Standard 1: 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 whole numbers, fractions, and money using concrete objects in a variety of situations.

Kindergarten Knowledge Base Indicators	Kindergarten Application Indicators
The student... 1. establishes a one-to-one correspondence with whole numbers from 0 through 20 using concrete objects and identifies, states, and writes the appropriate cardinal number (2.4.K1a) **($)**. 2. compares and orders whole numbers from 0 through 20 using concrete objects (2.4.K1a) **($)**. 3. recognizes a whole, a half, and parts of a whole using concrete objects (2.4.K1a,c) **($)**, e.g., half a pizza, part of a cookie, or the whole school. 4. identifies positions as first and last (2.4.K1a). 5. identifies pennies and dimes and states the value of the coins using money models (2.4.K1d) **($)**.	The student... 1. solves real-world problems using equivalent representations and concrete objects to compare and order whole numbers from 0 through 10 (2.4.A1a) **($)**.

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THESE STANDARDS ARE ALIGNED ONLY TO THE ASSESSMENTS THAT WILL BEGIN DURING THE 2005-06 SCHOOL YEAR.

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)

Mathematical models such as concrete objects, pictures, number lines, or unifix cubes 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.

Standard 1: 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 whole numbers with a special emphasis on place value in a variety of situations.

Kindergarten Knowledge Base Indicators	Kindergarten Application Indicators
The student... 1. reads and writes whole numbers from 0 through 20 in numerical form **($)**. 2. represents whole numbers from 0 through 20 using place value models (2.4.K1b) **($)**, e.g., ten frames, unifix cubes, straws bundled in 10s, or base ten blocks. 3. counts (2.4.K1a) **($)**: a. whole numbers from 0 through 20, b. whole numbers from 10 to 0 backwards, c. subsets of whole numbers from 0 through 20. 4. groups objects by 5s and by 10s (2.4.K1a). 5. **uses** the **concept** of the zero property of addition (additive identity) with whole numbers from 0 through 20 and demonstrates its meaning using concrete objects (2.4.K1a) **($)**, e.g., 4 apples and no (zero) other apples are 4 apples.	The student... 1. solves real-world problems with whole numbers from 0 through 20 using place value models (2.4.A1b) **($)**, e.g., group the class into tens, count by tens; then continue counting by ones to find the total. 2. counts forwards and backwards from a specific whole number using a number line from 0 through 10 (2.4.A1a).

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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, number lines, or unifix cubes 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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THESE STANDARDS ARE ALIGNED ONLY TO THE ASSESSMENTS THAT WILL BEGIN DURING THE 2005-06 SCHOOL YEAR.

Standard 1: 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 in a variety of situations.

Kindergarten Knowledge Base Indicators	Kindergarten Application Indicators
The student... 1. determines if a group of 20 concrete objects or less has more, less, or about the same number of concrete objects as a second set of the same kind of objects (2.4.K1a).	The student... 1. compares two randomly arranged groups of 10 concrete objects or less and states the comparison using the terms: more, less, about the same (2.4.A1a).

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, 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. (Principles and Standards for School Mathematics, NCTM, 2000)

In order for students to become more familiar with estimation, **estimation** should be introduced with examples where rounded or estimated numbers are used emphasizing 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.

Mathematical models such as concrete objects, pictures, number lines, or unifix cubes 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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Standard 1: 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 using concrete objects in a variety of situations.

Kindergarten Knowledge Base Indicators	Kindergarten Application Indicators
The student... 1. adds and subtracts using whole numbers from 0 through 10 and various mathematical models (2.4.K1a) **($)**, e.g., concrete objects, number lines, or unifix cubes. 2. uses repeated addition (multiplication) with whole numbers to find the sum when given the number of groups (three or less) and given the same number of **concrete objects** in each group (five or less) (2.4.K1a), e.g., two nests with three eggs in each nest means 3 + 3 = 6 or 2 groups of 3 makes 6. 3. uses repeated subtraction (division) with whole numbers when given the total number of **concrete objects** in each group to find the number of groups (2.4.K1a), e.g., there are 9 pencils. If each student gets 2 pencils, how many students get pencils? 9 – 2 – 2 – 2 – 2 or 9 minus 2 four times means four students get 2 pencils each and there is 1 pencil left over. *or* There are eight cookies to be shared equally among four people, how many cookies will each person receive?	The student... 1. solves one-step real-world addition or subtraction problems with whole numbers from 0 through 10 using concrete objects in various groupings and explains reasoning (2.4.A1a) **($)**, e.g., seven apples are in a basket and five students each take an apple; how many apples are left in the basket?

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Teacher Notes: The definition of **computation** is finding the standard representation for a number. For example, 6 + 6, 4 x 3, 17 – 5, 24 ÷ 2 are all representations for the standard representation of 12.

Mathematical models such as concrete objects, pictures, number lines, or unifix cubes 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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THESE STANDARDS ARE ALIGNED ONLY TO THE ASSESSMENTS THAT WILL BEGIN DURING THE 2005-06 SCHOOL YEAR.

Standard 2: 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 using concrete objects in a variety of situations.

Kindergarten Knowledge Base Indicators	Kindergarten Application Indicators
The student... 1. uses concrete objects, drawings, and other representations to work with **types** of patterns (2.4.K1a): a. repeating patterns, e.g., an AB pattern is like red-blue, red-blue, …; an ABC pattern is like dog-horse-pig, dog-horse-pig, …; or an AAB pattern is like Δ-Δ-O, Δ-Δ-O, …; b. growing (extending) patterns, e.g., 5, 6, 7, … is an example of a pattern that adds one to the previous number to continue the pattern. 2. uses these **attributes** to generate patterns: a. whole numbers (2.4.K1a), e.g., 2, 4, 6, …; b. geometric shapes with one attribute change (2.4.K1e), e.g., Δ, O, Δ, O, Δ, O, …; c. things related to daily life (2.4.K1a), e.g., breakfast, lunch, and dinner. 3. identifies and continues a pattern presented in various formats including numeric (list or table), visual (picture, table, or graph), verbal (oral description), and kinesthetic (action) (2.4.K1a) **($)**. 4. generates (2.4.K1a): a. repeating patterns for the AB pattern, the ABC pattern, and the AAB pattern; b. growing (extending) patterns that add 1, 2, or 10 to continue the pattern. 5. classifies and sorts concrete objects by similar attributes (2.4.K1a) **($)**.	The student... 1. generalizes the following patterns using pictorial, and/or oral descriptions including the use of concrete objects: a. repeating patterns for the AB pattern, the ABC pattern, and the AAB pattern (2.4.A1a) **($)**; b. patterns using geometric shapes with one attribute change (2.4.A1c). 2. recognizes multiple representations of the AB pattern (2.4.A1a), e.g., big- little, big-little, big-little, ... and 1-2, 1-2, 1-2, ..., or AB, AB, AB, ... 3. uses concrete objects to model a whole number pattern (2.4.A1a): a. counting by ones: ☸ ,☸☸, ☸☸☸, …; b. counting by twos: ♦♦, ♦♦ ♦♦ ♦♦, ♦♦ ♦♦, …; c. counting by tens: ■■■■■■■■■■, ■■■■■■■■■■ ■■■■■■■■■■ ■■■■■■■■■■, ■■■■■■■■■■ ■■■■■■■■■■, …

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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, whole numbers, measurement, geometry, probability, and functions. Working with patterns provides opportunities for students to recognize, describe, extend, develop, and explain.

Mathematical models such as concrete objects, pictures, number lines, or unifix cubes 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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Standard 2: Algebra – The student uses algebraic concepts and procedures in a variety of situations.

Benchmark 2: Variables, Equations, and Inequalities – The student solves addition equations using concrete objects in a variety of situations.

Kindergarten Knowledge Base Indicators	Kindergarten Application Indicators
The student... 1. finds the unknown sum using the basic facts with sums through 10 using concrete objects and pictures (2.4.K1a) **($)**, e.g., 5 marbles + 5 marbles = ∀.	The student... 1. describes real-world problems using concrete objects and pictures and the basic facts with sums through 10 (2.4.A1a) **($)**, e.g., given some marbles, Sue says: There are 3 red marbles and 3 blue marbles. Altogether, there are 6 marbles.

Teacher Notes: Understanding the **concept of variable** is fundamental to algebra. In the early grades, 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.

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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Standard 2: Algebra – The student uses algebraic concepts and procedures in a variety of situations.

Benchmark 3: Functions – The student recognizes and describes whole number relationships using concrete objects in a variety of situations.

Kindergarten Knowledge Base Indicators	Kindergarten Application Indicators
The student... 1. locates whole numbers from 0 through 20 on a number line (2.4.K1a).	The student... 1. represents and describes mathematical relationships for whole numbers from 0 through 10 using concrete objects, pictures, and oral descriptions (2.4.A1a) **($)**.

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. A number line (a mathematical model) is a diagram that represents numbers with equal distances marked off as points on a line, 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.

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.

Standard 2: Algebra – The student uses algebraic concepts and procedures in a variety of situations.

Benchmark 4: Models – The student uses mathematical models including concrete objects to represent, show, and communicate mathematical relationships in a variety of situations.

Kindergarten Knowledge Base Indicators	Kindergarten Application Indicators
The student... 1. knows, explains, and uses mathematical models to represent mathematical concepts, procedures, and relationships. Mathematical models include: a. process models (concrete objects, pictures, number lines, unifix cubes, measurement tools, or calendars) to model computational procedures and mathematical relationships, to compare and order numerical quantities, and to represent fractional parts (1.1.K1-4, 1.2.K3-5, 1.3.K1, 1.4.K1-3, 2.1.K1, 2.1.K2a, 2.1.K2c, 2.1.K3-5 2.2.K1, 2.3.K1, 3.1.K2, 3.2.K1-3, 3.3.K1-2, 3.4.K1-2) **($)**; b. place value models (ten frames, unifix cubes, bundles of straws, or base ten blocks) to represent numerical quantities (1.2.K2) **($)**; c. fraction models (fraction strips or pattern blocks) to represent numerical quantities (1.1.K3) **($)**; d. money models (base ten blocks or coins) to represent numerical quantities (1.1.K5) **($)**; e. two-dimensional geometric models (geoboards, dot paper, or attribute blocks), three-dimensional geometric models (solids), and real-world objects to compare size and to model attributes of geometric shapes (2.1.K1a, 3.1.K3); f. two-dimensional geometric models (spinners), three-dimensional geometric models (number cubes), and concrete objects to model probability (4.1.K1-2) **($)**; g. graphs using concrete objects, pictographs, and frequency tables to organize and display data (4.2.K1-3) **($)**. 2. uses concrete objects, pictures, drawings, diagrams, or dramatizations to show the relationship between two or more things **($)**.	The student... 1. recognizes that various mathematical models can be used to represent the same problem situation. Mathematical models include: a. process models (concrete objects, pictures, number lines, unifix cubes, measurement tools, or calendars) to model computational procedures and mathematical relationships, to compare and order numerical quantities, and to model problem situations (1.1.A1, 1.2.A2, 1.3.A1, 1.4.A1, 2.1.A1a, 2.1.A2-3, 2.2.A1, 2.3.A1, 3.1.A3, 3.2.A1-2, 3.3.A1-2, 3.4.A1) **($)**; b. place value models (ten frames, unifix cubes, bundles of straws, or base ten blocks) to represent numerical quantities (1.2.A1) **($)**; c. two-dimensional geometric models (geoboards, dot paper, or attribute blocks), three-dimensional geometric models (solids), and real-world objects to compare size and to model attributes of geometric shapes (3.1.A1-2); d. two-dimensional geometric models (spinners), three-dimensional geometric models (number cubes), and concrete objects to model probability (4.1.A1); e. graphs using concrete objects, pictographs, and frequency tables to organize and display data (4.1.A1, 4.2.A1) **($)**.

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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. For example, comparing the number of boys and girls in the classroom can be represented by lining them up in two different lines. The same situation also can be represented by pictures of the children (pictograph), a bar graph, or by using two different colors of the same manipulative (unifix cubes or color tiles).

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).

For assessment purposes, the mathematical modeling process appropriate to the indicator may be included as part of the item being assessed.

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.

Standard 3: 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 their attributes using concrete objects in a variety of situations.

Kindergarten Knowledge Base Indicators	Kindergarten Application Indicators
The student... 1. recognizes circles, squares, rectangles, triangles, and ellipses (ovals) (plane figures/ two-dimensional figures) (2.4.K1e). 2. recognizes and investigates attributes of circles, squares, rectangles, triangles, and ellipses using concrete objects, drawings, and/or appropriate technology (2.4.K1a,e). 3. sorts cubes, rectangular prisms, cylinders, cones, and spheres (solids/three-dimensional figures) by their attributes using concrete objects (2.4.K1e).	The student... 1. demonstrates how several plane figures (circles, squares, rectangles, triangles, ellipses) can be combined to make a new shape (2.4.A1c). 2. sorts by one attribute real-world geometric shapes that are representations of the solids (cubes, rectangular prisms, cylinders, cones, spheres) (2.4.A1c), e.g., boxes can be sorted as rectangular prisms, cans can be sorted as cylinders, some ice cream cones can be sorted as cones, and some balls can be sorted as spheres. 3. recognizes (2.4.A1a): a. circles, squares, rectangles, triangles, and ellipses (plane figures) within a picture; b. cubes, rectangular prisms, cylinders, cones, and spheres (solids) within a picture.

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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 $a - c > b - c$.

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Standard 3: Geometry – The student uses geometric concepts and procedures in a variety of situations.

Benchmark 2: Measurement and Estimation – The student estimates and measures using standard and nonstandard units of measure with concrete objects in a variety of situations.

Kindergarten Knowledge Base Indicators	Kindergarten Application Indicators
The student... 1. uses whole number approximations (estimations) for length using nonstandard units of measure (2.4.K1a) **($)**, e.g., the classroom door is about two kindergartners high or this paper is about two pencils long. 2. compares two measurements using these attributes (2.4.K1a) **($)**: a. longer, shorter (length); b. taller, shorter (height); c. heavier, lighter (weight). d. hotter, colder (temperature). 3. reads and tells time at the hour using analog and digital clocks (2.4.K1a).	The student... 1. compares and orders concrete objects by length or weight (2.4.A1a) **($)**. 2. locates and names concrete objects that are about the same length or weight as a given concrete object (2.4.A1a) **($)**.

Teacher Notes: The term *geometry* comes from two Greek words meaning "earth measure." The **process of learning to measure** at the early grades focuses on identifying what property (length, weight) is to be measured and to make comparisons. **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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Standard 3: Geometry – The student uses geometric concepts and procedures in a variety of situations.

Benchmark 3: Transformational Geometry – The student develops the foundation for spatial sense using concrete objects in a variety of situations.

Kindergarten Knowledge Base Indicators	Kindergarten Application Indicators
The student... 1. describes the spatial relationship between two concrete objects using appropriate vocabulary (2.4.K1a), e.g., behind, above, below, on, or under. 2. identifies two like objects or shapes from a set of four objects or shapes (2.4.K1a).	The student... 1. shows two concrete objects or shapes are congruent by physically fitting one object or shape on top of the other (2.4.A1a). 2. follows directions to move concrete objects from one location to another using appropriate vocabulary (2.4.A1a), e.g., up, down, behind, or above.

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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Standard 3: Geometry – The student uses geometric concepts and procedures in a variety of situations.

Benchmark 4: Geometry From An Algebraic Perspective – The student identifies one or more points on a number line in a variety of situations.

Kindergarten Knowledge Base Indicators	Kindergarten Application Indicators
The student... 1. locates and plots whole numbers from 0 through 20 on a horizontal number line (2.4.K1a). 2. counts forwards and backwards from a given whole number from 0 through 10 on a number line (2.4.K1a).	The student... 1. solves real-world problems involving counting whole numbers from 0 through 20 using a number line (2.4.A1a) **($)**, e.g., if Bill has 8 pieces of candy and his dad gives him 4 more pieces, how many pieces of candy does he have now?

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.

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Standard 4: 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 using concrete objects in a variety of situations.

Kindergarten Knowledge Base Indicators	Kindergarten Application Indicators
The student... 1. recognizes whether an event is impossible or possible (2.4.K1f) **($)**, e.g., the possibility of a person having ten heads is impossible, while the possibility of a person having red hair is possible. 2. recognizes and states whether a simple event in an experiment or simulation including the use of concrete objects can have more than one outcome (2.4.K1a,f).	The student... 1. conducts an experiment or simulation with a simple event and records the results in a graph using concrete objects or frequency tables (tally marks) (2.4.A1a,d-e).

Teacher Notes: Ideas from **probability** reinforce concepts in the other Standards, especially Number and Computation and Geometry. In the early grades, students need to develop an intuitive concept of chance – whether or not something is unlikely or likely to happen. Beginning probability experiences should be addressed through the use of concrete objects, coins, and geometric models (spinners or number cubes).

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Standard 4: Data – The student uses concepts and procedures of data analysis in a variety of situations.

Benchmark 2: Statistics – The student collects, records, and explains numerical (whole numbers) and non-numerical data sets including the use of concrete objects in a variety of situations.

Kindergarten Knowledge Base Indicators	Kindergarten Application Indicators
The student... 1. records numerical (quantitative) and non-numerical (qualitative) data including concrete objects, graphs, and tables using these **data displays** (2.4.K1a,g) **($)**: a. graphs using concrete objects, b. pictographs with a whole symbol or picture representing one (no partial symbols or pictures), c. frequency tables (tally marks). 2. collects data related to familiar everyday experiences by counting and tallying (2.4.K1a,g) **($)**. 3. determines the mode (most) after sorting by one attribute (2.4.K1a,g) **($)**, e.g., color, shape, or size.	The student... 1. communicates the results of data collection from graphs using concrete objects and frequency tables (2.4.A1e) **($)**, e.g., there are sixteen kindergartners. Using themselves as concrete objects, the six students wearing tennis shoes line up in a row. The ten students wearing sandals line up in a row. The kindergartners become the bar graph. Then someone says: There are less kids wearing tennis shoes than kids wearing sandals.

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Teacher Notes: Graphs (data displays) are pictorial representations of mathematical relationships and are used to tell a story. Emphasizing the importance of using equal-sized pictures or intervals is critical to ensuring that the data display is accurate. Graphs take many forms: pictographs and graphs using concrete objects compare discrete data, frequency tables show how many times a certain piece of data occurs using tally marks to record the data, circle graphs (pie charts) model parts of a whole, and line graphs show change over time.

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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