers. See standard 1.OA.6 for a list of mental strategies.

Work with equal groups of objects to gain foundations for multiplication.

3. Determine whether a group of objects (up to 20) has an odd or even number of members, e.g., by pairing objects or counting them by 2s; write an equation to express an even number as a sum of two equal addends.

Grade Two
Represent and solve problems involving addition and subtraction.

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. See Glossary, Table 1.

2. Solve word problems that call for addition of three whole numbers whose sum is less than or equal to 20, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem. Drawings need not show details, but should show the mathematics in the problem. (This applies wherever drawings are mentioned in the Standards.)

Understand and apply properties of operations and the relationship between addition and subtraction.

3. Determine whether a group of objects (up to 20) has an odd or even number of members, e.g., by pairing objects or counting them by 2s; write an equation to express an even number as a sum of two equal addends.

Grade Three
Represent and solve problems involving multiplication and division.

1. Interpret products of whole numbers, e.g., interpret 5 x 7 as the total number of objects in 5 groups of 7 objects each. (Note: These standards are written with the convention that a x b means a groups of b objects each; however, because of the commutative property, students may also interpret 5 x 7 as the total number of objects in 7 groups of 5 objects each.)

2. Interpret whole-number quotients of whole numbers, e.g., interpret 56 ÷ 8 as the number of objects in each share when 56 objects are partitioned equally into 8 shares, or as a number of shares when 56 objects are partitioned into equal shares of 8 objects each. For example, describe a context in which a number of a number of groups can be expressed as 56 ÷ 8.

3. Use multiplication and division within 100 to solve word problems 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. Drawings need not show details, but should show the mathematics in the problem. (This applies wherever drawings are mentioned in the Standards.)

Grade Four
Use the four operations with whole numbers to solve problems.

1. Interpret a multiplication equation as a comparison, e.g., interpret 35 = 5 x 7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations.

2. Multiply or divide to solve word problems involving multiplicative comparison, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem, distinguishing multiplicative comparison from additive comparison. See Glossary, Table 2. Drawings need not show details, but should show the mathematics in the problem. (This applies wherever drawings are mentioned in the Standards.)

Analyze patterns and relationships.

3. Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a variable representing the unknown quantity.

Grade Five
Write and interpretation numerical expressions.

1. Use parentheses in numerical expressions, and evaluate expressions with this symbol. Formal use of algebraic order of operations is not necessary.

2. Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them. For example, express the calculation “add 8 and 7, then multiply by 2” as (8 + 7) x 2. Recognize that 3 x (18,932 + 921) is three times as large as 18,932 + 921, without having to calculate the indicated sum or product.

Analyze patterns and relationships.

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.

Red Addition and Subtraction
Blue Multiplication and Division
Black Number
Brown Geometry
### Kindergarten

4. For any number from 1 to 9, find the number that makes 10 when added to the given number, e.g., by using objects or drawings, and record the answer with a drawing or, when appropriate, an equation.

5. Fluently add and subtract within 5.

### Grade One

4. Use addition to find the total number of objects arranged in rectangular arrays with up to 5 rows and up to 5 columns; write an equation to express the total as a sum of equal addends.

5. Relate counting to addition and subtraction, e.g., by counting on 2 to add 2.

6. Add and subtract within 20, demonstrating fluency with various strategies for addition and subtraction within 10. Strategies may include 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.

6. Fluently add and subtract within 20.

### Grade Two

4. Determine the unknown number that makes the equation true in each of the equations: 8 × □ = 48, 5 = □ ÷ 3, 6 × 6 = □.

5. Understand properties of multiplication and the relationship between multiplication and division.

6. Apply properties of operations as strategies to multiply and divide. For example, if $6 \times 4 = 24$ is known, then $4 \times 6 = 24$ is also known (Commutative Property of Multiplication); $3 \times 5 \times 2$ can be found by $3 \times 5 = 15$, then $15 \times 2 = 30$, or by $5 \times 2 = 10$, then $3 \times 10 = 30$ (Associative Property of Multiplication); knowing that $8 \times 5 = 40$ and $8 \times 2 = 16$, one can find $8 \times 7$ as $8 \times (5 + 2) = (8 \times 5) + (8 \times 2) = 40 + 16 = 56$ (Distributive Property). Students need not use formal terms for these properties.

### Grade Three

4. Determine the unknown number that makes the equation true in each of the equations: $8 \times □ = 48$, $5 = □ ÷ 3$, $6 \times 6 = □$.

5. Understand and apply properties of operations as strategies to multiply and divide. For example, if $6 \times 4 = 24$ is known, then $4 \times 6 = 24$ is also known (Commutative Property of Multiplication); $3 \times 5 \times 2$ can be found by $3 \times 5 = 15$, then $15 \times 2 = 30$, or by $5 \times 2 = 10$, then $3 \times 10 = 30$ (Associative Property of Multiplication); knowing that $8 \times 5 = 40$ and $8 \times 2 = 16$, one can find $8 \times 7$ as $8 \times (5 + 2) = (8 \times 5) + (8 \times 2) = 40 + 16 = 56$ (Distributive Property). Students need not use formal terms for these properties.

### Grade Four

4. Determine the unknown number that makes the equation true in each of the equations: $8 \times □ = 48$, $5 = □ ÷ 3$, $6 \times 6 = □$.

5. 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?

- $6 = 6$
- $7 = 8 − 1$
- $5 + 2 = 2 + 5$
- $4 + 1 = 5 + 2$

6. Determine the unknown whole number in an equation or subtraction equation relating three whole numbers. For example, determine the unknown number that makes the equation true in each of the equations: $8 + □ = 11$; $5 - □ = 3$; $6 + 6 = □$.

### Grade Five

4. Use addition to find the total number of objects arranged in rectangular arrays with up to 5 rows and up to 5 columns; write an equation to express the total as a sum of equal addends.

5. Use letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.

6. Understand factors and multiples.

- Letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.
- Understand factors and multiples.
- Generate and analyze patterns. For example, if $32 + 8$ by finding the number that makes 32 when multiplied by 8.

7. Fluently multiply and divide within 100.

- Multiply and divide within 100.

- Gain familiarity with factors and multiples.

- Generate and analyze patterns.

- 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.

8. Solve problems involving the four operations, and identify and explain patterns in arithmetic.

- Solve problems involving the four operations, and identify and explain patterns in arithmetic.

- Generate and analyze patterns.
8. Solve two-step word problems using the four operations. Represent these problems using equations with a letter or a symbol, which stands for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding. This standard is limited to problems posed with whole numbers and having whole-number answers. Students may use parentheses for clarification since algebraic order of operations is not expected.

9. Identify arithmetic patterns (including patterns in the addition table or multiplication table), and explain them using properties of operations. For example, observe that 4 times a number is always even, and explain why 4 times a number can be decomposed into two equal addends.
## Ohio’s K-5 Learning Progressions

### Geometry (K-5)

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<tr>
<td>Identify and describe shapes (squares, circles, triangles, rectangles, hexagons, cubes, cones, cylinders, and spheres).</td>
<td>Reason with shapes and their attributes.</td>
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<td>Draw and identify lines and angles, and classify shapes by properties of their lines and angles.</td>
<td>Draw and identify lines and angles, and classify shapes by properties of their lines and angles.</td>
<td>Graph points on the coordinate plane to solve real-world and mathematical problems.</td>
</tr>
<tr>
<td>1. Describe objects in the environment using names of shapes, and describe the relative positions of these objects using terms such as above, below, beside, in front of, behind, and next to.</td>
<td>1. Distinguish between defining attributes, e.g., triangles are closed and three-sided, versus non-defining attributes, e.g., color, orientation, overall size; build and draw shapes that possess defining attributes.</td>
<td>1. Recognize and identify triangles, quadrilaterals, pentagons, and hexagons based on the number of sides or vertices. Recognize and identify cubes, rectangular prisms, cones, and cylinders.</td>
<td>1. Draw points, lines, line segments, rays, angles (right, acute, and obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.</td>
<td>1. Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond, e.g., x-axis and y-coordinate.</td>
<td>1. Represent real-world and mathematical problems by graphing points in the first quadrant of the coordinate plane and interpreting coordinate values of points in the context of the situation.</td>
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<tr>
<td>2. Correctly name shapes regardless of their orientations or overall size.</td>
<td>2. Compose two-dimensional shapes (rectangles, squares, trapezoids, triangles, half-circles, and quarter-circles) or three-dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape, and compose new shapes from the composite shape. Students do not need to learn formal names such as “right rectangular prism.”</td>
<td>2. Partition a rectangle into rows and columns of same-size squares and count to find the total number of them.</td>
<td>2. Partition shapes into parts with equal areas. Express the area of each part as a unit fraction of the whole. For example, partition a shape into 4 parts with equal area, and describe the area of each part as 1/4 of the area of the shape.</td>
<td>2. Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines or the presence or absence of angles of a specified size.</td>
<td>2. Classify two-dimensional figures into categories based on their properties.</td>
</tr>
<tr>
<td>3. Identify shapes as two-dimensional (lying in a plane, “flat”) or three-dimensional (“solid”).</td>
<td>3. Partition circles and rectangles into two, three, or four equal shares; describe the shares using the words halves, thirds, or fourths and quarters, and use the phrases half of, third of, and quarter of. Describe the whole as two halves, three thirds, or four fourths in real-world contexts. Recognize that equal shares of identical wholes need not have the same shape.</td>
<td>3. Compare the area of each part to the total area and describe the area of each part as a unit fraction of the whole.</td>
<td>3. Identify and describe commonalities and differences of triangles based on angle measures (equiangular, right, acute, and obtuse triangles) and side lengths (isosceles, equilateral, and scalene triangles).</td>
<td>3. Identify and describe commonalities and differences of quadrilaterals based on angle measures, side lengths, and the presence or absence of parallel and perpendicular lines, e.g., squares, rectangles, parallelograms, trapezoids, and rhombuses.</td>
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<td>5. Model shapes in the world by building shapes from components (such as sticks and clay balls) and drawing shapes.</td>
<td>5. 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.</td>
<td>5. Correctly name shapes regardless of their orientations or overall size.</td>
<td>5. Identify shapes as two-dimensional (lying in a plane, “flat”) or three-dimensional (“solid”).</td>
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<td>6. Combine simple shapes to form larger shapes.</td>
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Ohio's Department of Education

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## Ohio’s K-5 Learning Progressions

### Measurement and Data

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<tr>
<td>Identify, describe, and compare measurable attributes.</td>
<td>Measure lengths indirectly and by iterating length units.</td>
<td>Measure lengths and distances using standard units.</td>
<td>Solve problems involving money and measurement and estimation of intervals of time, liquid volumes, and masses of objects.</td>
<td>Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.</td>
<td>Convert like measurement units within a given measurement system.</td>
</tr>
<tr>
<td>1. Order three objects by length; compare the lengths of two objects indirectly by using a third object.</td>
<td>1. Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.</td>
<td>1. Tell and write time to the nearest minute. Measure time intervals in minutes (within 90 minutes). Solve real-world problems involving addition and subtraction of time intervals (elapsed time) in minutes, e.g., by representing the problem on a number line diagram or clock.</td>
<td>1. Know relative sizes of the metric measurement units within one system of units. Metric units include kilometer, meter, centimeter, and millimeter; kilogram and gram; and liter and milliliter. Express a larger measurement unit in terms of a smaller unit.</td>
<td>1. Know relative sizes of these U.S. customary measurement units: pounds, ounces, miles, yards, feet, inches, gallons, quarts, pints, cups, fluid ounces, hours, minutes, and seconds. Convert between pounds and ounces; miles and feet; yards, feet, and inches; gallons, quarts, pints, cups, and fluid ounces; hours, minutes, and seconds in solving multi-step, real-world problems.</td>
<td>2. Display and interpret data in graphs (picture graphs, bar graphs, and line plots) to solve problems using numbers and operations for this grade, e.g., including U.S. customary units in fractions 1/2, 1/4, 1/8, or decimals. Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition.</td>
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<td><strong>should be limited to pennies.</strong></td>
<td><strong>4.</strong> Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, cubes, using cubic cm, cubic in., and how many more or less are in one category than in another.</td>
<td><strong>with a symbol for the unknown number to represent the problem.</strong></td>
<td><strong>then determine how many more/less in two given categories.</strong></td>
<td><strong>unknown factor, and given two adjacent side lengths of a rectangle, find the perimeter.</strong></td>
<td><strong>b.</strong> 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.</td>
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<td><strong>4.</strong> Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, cubes, using cubic cm, cubic in., and how many more or less are in one category than in another.</td>
<td><strong>Drawings need not show details but should show the mathematics in the problem. (This applies wherever drawings are mentioned in the Standards.)</strong></td>
<td><strong>4.</strong> Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by creating a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters.</td>
<td><strong>Geometric measurement: understand concepts of area and relate area to multiplication and addition.</strong></td>
<td><strong>Represent and interpret data.</strong></td>
<td><strong>4.</strong> Measure volumes by counting unit cubes, using cubic cm, cubic in., cubic ft, and improvised units.</td>
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<td><strong>5.</strong> 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. <strong>Work with time and money.</strong></td>
<td><strong>6.</strong> 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.</td>
<td><strong>Tell and write time from analog and digital clocks to the nearest five minutes, using a.m. and p.m.</strong></td>
<td><strong>Solve problems using numbers and operations for this grade.</strong></td>
<td><strong>4.</strong> Display and interpret data in graphs (picture graphs, bar graphs, and line plots) to solve problems using numbers and operations for this grade.</td>
<td><strong>5.</strong> Relate volume to the operations of multiplication and addition and solve real-world and mathematical problems involving volume.</td>
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<td><strong>6.</strong> 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. <strong>Work with time and money.</strong></td>
<td><strong>7.</strong> Tell and write time from analog and digital clocks to the nearest five minutes, using a.m. and p.m.</td>
<td><strong>6.</strong> Solve problems with money.</td>
<td><strong>a.</strong> Identify nickels and quarters by name and value.</td>
<td><strong>b.</strong> 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.</td>
<td><strong>a.</strong> 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.</td>
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<td><strong>b.</strong> Find the value of a collection of quarters, dimes, nickels, and pennies.</td>
<td><strong>7.</strong> Tell and write time from analog and digital clocks to the nearest five minutes, using a.m. and p.m.</td>
<td><strong>7.</strong> Solve problems with money.</td>
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<td><strong>b.</strong> Apply the formulas ( V = \ell \times w \times h ) and ( V = B \times 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.</td>
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<td><strong>7.</strong> Tell and write time from analog and digital clocks to the nearest five minutes, using a.m. and p.m.</td>
<td><strong>6.</strong> Solve problems with money.</td>
<td><strong>b.</strong> 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.</td>
<td><strong>7.</strong> Recognize angle measure as additive. <strong>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.</strong></td>
<td><strong>c.</strong> Recognize volume as additive. <strong>Find volumes of solid figures composed of two non-overlapping right rectangular prisms by adding the volumes of the non-overlapping solids.</strong></td>
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<td><strong>c.</strong> Solve word problems by adding and subtracting within 100, dollars with dollars and cents with cents (not using dollars and cents simultaneously) using the $ and $ symbols appropriately (not including decimal notation). Represent and interpret data.</td>
<td><strong>c.</strong> 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 $a \times b$ and $a \times c$ (represent the distributive property with visual models including an area model).</td>
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<td><strong>9.</strong> 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 creating a line plot, where the horizontal scale is marked off in whole-number units.</td>
<td><strong>10.</strong> Organize, represent, and interpret data with up to four categories; complete picture graphs when single-unit scales are provided; complete bar graphs when single-unit scales are provided; solve simple put-together, take-apart, and compare problems in a graph. See Glossary, Table 1.</td>
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<td><strong>8.</strong> 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.</td>
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**Geometric measurement:** recognize perimeter as an attribute of plane figures and distinguish between linear and area measures. **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.