## Number and Computation – The student uses numerical and computational concepts and procedures in a variety of situations.

### Benchmark 1: Number Sense – The student demonstrates number sense for integers, fractions, decimals, and money in a variety of situations.

| Fifth Grade Knowledge Base Indicators | Fifth Grade Application Indicators |
|---|---|
| The student…<br>1. ▲**N** knows, explains, and uses equivalent representations for **($)**:<br>a. whole numbers from 0 through 1,000,000 (2.4.K1a-b);<br>b. fractions greater than or equal to zero (including mixed numbers) (2.4.K1c);<br>c. decimals greater than or equal to zero through hundredths place and when used as monetary amounts (2.4.K1c).<br>2. compares and orders (2.4.K1a-c) **($)** :<br>a. integers,<br>b. fractions greater than or equal to zero (including mixed numbers),<br>c. decimals greater than or equal to zero through hundredths place.<br>3. explains the numerical relationships (relative magnitude) between whole numbers, fractions greater than or equal to zero (including mixed numbers), and decimals greater than or equal to zero through hundredths place (2.4.K1a-c).<br>4. knows equivalent percents and decimals for one whole, one-half, one-fourth, three-fourths, and one tenth through nine tenths (2.4.K1c), e.g., 1 = 100% = 1.0, 3/4 = 75% = .75, 3/10 = 30% = .3.<br>5. identifies integers and gives real-world problems where integers are used (2.4.K1a), e.g., making a T-table of the temperature each hour over a twelve hour period in which the temperature at the beginning is 10 degrees and then decreases 2 degrees per hour. | The student…<br>1. solves real-world problems using equivalent representations and concrete objects to **($)**:<br>a. compare and order (2.4.A1a-d) –<br>i. whole numbers from 0 through 1,000,000; e.g., using base ten blocks, represent the attendance at the circus over a three day stay; then represent the numbers using digits and compare and order in different ways;<br>ii. fractions greater than or equal to zero (including mixed numbers), e.g., Frank ate 2 ½ pizzas, Tara ate 9/4 of the pizza. Frank says he ate more. Is he correct? Use a model to explain. With drawings and shadings, student shows amount of pizza eaten by Frank and the amount eaten by Tara.<br>iii. decimals greater than or equal to zero to hundredths place, e.g., uses decimal squares, money (dimes as tenths, pennies as hundredths), the correct amount of hundred chart filled in, or a number line to show that .42 is less than .59.<br>iv. integers, e.g., plot winter temperature for a very cold region for a week (use Internet data); represent on a thermometer, number line, and with integers;<br>b. add and subtract whole numbers from 0 through 100,000 and decimals when used as monetary amounts (2.4.A1a,c), e.g., use real money to show at least 2 ways to represent $846.00, then subtract the cost of a new computer setup; |



**▲– Assessed Indicator on the Objective Assessment**
**■ – Assessed Indicator on the Optional Constructed Response Assessment**
**N – Noncalculator**
**($) – Financial Literacy**

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|---|---|
| | c. multiply through a two-digit whole number by a two-digit whole number (2.4.A1a-b), e.g., George charges $23 for mowing a lawn. How much will he make after he mows 3 lawns? Represent the $23 with money models - 2 $10 bills and 3 $1 bills and repeat that 3 times *or* represent the $23 using base ten blocks or 23 x 3 or 23 + 23 + 23.;<br>d. divide through a four-digit whole number by a two-digit whole number (2.4.A1a-b), e.g., the Boy Scout troop collected cans and held bake sales for a year and earned $492.60. The money will be divided evenly among the 12 troop members to buy new uniforms. Represent each boy's share of the money at least 2 ways - traditional division; use 4 hundreds, 9 tens, 2 ones, and 6 dimes to act out the situation; or use base ten blocks to act it out.<br>2. determines whether or not solutions to real-world problems that involve the following are reasonable **($)**:<br>a. whole numbers from 0 through 100,000 (2.4.A1a-b), e.g., the football is placed on your own 10-yard line with 90 yards to go for a touchdown. After the first down, your team gains 7 yards. On the second down, your team loses 4 yards. Is it reasonable for the football to be placed on the 3-yard line for the beginning of the third down?<br>b. fractions greater than or equal to zero (including mixed numbers) (2.4.A1c), e.g., explain if it is reasonable to say that a dog is ½ boxer, ¼ bulldog, ¼ collie, and ¼ rotweiler;<br>3. decimals greater than or equal to zero through hundredths place (2.4.A1c), e.g., five people a ate pizza. Is it reasonable to say that each person ate .3 of the pizza? |



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**Teacher Notes: Number sense** refers to one's ability to reason with numbers and to work with numbers in a flexible way. The ability to compute mentally, to estimate based on understanding of number relationships and magnitudes, and to judge reasonableness of answers are all involved in number sense. When we say that someone has good number sense, we mean that he or she possesses a variety of abilities and understandings that include an awareness of the relationships between numbers, an ability to represent numbers in a variety of ways, a knowledge of the effects of operations, and an ability to interpret and use numbers in real-world counting and measurement situations. Such a person predicts with some accuracy the result of an operation and consistently chooses appropriate measurement units. This "friendliness with numbers" goes far beyond mere memorization of computational algorithms and number facts; it implies an ability to use numbers flexibly, to choose the most appropriate representation of a number for a given circumstance, and to recognize when operations have been correctly performed. (Number Sense and Operations: Addenda Series, Grades K-6, NCTM, 1993)

At this grade level, rational numbers include positive numbers, large numbers (one million), and small numbers (one-hundredth). **Relative magnitude** refers to the size relationship one number has with another – is it much larger, much smaller, close, or about the same? For example, using the numbers 219, 264, and 457, answer questions such as –

- Which two are closest? Why?
- Which is closest to 300? To 250?
- About how far apart are 219 and 500? 5,000?
- If these are 'big numbers,' what are small numbers? Numbers about the same? Numbers that make these seem small?

(Elementary and Middle School Mathematics, John A. Van de Walle, Addison Wesley Longman, Inc., 1998)

**Mathematical models** such as concrete objects, pictures, diagrams, Venn diagrams, number lines, hundred charts, base ten blocks, or factor trees are necessary for conceptual understanding and should be used to explain computational procedures. If a mathematical model can be used to represent the concept, the indicator in the Models benchmark is identified in the parentheses. For example, (2.4.K1a) refers to Standard 2 (Algebra), Benchmark 4 (Models), and Knowledge Indicator 1a (process models). Then, the indicator in the Models benchmark lists some of the mathematical models that could be used to teach the concept. In addition, each indicator in the Models benchmark is linked back to the other indicators. Those indicators are identified in the parentheses. For example, *process models* are linked to 1.1.K3, 1.2.K6, 1.3.K1, … with 1.1.K3 referring to Standard 1 (Number and Computation), Benchmark 1 (Number Sense), and Knowledge Indicator 3.

The National Standards in **Personal Finance** identify what K-12 students should know and be able to do in personal finance; benchmarks are provided at three grade levels (grades 4, 8, and 12) and are grouped into four major categories: Income, Spending and Credit, Saving and Investing, and Money Management. Although the National Standards in Personal Finance are benchmarked at three grade levels, the indicators in the Kansas Curricular Standards for Mathematics that correlate with the National Standards in Personal Finance are indicated at each grade level with a **($)**. The National Standards in Personal Finance are included in the Appendix.



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**Number and Computation – The student uses numerical and computational concepts and procedures in a variety of situations.**

**Benchmark 2: Number Systems and Their Properties – The student demonstrates an understanding of the whole number system; recognizes, uses, and explains the concepts of properties as they relate to the whole number system; and extends these properties to integers, fractions (including mixed numbers), and decimals.**

| Fifth Grade Knowledge Base Indicators | Fifth Grade Application Indicators |
|---|---|
| The student…<br>1. classifies subsets of numbers as integers, whole number, fractions (including mixed numbers), or decimals (2.4.K1a-c, 2.4.K1k).<br>2. identifies prime and composite numbers from 0 through 50.<br>3. **uses** the **concepts** of these properties with whole numbers, integers, fractions greater than or equal to zero (including mixed numbers), and decimals greater than or equal to zero and demonstrates their meaning including the use of concrete objects (2.4.K1a) **($)**:<br>a. commutative properties of addition and multiplication, e.g., 43 + 34 = 34 + 43 and 12 x 15 = 15 x 12;<br>b. associative properties of addition and multiplication, e.g., 4 + (3 + 5) = (4 + 3) + 5;<br>c. zero property of addition (additive identity) and property of one for multiplication (multiplicative identity), e.g., 342 + 0 = 342 and 576 x 1 = 576;<br>d. symmetric property of equality, e.g., 35 = 11 + 24 is the same as 11 + 24 = 35;<br>e. zero property of multiplication, e.g., 438,223 x 0 = 0;<br>f. distributive property, e.g., 7(3 + 5) = 7(3) + 7(5);<br>g. substitution property, e.g., if a = 3 and a = b, then b = 3.<br>4. recognizes Roman Numerals that are used for dates, on clock faces, and in outlines.<br>5. recognizes the need for integers, e.g., with temperature, below zero is negative and above zero is positive; in finances, money in your pocket is positive and money owed someone is negative. | The student…<br>1. solves real-world problems with whole numbers from 0 through 100,000 and decimals through hundredths using place value models; money; and the concepts of these properties to explain reasoning (2.4.A1a-c,e) **($)**:<br>a. commutative and associative properties of addition and multiplication, e.g., lay out a $5, $10 and $20 bills. Ask for the total of the money. The student says: Because you can add in any order (commutative) I can rearrange the money and count $20, $10 and $5 for $20 + $10 + $5 or Lay out 4 $5 bills. The student is asked the amount. The student says: I don't know what 4 x 5 is, but I know 5 x 4 is $20 and since multiplication can be done in any order, then it is $20.<br>b. zero property of addition, e.g., have students lay out 6 dimes. Tell them to add zero. How many dimes? 6 + 0 = 6<br>c. property of one for multiplication, e.g., there are 24 students in our class. I want one math book per student, so I compute 24 x 1= 24. Multiplying times 1 does not change the product because it is one group of 24.<br>d. symmetric property of equality, e.g., Pat knows he has $56. He has 2 twenty-dollar bills in his wallet. How much does he have at home in his bank? This can be represented as –<br>56 = (2 x 20) + □, so ( 2 x 20) + □ = 56<br>56 = 40 + □, so 40 + □ = 56<br>56 = 20 + 20 + 16, so 20 + 20 + 16 = 56.<br>e. zero property of multiplication, e.g., in science, you are observing a snail. The snail does not move over a 4-hour period. To figure its total movement, you say 4 x 0 = 0. |



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|---|---|
| | f. distributive property, e.g., Juan has 7 quarters and 7 dimes. What is the total amount of money he has? 7($.25 + $.10) = 7($.25) + 7($.10).<br>2. performs various computational procedures with whole numbers from 0 through 100,000 using the concepts of these properties; extends these properties to fractions greater than or equal to zero (including mixed numbers) and decimals greater than or equal to zero through hundredths place; and explains how the properties were used (2.4.A1a-c,e):<br>a. commutative and associative properties of addition and multiplication, e.g., given 4.2 x 10, the student says: I know that it is 42 because I know that 10 x 4.2 = 42, since you can multiply in any order and get the same answer. *or* The student says I don't know what 9 + 8 is, but I know my doubles of 8 + 8, so I make the 9 into 1 + 8 and after adding 8 and 8, I add 1 more;<br>b. zero property of addition, e.g., given 47 + 917 + 0, the student says: I know that the answer is 964 because adding 0 does not change the answer (sum);<br>c. property of one for multiplication, e.g., $9.62 x 1. The student says: I know the product is still $9.62 because multiplication by one never changes the product. It is like if I had $9.62 in one pile, I would just have $9.62;<br>d. symmetric property of equality, e.g., given □ = ½ + ¼, the student says: That is the same as ½ + ¼ because I must make both sides equal;<br>e. zero property of multiplication e.g., given .7 x 0, the student says: I know the answer (product) is zero because no matter how many factors you have, multiplying by 0, the product is 0;<br>f. distributive property, e.g., given 4 x 614, the student can explain that you can solve it (in your head?) by computing 4(600) + 4(10) + 4(4), which is 2,400 + 40 + 4 = 2,444.<br>3. states the reason for using integers, whole numbers, fractions (including mixed numbers), or decimals when solving a given real-world problem (2.4.A1a-c) **($)**. |

**Teacher Notes:** From the Mathematics Dictionary and Handbook (Nichols Schwartz Publishing, 1999), **property** as a mathematical term means a characteristic (an attribute) of a number, geometric shape, mathematical operation, equation, or inequality. To give an example:

- Property of a number: 8 is divisible by 2.
- Property of a geometric shape: Each of the four sides of a square is of the same length.
- Property of an operation: Addition is commutative. For all numbers x and y, $x + y = y + x$.
- Property of an equation: For all numbers a, b, and c, if $a = b$, then $a + c = b + c$.
- Property of an inequality: For all numbers a, b, and c, if $a > b$, then $a – c > b – c$.

**Mathematical models** such as concrete objects, pictures, diagrams, Venn diagrams, number lines, hundred charts, base ten blocks, or factor trees are necessary for conceptual understanding and should be used to explain computational procedures. If a mathematical model can be used to represent the concept, the indicator in the Models benchmark is identified in the parentheses. For example, (2.4.K1a) refers to Standard 2 (Algebra), Benchmark 4 (Models), and Knowledge Indicator 1a (process models). Then, the indicator in the Models benchmark lists some of the mathematical models that could be used to teach the concept. In addition, each indicator in the Models benchmark is linked back to the other indicators. Those indicators are identified in the parentheses. For example, *process models* are linked to 1.1.K3, 1.2.K6, 1.3.K1, … with 1.1.K3 referring to Standard 1 (Number and Computation), Benchmark 1 (Number Sense), and Knowledge Indicator 3.

The National Standards in **Personal Finance** identify what K-12 students should know and be able to do in personal finance; benchmarks are provided at three grade levels (grades 4, 8, and 12) and are grouped into four major categories: Income, Spending and Credit, Saving and Investing, and Money Management. Although the National Standards in Personal Finance are benchmarked at three grade levels, the indicators in the Kansas Curricular Standards for Mathematics that correlate with the National Standards in Personal Finance are indicated at each grade level with a **($)**. The National Standards in Personal Finance are included in the Appendix.

**Number and Computation – The student uses numerical and computational concepts and procedures in a variety of situations.**

**Benchmark 3: Estimation – The student uses computational estimation with whole numbers, fractions, decimals, and money in a variety of situations.**

| Fifth Grade Knowledge Base Indicators | Fifth Grade Application Indicators |
|---|---|
| The student:<br>1. estimates whole numbers quantities from 0 through 100,000; fractions greater than or equal to zero (including mixed numbers); decimals greater than or equal to zero through hundredths place; and monetary amounts to $10,000 using various computational methods including mental math, paper and pencil, concrete materials, and appropriate technology (2.4.K1a-c) **($)**.<br>2. ▲**N** uses various estimation strategies to estimate whole number quantities from 0 through 100,000; fractions greater than or equal to zero (including mixed numbers); decimals greater than or equal to zero through hundredths place; and monetary amounts to $10,000 and explains how various strategies are used (2.4.K1a-c) **($)**.<br>3. recognizes and explains the difference between an exact and an approximate answer (2.4.K1a-c).<br>4. explains the appropriateness of an estimation strategy used and whether the estimate is greater than (overestimate) or less than (underestimate) the exact answer (2.4.K1a). | The student:<br>1. adjusts original estimate using whole numbers from 0 through 100,000 of a real-world problem based on additional information (a frame of reference) (2.4.A1a) **($)**, e.g., given a large container of marbles, estimate the quantity of marbles. Then, using a smaller container filled with marbles, count the number of marbles in the smaller container and adjust your original estimate.<br>2. estimates to check whether or not the result of a real-world problem using whole numbers from 0 through 100,000; fractions greater than or equal to zero (including mixed numbers); decimals greater than or equal to zero to tenths place; and monetary amounts to $10,000 is reasonable and makes predictions based on the information (2.4.A1a-c) **($)**, e.g., at your birthday party, you ate 4 ½ pepperoni pizzas, 3 ¼ cheese pizzas, and 2 ¾ sausage pizzas. On the bill they charged you for 10 pizzas. Is that reasonable? If pizzas cost $6.99 each, about how much should you save for your next birthday party?<br>3. selects a reasonable magnitude from given quantities based on a real-world problem using whole numbers from 0 through 100,000 and explains the reasonableness of selection (2.4.A1a), e.g., about how many tulips can fit in the flower vase, 2, 10, or 25? The student chooses ten and explains that the vase at home is a jelly jar and either two or ten will fit, but ten looks prettier.<br>4. ▲ ■ determines if a real-world problem calls for an exact or approximate answer using whole numbers from 0 through 100,000 and performs the appropriate computation using various computational methods including mental math, paper and pencil, concrete materials, and appropriate technology (2.4.A1a) **($)**. |



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**Teacher Notes**: **Estimate**, as a verb, means to make an educated guess based on information in a problem or to give an answer close to the exact number. Estimation is used when an exact answer is not needed, as in many real-life situations for which "ballpark" computations are acceptable. Good number sense enables one to estimate a quantity, estimate a measure, or estimate an answer.

**Estimation** serves as an important companion to computation. It provides a tool for judging the reasonableness of computational methods including mental math, paper and pencil, concrete objects, and appropriate technology. However, being able to compute does not automatically lead to an ability to estimate or judge reasonableness of answers. Frequent modeling by the teacher helps students develop a range of estimation strategies. Students should be encouraged to frequently explain their thinking as they estimate. As with exact computation, sharing estimation strategies allows students access to others' thinking and provides opportunities for class discussion. Identifying the estimation strategy by name is not critical; however, explaining the thinking behind the strategy to make a valid estimation is important. [For example, an invented approach for adding 37 + 89 could involve arriving at the solution by adding the tens, adding the ones, and then adding the partial sums to get the total.] (Principles and Standards for School Mathematics, NCTM, 2000)

**Mental math** and **estimation** are distinct but related mathematical skills. Proficiency in mental math contributes to increased skill in estimation. In order for students to become more familiar with estimation, teachers should introduce estimation with examples where rounded or estimated numbers are used. Emphasis should be placed on real-world examples where only estimation is required, e.g., About how many hours do you sleep a night? Using the language of estimation is important, so students begin to realize that a variety of estimates (answers) are possible.
In addition, when students are taught specific estimation strategies, they develop mental math and estimation skills easier. Estimation strategies include front-end with adjustment, compatible "nice" numbers, clustering, or special numbers.

**Mathematical models** such as concrete objects, pictures, diagrams, Venn diagrams, number lines, hundred charts, base ten blocks, or factor trees are necessary for conceptual understanding and should be used to explain computational procedures. If a mathematical model can be used to represent the concept, the indicator in the Models benchmark is identified in the parentheses. For example, (2.4.K1a) refers to Standard 2 (Algebra), Benchmark 4 (Models), and Knowledge Indicator 1a (process models). Then, the indicator in the Models benchmark lists some of the mathematical models that could be used to teach the concept. In addition, each indicator in the Models benchmark is linked back to the other indicators. Those indicators are identified in the parentheses. For example, *process models* are linked to 1.1.K3, 1.2.K6, 1.3.K1, … with 1.1.K3 referring to Standard 1 (Number and Computation), Benchmark 1 (Number Sense), and Knowledge Indicator 3.

The National Standards in **Personal Finance** identify what K-12 students should know and be able to do in personal finance; benchmarks are provided at three grade levels (grades 4, 8, and 12) and are grouped into four major categories: Income, Spending and Credit, Saving and Investing, and Money Management. Although the National Standards in Personal Finance are benchmarked at three grade levels, the indicators in the Kansas Curricular Standards for Mathematics that correlate with the National Standards in Personal Finance are indicated at each grade level with a **($)**. The National Standards in Personal Finance are included in the Appendix.



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**Number and Computation – The student uses numerical and computational concepts and procedures in a variety of situations.**

**Benchmark 4: Computation – The student models, performs, and explains computation with whole numbers, fractions including mixed numbers, and decimals including the use of concrete objects in a variety of situations.**

### Fifth Grade Knowledge Base Indicators

The student…

1. computes with efficiency and accuracy using various computational methods including mental math, paper and pencil, concrete materials, and appropriate technology (2.4.K1a).
2. performs and explains these computational procedures:
   a. **N** divides whole numbers through a 2-digit divisor and a 4-digit dividend with the remainder as a whole number or a fraction using paper and pencil (2.4.K1a-b), e.g., 7452 ÷ 24 = 310 r 12 or 310 ½;
   b. divides whole numbers beyond a 2-digit divisor and a 4-digit dividend using appropriate technology (2.4.K1a-b), e.g., 73,368 ÷ 36 = 2,038;
   c. **N** adds and subtracts decimals from thousands place through hundredths place (2.4.K1c);
   d. **N** multiplies decimals up to three digits by two digits from hundreds place through hundredths place (2.4.K1c);
   e. **N** adds and subtracts fractions (like and unlike denominators) greater than or equal to zero (including mixed numbers) without regrouping and without expressing answers in simplest form with special emphasis on manipulatives, drawings, and models; (2.4.K1c);
   f. **N** multiplies and divides by 10; 100; 1,000; or single-digit multiples of each (2.4.K1a-b), e.g., 20 • 300 or 4,400 ÷ 500.
3. reads and writes horizontally, vertically, and with different operational symbols the same addition, subtraction, multiplication, or division expression, e.g., 6 • 4 is the same as 6 x 4 is the same as 6(4) and $\begin{array}{r}6\\ \underline{\times 4}\end{array}$ or 10 divided by 2 is the same as 10 ÷ 2 or $\frac{10}{2}$.

### Fifth Grade Application Indicators

The student…

1. ▲**N** solves one- and two-step real-world problems using these computational procedures **($)** (For the purpose of assessment, two-step could include any combination of a, b, c, d, e, or f.):
   a. adds and subtracts whole numbers from 0 through 100,000 (2.4.A1a-b); e.g., Lee buys a bike for $139, a helmet for $29 and a reflector for $6. How much of his $200 check from his grandparents will he have left?
   b. multiplies through a four-digit whole number by a two-digit whole number (2.4.A1a-b), e.g., at the amusement park, Monday's attendance was 4,414 people. Tuesday's attendance was 3,042 people. If the cost per person is $23, how much money was collected on those days?
   c. multiplies monetary amounts up to $1,000 by a one- or two-digit whole number (2.4.A1c), e.g., what is the cost of 4 items each priced at $3.49?
   d. divides whole numbers through a 2-digit divisor and a 4-digit dividend with the remainder as a whole number or a fraction (2.4.A1a-c);
   e. adds and subtracts decimals from thousands place through hundredths place when used as monetary amounts (2.4.A1a-c) (The set of decimal numbers includes whole numbers.), e.g., at the track meet, Peter ran the 100 meter dash in 12.3 seconds. Tanner ran the same race in 12.19 seconds. How much faster was Tanner?



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|---|---|
| 4. ▲**N** identifies, explains, and finds the greatest common factor and least common multiple of two or more whole numbers through the basic multiplication facts from 1 x 1 through 12 x 12 (2.4.K1d). | f. ■ multiplies and divides by 10; 100; and 1,000 and single digit multiples of each (10, 20, 30, …; 100, 200, 300, …; 1,000; 2,000; 3,000; …) (2.4.A1a-b), e.g., Matti has 1,590 stamps to place in her stamp album. 30 stamps fit on a page. What is the minimum number of pages she needs in her album? |



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**Teacher Notes: Efficiency and accuracy** means that students are able to compute single-digit numbers with fluency. Students increase their understanding and skill in addition, subtraction, multiplication, and division by understanding the relationships between addition and subtraction, addition and multiplication, multiplication and division, and subtraction and division. Students learn basic number combinations and develop strategies for computing that makes sense to them. Through class discussions, students can compare the ease of use and ease of explanation of various strategies. In some cases, their strategies for computing will be close to conventional algorithms; in other cases, they will be quite different. Many times, students' invented approaches are based on a sound understanding of numbers and operations, and these invented approaches often can be used with efficiency and accuracy. [For example, an invented approach for adding 37 + 89 could involve arriving at the solution by adding the tens, adding the ones, and then adding the partial sums to get the total.] (Principles and Standards for School Mathematics, NCTM, 2000)

The definition of computation is finding the standard representation for a number. For example, 6 + 6, 4 x 3, 17 – 5, and 24 ÷ 2 are all representations for the standard representation of 12. **Mental math** is mentally finding the standard representation for a number – calculating in your head instead of calculating using paper and pencil or technology. One of the main reasons for teaching mental math is to help students determine if a computed/calculated answer is reasonable; in other words, using mental math to estimate to see if the answer makes sense. Students develop mental math skills easier when they are taught specific strategies. Mental math strategies include counting on, doubling, repeated doubling, halving, making tens, dividing with tens, thinking money, and using compatible "nice" numbers.

**Mathematical models** such as concrete objects, pictures, diagrams, Venn diagrams, number lines, hundred charts, base ten blocks, or factor trees are necessary for conceptual understanding and should be used to explain computational procedures. If a mathematical model can be used to represent the concept, the indicator in the Models benchmark is identified in the parentheses. For example, (2.4.K1a) refers to Standard 2 (Algebra), Benchmark 4 (Models), and Knowledge Indicator 1a (process models). Then, the indicator in the Models benchmark lists some of the mathematical models that could be used to teach the concept. In addition, each indicator in the Models benchmark is linked back to the other indicators. Those indicators are identified in the parentheses. For example, *process models* are linked to 1.1.K3, 1.2.K6, 1.3.K1, … with 1.1.K3 referring to Standard 1 (Number and Computation), Benchmark 1 (Number Sense), and Knowledge Indicator 3.

**Technology** is changing mathematics and its uses. The use of technology including calculators and computers is an important part of growing up in a complex society. It is not only necessary to estimate appropriate answers accurately when required; it is also important to have a good understanding of the underlying concepts in order to know when to apply the appropriate procedure. Technology does not replace the need to learn
basic facts, to compute mentally, or to do reasonable paper-and-pencil computation. However, dividing a 5-digit number by a 2-digit number is appropriate with the exception of dividing by 10, 100, or 1,000 and simple multiples of each.

The National Standards in **Personal Finance** identify what K-12 students should know and be able to do in personal finance; benchmarks are provided at three grade levels (grades 4, 8, and 12) and are grouped into four major categories: Income, Spending and Credit, Saving and Investing, and Money Management. Although the National Standards in Personal Finance are benchmarked at three grade levels, the indicators in the Kansas Curricular Standards for Mathematics that correlate with the National Standards in Personal Finance are indicated at each grade level with a **($)**. The National Standards in Personal Finance are included in the Appendix.



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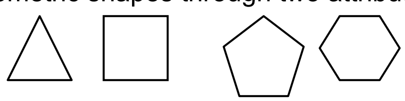
### Algebra – The student uses algebraic concepts and procedures in a variety of situations.

### Benchmark 1: Patterns – The student recognizes, describes, extends, develops, and explains relationships in patterns in a variety of situations.

| Fifth Grade Knowledge Base Indicators | Fifth Grade Application Indicators |
| --- | --- |
| The student…<br>1. uses concrete objects, drawings, and other representations to work with these **types** of patterns(2.4.K1a):<br>a. repeating patterns, e.g., 9, 10, 11, 9, 10, 11, …;<br>b. growing patterns, e.g., 20, 30, 28, 38, 36, … where the rule is add 10, then subtract 2; or 2, 5, 8, … as an example of an arithmetic sequence – each term after the first is found by adding the same number to the preceding term.<br>2. uses these **attributes** to generate patterns:<br>a. counting numbers related to number theory (2.4.K1a), e.g., multiples or perfect squares;<br>b. whole numbers (2.4.K1a) **($)**, e.g., 10; 100; 1,000; 10,000; 100,000; … (powers of ten);<br>c. geometric shapes through two attribute changes (2.4.K1g), e.g., … when the next shape has one more side; or when both the color and the shape change at the same time;<br>d. measurements (2.4.K1a), e.g., 3 m, 6 m, 9 m, …;<br>e. things related to daily life (2.4.K1a), e.g., sports scores, longitude and latitude, elections, eras, or appropriate topics across the curriculum;<br>f. things related to size, shape, color, texture, or movement (2.4.K1a), e.g., square dancing moves (kinesthetic patterns) | The student…<br>1. generalizes these patterns using a written description:<br>a. numerical patterns (2.4.K1a) **($)**,<br>b. patterns using geometric shapes through two attribute changes (2.4.A1a,g),<br>c. measurement patterns (2.4.A1a),<br>d. patterns related to daily life (2.4.A1a)<br>2. recognizes multiple representations of the same pattern (2.4.A1a) **($)**, e.g., 10; 100; 1,000; …<br>– represented as 10; 10 x 10; 10 x 10 x 10; …;<br>– represented as a rod, a flat, a cube, … using base ten blocks; or<br>– represented by a $10 bill; a $100 bill; a $1,000 bill; …. |





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| | |
|---|---|
| 3. identifies, states, and continues a pattern presented in various formats including numeric (list or table), visual (picture, table, or graph), verbal (oral description), kinesthetic (action), and written (2.4.K1a) **($)**.<br>4. generates:<br>a. a pattern (repeating, growing) (2.4.K1a).<br>b. a pattern using a function table (input/output machines, T-tables) (2.4.K1g). | |

**Teacher Notes:** Working with **patterns** is an important process in the development of mathematical thinking. Patterns can be based on geometric attributes (shapes, regions, angles); measurement attributes (color, texture, length, weight, volume, number); relational attributes (proportion, sequence, functions); and affective attributes (values, likes, dislikes, familiarity, heritage, culture). (Learning to Teach Mathematics, Randall J. Souviney, Macmillan Publishing Company, 1994)

This process (working with patterns) can be used to develop or deepen understandings of important concepts in number theory, positive rational numbers, measurement, geometry, probability, and functions. Working with patterns provides opportunities for students to recognize, describe, extend, develop, and explain.

**Number theory** is the study of the properties of the counting (natural) numbers, their relationships, ways to represent them, and patterns among them. Number theory includes the concepts of odd and even numbers, factors and multiples, primes and composites, greatest common factor and least common multiple, and sequences.

**Mathematical models** such as concrete objects, pictures, diagrams, number lines, unifix cubes, hundred charts, or base ten blocks are necessary for conceptual understanding and should be used to explain computational procedures. If a mathematical model can be used to represent the concept, the indicator in the Models benchmark is identified in the parentheses. For example, (2.4.K1a) refers to Standard 2 (Algebra), Benchmark 4 (Models), and Knowledge Indicator 1a (process models). Then, the indicator in the Models benchmark lists some of the mathematical models that could be used to teach the concept. In addition, each indicator in the Models benchmark is linked back to the other indicators. Those indicators are identified in the parentheses. For example, *process models* are linked to 1.1.K3, 1.2.K6, 1.3.K1, … with 1.1.K3 referring to Standard 1 (Number and Computation), Benchmark 1 (Number Sense), and Knowledge Indicator 3.

The National Standards in **Personal Finance** identify what K-12 students should know and be able to do in personal finance; benchmarks are provided at three grade levels (grades 4, 8, and 12) and are grouped into four major categories: Income, Spending and Credit, Saving and Investing, and Money Management. Although the National Standards in Personal Finance are benchmarked at three grade levels, the indicators in the Kansas Curricular Standards for Mathematics that correlate with the National Standards in Personal Finance are indicated at each grade level with a **($)**. The National Standards in Personal Finance are included in the Appendix.

**Algebra – The student uses algebraic concepts and procedures in a variety of situations.**

**Benchmark 2: Variables, Equations, and Inequalities – The student uses variables, symbols, whole numbers, and algebraic expressions in one variable to solve linear equations in a variety of situations.**

| Fifth Grade Knowledge Base Indicators | Fifth Grade Application Indicators |
|---|---|
| The student…<br>1. ▲ explains and uses variables and symbols to represent unknown whole number quantities from 0 through 1,000 and variable relationships (2.4.K1a)<br>2. **▲N** solves one-step linear equations with one variable and a whole number solution using addition and subtraction with whole numbers from 0 through 100 and multiplication with the basic facts (2.4.K1a,e) **($)**, e.g., 3y = 12, 45 = 17 + q, or r – 42 = 36.<br>3. explains and uses equality and inequality symbols (=, ≠, <, ≤, >, ≥) and corresponding meanings (is equal to, is not equal to, is less than, is less than or equal to, is greater than, is greater than or equal to) with whole numbers from 0 to 100,000 (2.4.K1a-b) **($)**.<br>4. recognizes ratio as a comparison of part-to-part and part-to-whole relationships (2.4.K1a), e.g., the relationship between the number of boys and the number of girls (part-to-part) or the relationship between the number of girls to the total number of students in the classroom (part-to-whole). | The student…<br>1. represents real-world problems using variables, symbols, and one-step equations with unknown whole number quantities from 0 through 1,000 (2.4.A1a,e) **($)**; e.g., Your parents say you must read 5 minutes each and every day of the next year. How many minutes will you read? This is represented by 365 x 5 = M.<br>2. generates one-step linear equations to solve real-world problems with whole numbers from 0 through 1,000 with one unknown and a whole number solution using addition, subtraction, multiplication, and division (2.4.A1a,e) **($)**, e.g., Ninety-six items are being shared with four people. How much does each person receive? becomes 96 ÷ 4 = n.<br>3. generates (2.4.A1a,e) **($)**:<br>a. a real-world problem with one operation to match a given addition, subtraction, multiplication, or division equation using whole numbers from 0 through 1,000 (2.4.A1a), e.g., given 95 ÷ 5 = x students write: There are 95 kids at camp who need to be divided into teams of 5. How many teams will there be?<br>b. number comparison statements using equality and inequality symbols (=, <, >) with whole numbers, measurement, and money e.g., 1 ft < 15 in or 10 quarters > $2. |



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**Teacher Notes:** Understanding the **concept of variable** is fundamental to algebra. Students use various symbols, including letters and geometric shapes to represent unknown quantities that both do and do not vary. Quantities that are not given and do not vary are often referred to as unknowns or missing elements when they appear in equations, e.g., 2 + 4 = Δ or 3 + s = 7. Various symbols or letters should be used interchangeably in equations.

**Mathematical models** such as concrete objects, pictures, diagrams, number lines, unifix cubes, hundred charts, or base ten blocks are necessary for conceptual understanding and should be used to explain computational procedures. If a mathematical model can be used to represent the concept, the indicator in the Models benchmark is identified in the parentheses. For example, (2.4.K1a) refers to Standard 2 (Algebra), Benchmark 4 (Models), and Knowledge Indicator 1a (process models). Then, the indicator in the Models benchmark lists some of the mathematical models that could be used to teach the concept. In addition, each indicator in the Models benchmark is linked back to the other indicators. Those indicators are identified in the parentheses. For example, *process models* are linked to 1.1.K3, 1.2.K6, 1.3.K1, … with 1.1.K3 referring to Standard 1 (Number and Computation), Benchmark 1 (Number Sense), and Knowledge Indicator 3.

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**Algebra – The student uses algebraic concepts and procedures in a variety of situations.**

**Benchmark 3: Functions – The student recognizes, describes, and examines whole number relationships in a variety of situations.**

## Fifth Grade Knowledge Base Indicators

The student…

1. states mathematical relationships between whole numbers from 0 through 10,000 using various methods including mental math, paper and pencil, concrete objects, and appropriate technology (2.4.K1a) **($)**.
2. finds the values, determines the rule, and states the rule using symbolic notation with one operation of whole numbers from 0 through 10,000 using a vertical or horizontal function table (input/output machine, T-table) (2.4.K1f), e.g., using the function table, fill in the values and find the rule, the rule is N • 80.

| **N** | 4 | 9 | 11 | ? | 2 | 7 | ? |
|---|---|---|---|---|---|---|---|
| **?** | 320 | 720 | 880 | 640 | ? | ? | 800 |

3. generalizes numerical patterns using whole numbers from 0 through 5,000 up to two operations by stating the rule using words, e.g., If the sequence is 2400, 1200, 600, 300, 150, …; in words, the rule could be split the number in half or divide the previous number by 2 or if the sequence is 4, 11, 25, 53, 109, …; in words, the rule could be double the number and add 3 to get the next number or multiply the number by 2 and add 3.
4. ▲ ■ uses a function table (input/output machine, T-table) to identify, plot, and label whole number ordered pairs in the first quadrant of a coordinate plane (2.4.K1a,f).
5. plots and locates points for integers (positive and negative whole numbers) on a horizontal number line and vertical number line (2.4.K1a).
6. describes whole number relationships using letters and symbols.

## Fifth Grade Application Indicators

The student…

1. represents and describes mathematical relationships between whole numbers from 0 through 5,000 using written and oral descriptions, tables, graphs, and symbolic notation (2.4.A1a) **($)**.
2. finds the rule, states the rule, and extends numerical patterns using real-world problems with whole numbers from 0 through 5,000 (2.4.A1a,f) **($)**, e.g., the class sells cookies at lunch recess to raise money for a field trip. The goal is to sell 3,000 cookies at 25¢ each. A student notices that every $4^{th}$ day, a new case of cookies has to be opened. Each case holds 450 cookies. If the class keeps selling cookies at the same rate, how many days will it take to sell 3,000 cookies?

| **Day** | **# of Cookies Sold** |
|---|---|
| 4 | 450 |
| 8 | 900 |
| 12 | 1350 |
| 16 | 1800 |
| 20 | 2250 |
| 24 | 2700 |
| 28 | 3150 |

A student's answer might be: 28 days because that will be 150 over the goal or on day 27 until 3,000 cookies are sold.

3. translates between verbal, numerical, and graphical representations including the use of concrete objects to describe mathematical relationships (2.4.A1a,k), e.g., when the temperature is 20º and then it drops 2º an hour for 12 hours, the result is a negative number; the student could model this using a vertical number line.



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**Teacher Notes**: **Functions** are relationships or rules in which each member of one set is paired with one, and only one, member of another set (an ordered pair). The concept of function can be introduced using function machines. Any number put in the machine will be changed according to some rule. A record of inputs and corresponding outputs can be maintained in a two-column format. Function tables, input/output machines, and T-tables may be used interchangeably and serve the same purpose.

Function concepts should be developed from **growing patterns**. Each term in a number sequence is related to its position in the sequence – the functional relationship. The pattern – 4, 7, 10, 13, 16, 19, and so on – is an arithmetic sequence *with a difference of 3*. The pattern could be described as *add 3* meaning that 3 must be added to the previous term to find the next. This pattern is explained by using the recursive definition for a sequence. The recursive definition for a sequence is a statement or a set of statements that explains how each successive term in the sequence is obtained from the previous term(s).

In the pattern 1, 4, 9, 16, 25, …, 225; there is *no common difference.* This sequence is not arithmetic or geometric (no common ratio between geometric terms). Neither is it a combination of the two; however, there is a pattern and the missing terms between 25 and 225 can be found. To find the term value, square the number of the term. The next missing terms would be 36, 49, 64, 81, 100, 121, and 144. This pattern is explained by using the explicit formula for a sequence. The explicit formula for a sequence defines a rule for finding each term in the number sequence related to its position in the sequence. In other words, to find the term value, square the number of the term – the $5^{th}$ term is $5^2$, the $8^{th}$ term is $8^2$, …

Patterns themselves are not explicit or recursive. The *RULE* for the pattern can be expressed explicitly or recursively and *MOST* patterns can be explained using either format especially *IF* that pattern reflects either an arithmetic sequence or geometric sequence.

**Mathematical models** such as concrete objects, pictures, diagrams, number lines, unifix cubes, hundred charts, or base ten blocks are necessary for conceptual understanding and should be used to explain computational procedures. If a mathematical model can be used to represent the concept, the indicator in the Models benchmark is identified in the parentheses. For example, (2.4.K1a) refers to Standard 2 (Algebra), Benchmark 4 (Models), and Knowledge Indicator 1a (process models). Then, the indicator in the Models benchmark lists some of the mathematical models that could be used to teach the concept. In addition, each indicator in the Models benchmark is linked back to the other indicators. Those indicators are identified in the parentheses. For example, *process models* are linked to 1.1.K3, 1.2.K6, 1.3.K1, … with 1.1.K3 referring to Standard 1 (Number and Computation), Benchmark 1 (Number Sense), and Knowledge Indicator 3.

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**Algebra – The student uses algebraic concepts and procedures in a variety of situations.**

**Benchmark 4: Models – The student develops and uses mathematical models including the use of concrete objects to represent and explain mathematical relationships in a variety of situations.**

| Fifth Grade Knowledge Base Indicators | Fifth Grade Application Indicators |
|---|---|
| The student…<br>1. knows, explains, and uses mathematical models to represent mathematical concepts, procedures, and relationships. Mathematical models include:<br>a. process models (concrete objects, pictures, diagrams, number lines, hundred charts, measurement tools, multiplication arrays, division sets, or coordinate planes/grids) to model computational procedures and mathematical relationships and to solve equations (1.1.K1a, 1.1K1c, 1.1.K2, 1.1.K3, 1.1.K5, 1.2.K1, 1.2.K3, 1.3.K1-4, 1.4.K1, 1.4.K2a-b, 1.4.K.2f, 2.1.K1, 2.1.K2a-b, 2.1.K2d-h, 2.1.K2, 2.2.K1-4, 2.3.K1, 2.3.K4-5, 3.1.K1-6, 3.2.K1-4, 3.3.K1-2, 3.4.K1-4, 4.2.K3) **($)**;<br>b. place value models (place value mats, hundred charts, base ten blocks, or unifix cubes) to compare, order, and represent numerical quantities and to model computational procedures (1.1.K1a, 1.1.K2, 1.1.K4, 1.2.K1, 1.3.K1-3, 1.4.K2a-b, 1.4.K2f, 2.2.K3) **($)**;<br>c. fraction and mixed number models (fraction strips or pattern blocks) and decimal and money models (base ten blocks or coins) to compare, order, and represent numerical quantities (1.1.K1b, 1.1.K2-4, 1.2.K1, 1.3.K1-3, 1.4.K2c-e, 4.1.K4) **($)**;<br>d. factor trees to find least common multiple and greatest common factor (1.2.K2, 1.4.K4);<br>e. equations and inequalities to model numerical relationships (2.2.K2) **($)**;<br>f. function tables (input/output machines, T-tables) to model numerical and algebraic relationships (2.1.K1c, 2.1.K1j, 3.1.K1-8, 3.2.K7-8, 3.3.K1-3) **($)**; | The student…<br>1. recognizes that various mathematical models can be used to represent the same problem situation. Mathematical models include:<br>a. process models (concrete objects, pictures, diagrams, number lines, hundred charts, measurement tools, multiplication arrays, division sets, or coordinate planes/grids) to model computational procedures, mathematical relationships, and problem situations and to solve equations (1.1.A1, 1.1.A2a, 1.2.A1-3, 1.3.A1-4, 1.4.A1a-b, 1.4.A1d-f, 2.1.A1a, 2.1.A1c-d, 2.1.A2, 2.2.A1-3, 2.3.A1-3, 3.2.A1a-f, 3.2.A2-4, 3.3.A1, 3.4.A1-2. 4.2.A2) **($)**;<br>b. place value models (place value mats, hundred charts, base ten blocks, or unifix cubes) to model problem situations (1.1.A1, 1.1.A2a, 1.2.A1-3, 1.3.A2, 1.4.A1a-b, 1.4.A1f, 1.4.A3a-e, 2.2.K3) **($)**;<br>c. fraction and mixed number models (fraction strips or pattern blocks) and decimal and money models (base ten blocks or coins) to compare, order, and represent numerical quantities (1.1.A1a-b, 1.1.A2b-c, 1.2.A1-3, 1.3.A2, 1.4.A1c-e) **($)**;<br>d. factor trees to find least common multiple and greatest common factor;<br>e. equations and inequalities to model numerical relationships (2.1.A1-2, 2.2.A1-3) **($)**;<br>f. function tables (input/output machines, T-tables) to model numerical and algebraic relationships (2.3.A2, 3.2.A1g-h, 3.3.A3) **($)**;<br>g. two-dimensional geometric models (geoboards or dot paper) to model perimeter, area, and properties of geometric shapes and three-dimensional models (nets or solids) and real-world objects to compare size and to model volume and properties of |



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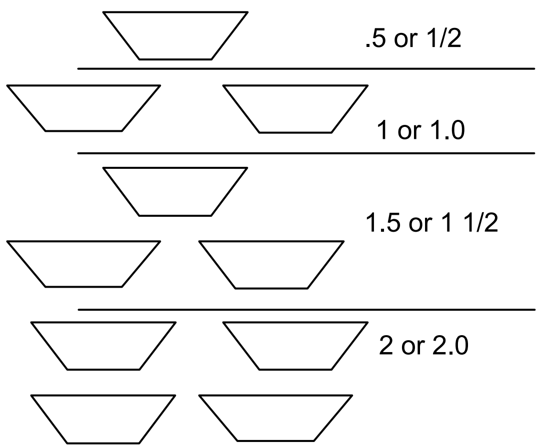
geometric shapes (2.1.A1b, 3.1.A1-2, 3.2.A4, 4.1.A1-3);

g. two-dimensional geometric models (geoboards or dot paper) to model perimeter, area, and properties of geometric shapes and three-dimensional models (nets or solids) and real-world objects to compare size and to model volume and properties of geometric shapes (2.1.K2c, 2.1.K4b, 3.2.K5, 3.3.K3, 4.1.K2);
h. tree diagrams to organize attributes through three different sets and determine the number of possible combinations (4.1.K2, 4.2.K1a-d, 4.2.K1f-l; 4.2.K2, 4.2);
i. two- and three-dimensional geometric models (spinners or number cubes) and process models (concrete objects, pictures, diagrams, or coins) to model probability (4.1.K1-3, 4.2.K1e, 4.2.K2) **($)** ;
j. graphs using concrete objects, pictographs, frequency tables, bar graphs, line graphs, circle graphs, Venn diagrams, line plots, charts, tables, and single stem-and-leaf plots to organize and display data (4.1.K2, 4.2.K1-2) **($)** ;
k. Venn diagrams to sort data and show relationships.

2. creates mathematical models to show the relationship between two or more things, e.g., using trapezoids to represent numerical quantities –




h. scale drawings to model large and small real-world objects (3.3.A2);
i. tree diagrams to organize attributes through three different sets and determine the number of possible combinations;
j. two- and three-dimensional geometric models (spinners or number cubes) and process models (concrete objects, pictures, diagrams, or coins) to model probability (4.1.A1-3, 4.2.A1) **($)**;
k. graphs using concrete objects, pictographs, frequency tables, bar graphs, line graphs, circle graphs, Venn diagrams, line plots, charts, and tables to organize, display, explain, and interpret data (2.3.A3; 4.1.A1-2, 4.2.A1, 4.2.A3-4) **($)**;
l. Venn diagrams to sort data and show relationships.

2. selects a mathematical model and explains why some mathematical models are more useful than other mathematical models in certain situations.



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**Teacher Notes:** For assessment purposes, the mathematical modeling process appropriate to the indicator may be included as part of the item being assessed. The **mathematical modeling** process involves:

a. selecting key features and relationships within the real-world situation and representing these concepts in mathematical terms through some sort of mathematical model,
b. performing manipulations and mathematical procedures within the mathematical model,
c. interpreting the results of the manipulations within the mathematical model,
d. using these results to make inferences about the original real-world situation.

The use of **mathematical models** is necessary for conceptual understanding. The ways in which mathematical ideas are represented is fundamental to how students understand and use those ideas. As students begin to use multiple representations of the same situation, they begin to develop an understanding of the advantages and disadvantages of the various representations/models.

Many **mathematical models** are listed in this benchmark. The indicator lists some of the mathematical models that could be used to teach a concept. Each indicator in this benchmark is linked to other indicators in other benchmarks; those indicators are identified in the parentheses. For example, *process models* are linked to 1.1.K3, 1.2.K6, 1.3.K1, … with 1.1.K3 referring to Standard 1 (Number and Computation), Benchmark 1 (Number Sense), and Knowledge Indicator 3. In addition, the indicator in the other benchmarks identifies, in parentheses, the Models' indicator. For example, (2.4.K1a) refers to Standard 2 (Algebra), Benchmark 4 (Models), and Knowledge Indicator 1a (process models).

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**Standard 3: Geometry** **FIFTH GRADE**

**Geometry – The student uses geometric concepts and procedures in a variety of situations.**

**Benchmark 1: Geometric Figures and Their Properties – The student recognizes geometric shapes and compares their properties in a variety of situations.**

| Fifth Grade Knowledge Base Indicators | Fifth Grade Application Indicators |
|---|---|
| The student…<br>1. recognizes and investigates properties of plane figures and solids using concrete objects, drawings, and appropriate technology (2.4.K1g).<br>2. recognizes and describes (2.4.K1g):<br>a. regular polygons having up to and including ten sides;<br>b. similar and congruent figures.<br>3. ▲ recognizes and describes the solids (cubes, rectangular prisms, cylinders, cones, spheres, triangular prisms, rectangular pyramids, triangular pyramids) using the terms faces, edges, and vertices (corners) (2.4.K1g).<br>4. determines if geometric shapes and real-world objects contain line(s) of symmetry and draws the line(s) of symmetry if the line(s) exist(s) (2.4.K1g).<br>5. recognizes, draws, and describes (2.4.K1g):<br>a. points, lines, line segments, and rays;<br>b. angles as right, obtuse, or acute.<br>6. recognizes and describes the difference between intersecting, parallel, and perpendicular lines (2.4.K1g).<br>7. identifies circumference, radius, and diameter of a circle (2.4.K1g). | The student…<br>1. solves real-world problems by applying the properties of (2.4.A1g):<br>a. ▲ plane figures (circles, squares, rectangles, triangles, ellipses, rhombi, parallelograms, hexagons, pentagons) and the line(s) of symmetry; e.g., twins are having a birthday party. The rectangular birthday cake is to be cut into two pieces of equal size and with the same shape. How would the cake be cut? Would the cut be a line of symmetry? How would you know?<br>b. solids (cubes, rectangular prisms, cylinders, cones, spheres, triangular prisms) emphasizing faces, edges, vertices, and bases; e.g., ribbon is to be glued on all of the edges of a cube. If one edge measures 5 inches, how much ribbon is needed? If a letter was placed on each face, how many letters would be needed?<br>c. intersecting, parallel, and perpendicular lines; e.g., relate these terms to maps of city streets, bus routes, or walking paths. Which street is parallel to the street where the school is located?<br>2. identifies the plane figures (circles, squares, rectangles, triangles, ellipses, rhombi, octagons, pentagons, hexagons, trapezoids, parallelograms) used to form a composite figure (2.4.A1g). |



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**Teacher Notes: Geometry** is the study of shapes, their properties, and their relationships to other shapes. Symbols and numbers are used to describe their properties and their relationships to other shapes. The fundamental concepts in geometry are point (no dimension), line (one-dimensional), plane (two-dimensional), and space (three-dimensional). Plane figures are referred to as two-dimensional and solids are referred to as three-dimensional.

From the Mathematics Dictionary and Handbook (Nichols Schwartz Publishing, 1999), **property** as a mathematical term means a characteristic (an attribute) of a number, geometric shape, mathematical operation, equation, or inequality. To give an example:

- Property of a number: 8 is divisible by 2.
- Property of a geometric shape: Each of the four sides of a square is of the same length.
- Property of an operation: Addition is commutative. For all numbers x and y, x + y = y + x.
- Property of an equation: For all numbers a, b, and c, if a = b, then a + c = b + c.
- Property of an inequality: For all numbers a, b, and c, if a > b, then a – c > b – c.

**Mathematical models** such as concrete objects, pictures, diagrams, number lines, unifix cubes, hundred charts, or base ten blocks are necessary for conceptual understanding and should be used to explain computational procedures. If a mathematical model can be used to represent the concept, the indicator in the Models benchmark is identified in the parentheses. For example, (2.4.K1a) refers to Standard 2 (Algebra), Benchmark 4 (Models), and Knowledge Indicator 1a (process models). Then, the indicator in the Models benchmark lists some of the mathematical models that could be used to teach the concept. In addition, each indicator in the Models benchmark is linked back to the other indicators. Those indicators are identified in the parentheses. For example, *process models* are linked to 1.1.K3, 1.2.K6, 1.3.K1, … with 1.1.K3 referring to Standard 1 (Number and Computation), Benchmark 1 (Number Sense), and Knowledge Indicator 3.

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**Geometry – The student uses geometric concepts and procedures in a variety of situations.**

**Benchmark 2: Measurement and Estimation – The student estimates, measures, and uses measurement formulas in a variety of situations.**

| Fifth Grade Knowledge Base Indicators | Fifth Grade Application Indicators |
|---|---|
| The student…<br>1. determines and uses whole number approximations (estimations) for length, width, weight, volume, temperature, time, perimeter, and area using standard and nonstandard units of measure (2.4.K1a) **($)**.<br>2. selects, explains the selection of, and uses measurement tools, units of measure, and degree of accuracy appropriate for a given situation to measure length, width, weight, volume, temperature, time, perimeter, and area using (2.4.K1a) **($)**:<br>a. customary units of measure to the nearest fourth and eighth inch,<br>b. metric units of measure to the nearest centimeter,<br>c. nonstandard units of measure to the nearest whole unit,<br>d. time including elapsed time.<br>3. states the number of feet and yards in a mile (2.4.K1a).<br>4. converts (2.4.K1a):<br>a. ▲ ■ within the customary system: inches and feet, feet and yards, inches and yards, cups and pints, pints and quarts, quarts and gallons, pounds and ounces;<br>b. within the metric system: centimeters and meters, meters and kilometers, milliliters and liters, grams and kilograms.<br>5. knows and uses perimeter and area formulas for squares and rectangles (2.4.K1g). | The student…<br>1. solves real-world problems by applying appropriate measurements and measurement formulas **($)**:<br>a. ▲ length to the nearest eighth of an inch or to the nearest centimeter (2.4.A1a), e.g., in science, we are studying butterflies. What is the wingspan of each of the butterflies studied to the nearest eighth of an inch?<br>b. temperature to the nearest degree (2.4.A1a), e.g., what would the temperature be if it was a good day for swimming?<br>c. ▲ weight to the nearest whole unit (pounds, grams, nonstandard units) (2.4.A1a), e.g., if you bought 200 bricks (each one weighed 5 pounds), how much would the whole load of bricks weigh?<br>d. time including elapsed time (2.4.A1a), e.g., Bob left Wichita at 10:45 a.m. He arrived in Kansas city at 1:30. How long did it take Bob to travel to Kansas City?<br>e. hours in a day, days in a week, and days and weeks in a year (2.4.A1a), e.g., John spent 59 days in New York City. How many weeks did he stay in New York City?<br>f. ▲ months in a year and minutes in an hour (2.4.A1a), e.g., it took Susan 180 minutes to complete her homework assignment. How many hours did she spend doing homework?<br>g. ▲ perimeter of squares, rectangles, and triangles (2.4.A1g), e.g., Mark wants to put up a fence up in his rectangle-shaped back yard. If his yard measures 18 feet by 36 feet, how many feet of fence will he need to go around his yard?<br>h. ▲ area of squares and rectangles (2.4.A1g), e.g., a farmer's square-shaped field is 35 feet on each side. How many square feet does he have to plow? |



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| | |
|---|---|
| | 2. solves real-world problems that involve conversions within the same measurement system: inches and feet, feet and yards, inches and yards, cups and pints, pints and quarts, quarts and gallons, centimeters and meters (2.4.A1a), e.g., you estimate that each person will chew 6 inches of bubblegum tape. If each package has 9 feet of bubblegum tape, how many people will get gum from that package?<br>3. estimates to check whether or not measurements or calculations for length, weight, temperature, time, perimeter, and area in real-world problems are reasonable (2.4.A1a) **($)**, e.g. is it reasonable to say you need 30 mL of water to fill a fish tank or would you need 30 L of water to fill the fish tank?<br>4. adjusts original measurement or estimation for length, width, weight, volume, temperature, time, and perimeter in real-world problems based on additional information (a frame of reference) (2.4.A1a,g) **($)**, e.g., after estimating the outside temperature to be 75º F, you find out that yesterday's high temperature at 3 p.m. was 62º. Should you adjust your estimate? Why or why not? |

**Teacher Notes:** The term *geometry* comes from two Greek words meaning "earth measure." **Measurement** provides the tools required to apply geometric concepts in the real-world. **Estimation in measurement** is defined as making guesses as to the exact measurement of an object without using any type of measurement tool. Estimation helps students develop a relationship between the different sizes of units of measure. It helps students develop basic properties of measurement and it gives students a tool to determine whether a given measurement is reasonable.

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**Geometry – The student uses geometric concepts and procedures in a variety of situations.**

**Benchmark 3: Transformational Geometry – The student recognizes and performs transformations on geometric shapes including the use of concrete objects in a variety of situations.**

| Fifth Grade Knowledge Base Indicators | Fifth Grade Application Indicators |
|---|---|
| The student…<br>1. recognizes and performs through two transformations (reflection, rotation, translation) on a two-dimensional figure (2.4.K1a).<br>2. recognizes when an object is reduced or enlarged (2.4.K1a).<br>3. ▲ recognizes three-dimensional figures (rectangular prisms, cylinders, cones, spheres, triangular prisms, rectangular pyramids) from various perspectives (top, bottom, side, corners) (2.4.K1g). | The student…<br>1. describes and draws a two-dimensional figure after performing one transformation (reflection, rotation, translation) (2.4.A1a).<br>2. makes scale drawings of two-dimensional figures using a simple scale and grid paper (2.4.A1h), e.g., using the scale 1 cm = 3 m, the student makes a scale drawing of the classroom. |

**Teacher Notes: Transformational geometry** is another way to investigate geometric figures by moving every point in a plane figure to a new location. To help students form images of shapes through different transformations, students can use concrete objects, figures drawn on graph paper, mirrors or other reflective surfaces, or appropriate technology.

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**Geometry – The student uses geometric concepts and procedures in a variety of situations.**

**Benchmark 4: Geometry From An Algebraic Perspective – The student relates geometric concepts to a number line and the first quadrant of a coordinate plane in a variety of situations.**

| Fifth Grade Knowledge Base Indicators | Fifth Grade Application Indicators |
|---|---|
| The student…<br>1. locates and plots points on a number line (vertical/horizontal) using integers (positive and negative whole numbers) (2.4.K1a).<br>2. explains mathematical relationships between whole numbers, fractions, and decimals and where they appear on a number line (2.4.K1a).<br>3. identifies and plots points as ordered pairs in the first quadrant of a coordinate plane (coordinate grid) (2.4.K1a).<br>4. organizes whole number data using a T-table and plots the ordered pairs in the first quadrant of a coordinate plane (coordinate grid) (2.4.K1a,f). | The student…<br>1. solves real-world problems that involve distance and location using coordinate planes (coordinate grids) and map grids with positive whole number and letter coordinates (2.4.A1a), e.g., identifying locations and giving and following directions to move from one location to another.<br>2. solves real-world problems by plotting ordered pairs in the first quadrant of a coordinate plane (coordinate grid) (2.4.A1a) **($)** , e.g., graph daily the cumulative number of recess minutes in a 5-day school week. |



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**Teacher Notes:** A **number line** (a mathematical model) is a diagram that represents numbers with equal distances marked off as points on a line, and is an example of one-to-one correspondence (a relation). A number line can be used as a visual representation of numbers and operations. In addition, a number line used horizontally and vertically is a precursor to the coordinate plane; and the distance between two numbers on a number line is a precursor to absolute value.

A **coordinate plane** (coordinate grid) consists of a horizontal number line called the *x*-axis and a vertical number line called the *y*-axis. These two lines intersect at a point called the origin. The x-axis and the y-axis divide the plane into four sections called quadrants. Any point on the coordinate plane can be named with two numbers called coordinates. The first number is the x-coordinate. The second number is the y-coordinate. Since the pair is always named in order (first x, then y), it is called an ordered pair.

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**Standard 4: Data** **FIFTH GRADE**

**Data – The student uses concepts and procedures of data analysis in a variety of situations.**

**Benchmark 1: Probability – The student applies the concepts of probability to draw conclusions and to make predictions and decisions including the use of concrete objects in a variety of situations.**

| Fifth Grade Knowledge Base Indicators | Fifth Grade Application Indicators |
|---|---|
| The student…<br>1. recognizes that all probabilities range from zero (impossible) through one (certain) (2.4.K1i) **($).**<br>2. lists all possible outcomes of a simple event in an experiment or simulation in an organized manner including the use of concrete objects (2.4.K1g-j).<br>3. recognizes a simple event in an experiment or simulation where the probabilities of all outcomes are equal (2.4.K1i).<br>4. represents the probability of a simple event in an experiment or simulation using fractions (2.4.K1c). | The student...<br>1. ■ conducts an experiment or simulation with a simple event including the use of concrete materials; records the results in a chart, table, or graph; uses the results to draw conclusions about the event; and makes predictions about future events (2.4.A1j-k).<br>2. uses the results from a completed experiment or simulation of a simple event to make predictions in a variety of real-world situations (2.4.A1j-k), e.g., the manufacturer of Crunchy Flakes puts a prize in 20 out of every 100 boxes. What is the probability that a shopper will find a prize in a box of Crunchy Flakes, if they purchase 10 boxes?<br>3. compares what should happen (theoretical probability/expected results) with what did happen (empirical probability/experimental results) in an experiment or simulation with a simple event (2.4.A1j). |



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**Teacher Notes:** Ideas from **probability** reinforce concepts in the other Standards, especially Number and Computation and Geometry. Students need to develop an intuitive concept of chance – whether or not something is unlikely or likely to happen. Probability experiences should be addressed through the use of concrete objects, coins, and geometric models (spinners, number cubes, or dartboards). Probabilities are ratios, expressed as fractions, decimals, or percents, determined by considering results or outcomes of experiments. Some examples of uses of probability in every day life include: There is a 50% chance of rain today. What is the probability that the team will win every game?

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**Data – The student uses concepts and procedures of data analysis in a variety of situations.**

**Benchmark 2: Statistics – The student collects, organizes, displays, explains, and interprets numerical (rational numbers) and non-numerical data sets in a variety of situations with a special emphasis on measures of central tendency.**

| Fifth Grade Knowledge Base Indicators | Fifth Grade Application Indicators |
|---|---|
| The student…<br>1. organizes, displays, and reads numerical (quantitative) and non-numerical (qualitative) data in a clear, organized, and accurate manner including a title, labels, categories, and whole number and decimal intervals using these **data displays** (2.4.K1j) **($)**:<br>a. graphs using concrete objects,<br>b. pictographs,<br>c. frequency tables,<br>d. bar and line graphs,<br>e. Venn diagrams and other pictorial displays, e.g., glyphs,<br>f. line plots,<br>g. charts and tables,<br>h. circle graphs,<br>i. single stem-and-leaf plots.<br>2. collects data using different techniques (observations, polls, tallying, interviews, surveys, or random sampling) and explains the results (2.4.K1j) **($).**<br>3. ▲ identifies, explains, and calculates or finds these statistical measures of a whole number data set of up to twenty whole number data points from 0 through 1,000 (2.4.K1a) **($)**:<br>a. minimum and maximum values,<br>b. range,<br>c. mode (no-, uni-, bi-),<br>d. median (including answers expressed as a decimal or a fraction without reducing to simplest form),<br>e. mean (including answers expressed as a decimal or a fraction without reducing to simplest form). | The student…<br>1. ▲ interprets and uses data to make reasonable inferences, predictions, and decisions, and to develop convincing arguments from these data displays (2.4.A1k) **($)**:<br>a. graphs using concrete materials,<br>b. pictographs,<br>c. frequency tables,<br>d. bar and line graphs,<br>e. Venn diagrams and other pictorial displays,<br>f. line plots,<br>g. charts and tables,<br>h. circle graphs.<br>2. uses these statistical measures of a whole number data set to make reasonable inferences and predictions, answer questions, and make decisions (2.4.A1a) **($)**:<br>a. minimum and maximum values,<br>b. range,<br>c. mode,<br>d. median,<br>e. mean when the data set has a whole number mean.<br>3. recognizes that the same data set can be displayed in various formats and discusses why a particular format may be more appropriate than another (2.4.A1k) **($).**<br>4. recognizes and explains the effects of scale and interval changes on graphs of whole number data sets (2.4.A1k). |



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**Teacher Notes: Graphs (data displays)** are pictorial representations of mathematical relationships, are used to tell a story, and are an important part of statistics. When a graph is made, the axes and the scale (numbers running along a side of the graph) are chosen for a reason. The difference between numbers from one grid line to another is the **interval.** The interval will depend on the lowest and highest values in the data set. Emphasizing the importance of using equal-sized pictures or intervals is critical to ensuring that the data display is accurate.

Graphs take many forms:
– bar graphs and pictographs compare discrete data,
– frequency tables show how many times a certain piece of data occurs,
– circle graphs (pie charts) model parts of a whole,
– line graphs show change over time,
– Venn diagrams show relationships between sets of objects,
– line plots show frequency of data on a number line, and
– single stem-and-leaf plots (closely related to line plots except that the number line is usually vertical and digits are used rather than x's) show frequency distribution by arranging numbers (stems) on the left side of a vertical line with numbers (leaves) on the right side.

An important aspect of data is its *center.* The **measures of central tendency** (averages) of a data set are mean, median, and mode. Conceptual understanding of mean, median, and mode is developed through the use of concrete objects that represent the data values.

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