ELEMENTARY MATHEMATICS CURRICULUM STANDARDS K-8

Catholic Schools Office
Diocese of Phoenix
November 2013

ELEMENTARY MATHEMATICS CURRICULUM STANDARDS K-8

Diocese of Phoenix

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The Catholic Schools office of the Diocese of Phoenix expresses gratitude to the Elementary Mathematics Curriculum Committee for its work in analyzing, revising, and updating the Mathematics Standards for the Catholic schools of the Diocese of Phoenix.

Mathematics is recognized as a great example of God's gift of the human mind and its capacity in understanding creation for the betterment of all mankind.

Mathematics is basic to our daily lives. Mathematical truths and methods can be used to solve problems in the real world. It provides tools for research, enables the analysis of economic trends to make informed decisions in health care, weather forecasting, space exploration, and foreign policies, to name a few, along with the vast myriad of ordinary day-to-day life decisions.

Teachers are expected to be creative as they teach their students how to correctly use new mathematical tools, communication media, and technology to solve cross-curricular problems and integration.

It is our hope that these standards assist our schools and teachers in developing in our students an interest, curiosity, and mastery in Mathematics as they recognize the integration of Catholic values that involves beliefs, communications, and technology.

Sincerely

MaryBeth Mueller

MaryBeth Mueller
Superintendent of Catholic Schools
Executive Director of the Division of Education and Evangelization

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TABLE OF CONTENTS

ELEMENTARY MATHEMATICS CURRICULUM STANDARDS

PHILOSOPHY

The Elementary Mathematics Curriculum Standards outline the essential components of the Mathematics curriculum for each grade level (K-8) for the Catholic Schools of the Diocese of Phoenix. The overall academic, personal, spiritual, and physical development of the child is an integral part of these standards necessary for functioning and contributing to society in the 21st Century. Mathematics is recognized as a great example of God's gift of the human mind and its capacity in understanding creation for the betterment of all mankind. St. Thomas Aquinas said, *"[t]he use of reason is one way we reflect that we are made in God's image."* As Catholic educators we realize reason is not complete without faith and faith is not complete without reason.

Catholic educators continually reflect on current practices within their schools that connect mathematics curriculum with their Catholic identity. Our Catholic school teachers use the Seven Principles of Catholic Social Teaching to ensure mathematics instruction reflects our Catholic Identity.

Seven Principles of Catholic Social Teaching:45

1. The Right to Life and Dignity of the Human Person
2. Call to Family, Community and Participation
3. Rights and Responsibilities
4. Option for the Poor and Vulnerable
5. Dignity of Works and Rights of Workers
6. Solidarity
7. Caring for God's Creation

As Catholic educators in today's global society, we are challenged to fully understand and effectively model mathematical concepts to assure a peaceful, productive, and more equitable world. Our daily lives are increasingly mathematical and technological. As we weave Catholic teachings into real-life situations, students can give meaning to gospel values as they apply the use of quantitative and reasoning skills to solve problems. All students are given the opportunity to learn and understand mathematical concepts and are expected to demonstrate mathematical practices. Learning experiences must include critical areas of focus and teaching strategies must be varied, meaningful and engaging to students.

Students are expected to effectively communicate using new tools, media and technology to solve cross-curricular mathematical problems. Fluency of computational skills, proper mathematical terminology, and perseverance in problem solving should be accomplished at the appropriate grade level. The students are led to raise questions, to think critically and creatively, and to construct viable arguments. They should attend to precision with mathematical skills, concepts, and technology. It is through communication and collaboration that we will advance our students towards a deeper appreciation and knowledge of mathematics.

GOALS

The goals for the Elementary Mathematics Curriculum Standards are that all students will:

- recognize that mathematics integrates Catholic values that involves beliefs, communications, and technology.
- use Catholic social teachings in problem solving.
- reason abstractly and quantitatively while making use of structure to appreciate the beauty of God's creation through mathematics in everyday life.
- develop an understanding of the mathematical skills and the ability to make sense of problems and persevere in solving them.
- remain curious and expand their ability to construct viable arguments and critique the reasoning of others in order to deepen an appreciation and knowledge of mathematics.
- model and apply with precision specific mathematical skills and use appropriate tools strategically.

Academic Excellence:

The United States Conference of Catholic Bishops affirms the message of the Congregation on Catholic Education that intellectual development of the person and growth as a Christian go forward hand in hand. Rooted in the mission of the Church, the Catholic school brings faith, culture and life together in harmony. In 2005, the bishops noted that "young people of the third millennium must be a source of energy and leadership in our church and our nation. And, therefore, we must provide young people with an academically rigorous and doctrinally sound program of education" *(Renewing Our Commitment to Catholic Elementary and Secondary School is in the Third Millennium, 2005).*

The essential elements of "an academically rigorous and doctrinally sound program" mandate curricular experiences-including co-curricular and extra-curricular activities-which are rigorous, relevant, research-based, and infused with Catholic faith and traditions. The following essential elements provide a framework for the design, implementation, and assessment of authentic academic excellence in Catholic school education from pre-kindergarten through secondary school.

Standard 7: An excellent Catholic school has a clearly articulated, rigorous curriculum aligned with relevant standards, 21st century skills, and Gospel values, implemented through effective instruction. ***BENCHMARKS:***

7.1 The curriculum adheres to appropriate, delineated standards, and is vertically aligned to ensure that every student successfully completes a rigorous and coherent sequence of academic courses based on the standards and rooted in Catholic values.

7.2 Standards are adopted across the curriculum, and include integration of the religious, spiritual, moral, and ethical dimensions of learning in all subjects.

7.3 Curriculum and instruction for the 21st century learning provide students with the knowledge, understanding and skills to become creative, reflective, literate, critical, and moral evaluators, problem solvers, decision makers, and socially responsible global citizens.

7.4 Curriculum and instruction for 21st century learning prepares students to become expert users of technology, able to create, publish, and critique digital products that reflect their understanding of the content and their technological skills.

7.5 Classroom instruction is designed to intentionally address the effective dimensions of learning, such as intellectual and social dispositions, relationship building, and habits of mind.

7.6 Classroom instruction is designed to engage and motivate all students, addressing the diverse needs and capabilities of each student, and accommodating students with special needs as fully as possible.

7.7 Faculty collaborate in professional learning communities to develop, implement and continuously improve the effectiveness of the curriculum and instruction to result in high levels of student achievement.

7.8 The faculty and professional support staff meet (arch) diocesan, state, and/or national requirements for academic preparation and licensing to ensure their capacity to provide effective curriculum and instruction.

7.9 Faculty and professional support staff demonstrate and continuously improve knowledge and skills necessary for effective instruction, cultural sensitivity, and modeling of Gospel values.

7.10 Faculty and staff engage in high quality professional development, including religious formation, and are accountable for implementation that supports student learning.

Standard 8: An excellent Catholic school uses school-wide assessment methods and practices to document student learning and program effectiveness, to make student performances transparent, and to inform the continuous review of curriculum and the improvement of instructional practices. ***BENCHMARKS:***

8.1 School-wide and student data generated by a variety of tools are used to monitor, review, and evaluate the curriculum and co-curricular programs; to plan for continued and sustained student growth; and to monitor and assess faculty performance.

8.2 School-wide and aggregated student data are normed to appropriate populations and are shared with all stakeholders.

8.3 Faculty use a variety of curriculum-based assessments aligned with learning outcomes and instructional practices to access student learning, including formative, summative, authentic performance, and student self-assessment.

8.4 Criteria used to evaluate student work and the reporting mechanisms are valid, consistent, transparent, and justly administered.

8.5 Faculty collaborate in professional learning communities to monitor individual and class-wide student learning through methods such as common assessments and rubrics.

Standard 9 An excellent Catholic school provides programs and services aligned with the mission to enrich the academic program and support the development of student and family life. ***BENCHMARKS:***

9.1 School-wide programs for parents/guardians provide opportunities for parents/guardians to partner with school leaders, faculty, and other parents/guardians to enhance the educational experiences for the school community.

9.2 Guidance services, wellness programs, behavior management programs, and ancillary services provide the necessary support for students to successfully complete the school program.

9.3 Co-curricular and extra-curricular activities provide opportunities outside the classroom for students to further identify and develop their gifts and talents and to enhance their creative, aesthetic, social/emotional, physical, and spiritual capabilities.

Code:

The 2008 Diocesan K-8 Mathematics Guidelines are used in the alignment process:

DG4-S1-C1-DPO9

Diocesan Guidelines

Grade 4

Strand 1

Concept 1

Diocesan Performance Objective 9

All Diocesan Guidelines are bold and italics

MATHEMATICS

Diocese of Phoenix Catholic Schools Academic Content Standards

Kindergarten

Aligned and Adapted by Diocese of Phoenix Catholic Schools
Updated November 2013

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Kindergarten

Grade K Overview

Counting and Cardinality (CC)
- Know number names and the count sequence.
- Count to tell the number of objects.
- Compare numbers.

Operations and Algebraic Thinking (OA)
- Understand addition as putting together and adding to, and understand subtraction as taking apart and taking from.

Number and Operations in Base Ten (NBT)
- Work with numbers 11–19 to gain foundations for place value.

Measurement and Data (MD)
- Describe and compare measurable attributes.
- Classify objects and count the number of objects in categories.

Geometry (G)
- Identify and describe shapes.
- Analyze, compare, create, and compose shapes.

Performance Objectives
1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Kindergarten

Introduction:

In Kindergarten, instructional time should focus on two critical areas: (1) representing, relating, and operating on whole numbers, initially with sets of objects; (2) describing shapes and space. More learning time in Kindergarten should be devoted to number than to other topics.

(1) Students use numbers, including written numerals, to represent quantities and to solve quantitative problems, such as counting objects in a set; counting out a given number of objects; comparing sets or numerals; and modeling simple joining and separating situations with sets of objects, or eventually with equations such as 5 + 2 = 7 and 7 – 2 = 5. (Kindergarten students should see addition and subtraction equations, and student writing of equations in kindergarten is encouraged, but it is not required.) Students choose, combine, and apply effective strategies for answering quantitative questions, including quickly recognizing the cardinalities of small sets of objects, counting and producing sets of given sizes, counting the number of objects in combined sets, or counting the number of objects that remain in a set after some are taken away.

(2) Students describe their physical world using geometric ideas (e.g., shape, orientation, spatial relations) and vocabulary. They identify, name, and describe basic two-dimensional shapes, such as squares, triangles, circles, rectangles, and hexagons, presented in a variety of ways (e.g., with different sizes or orientations), as well as three-dimensional shapes such as cones, cylinders, and spheres. They use basic shapes and spatial reasoning to model objects in their environment and to construct more complex shapes.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Kindergarten

Counting and Cardinality Know number names and the count sequence.	
Standards	*Performance Objectives*
Students are expected to:	
K.CC.1. Count to 100 by ones and by tens. ***DG1-S1-C1-PO2*** Identify a whole number represented by a model with a word name and symbol 0 to 100.	• Look for/make use of structure. • Look for/express regularity in repeated reasoning.
K.CC.2. Count forward beginning from a given number within the known sequence (instead of having to begin at 1). ***DGK-S1-C1-DPO3*** Count from any number, forward or backwards, 1-31. ***DG1-S1-C1-PO3*** Count aloud forward or backward in consecutive order (0 through 100)	• Look for/make use of structure.
K.CC.3. Write numbers from 0 to 20. Represent a number of objects with a written numeral 0–20 (with 0 representing a count of no objects). ***DGK-S1-C1-PO4/DGK-S1-C1-PO5*** Identify and write whole numbers through 20 in or out of order. Connections: K.CC.4; K.NBT.1; K.MD.3; K.RI.3	• Reason abstractly and quantitatively. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Kindergarten

Counting and Cardinality Know number names and the count sequence.	
Standards	*Performance Objectives*
Students are expected to:	
K.CC.4. Understand the relationship between numbers and quantities; connect counting to cardinality. ***DGK-S1-C1-DPO2*** Identify orally a whole number represented by a model with a word name and symbol 0-31. ***DGK-S1-C1-DPO4*** Understand concepts: few, many, more, less, equal, zero. ***DGK-S1-C1-DPO5*** Recognize the ordinal numbers through the 10^{th} place. ***DGK-S1-C1-DPO6*** Count objects to 100. ***DGK-S1-C1-PO7*** Compare two whole numbers through 20. ***DGK-S1-C1-PO9*** Order three or more whole numbers through 20 (least to greatest or greatest to least). a. When counting objects, say the number names in the standard order, pairing each object with one and only one number name and each number name with one and only one object. b. Understand that the last number name said tells the number of objects counted. The number of objects is the same regardless of their arrangement or the order in which they were counted. c. Understand that each successive number name refers to a quantity that is one larger. Connections: K.RI.3; ET00-S1C4-01; ET00-S2C1-01	

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Kindergarten

Counting and Cardinality Know number names and the count sequence.	
Standards	***Performance Objectives***
Students are expected to:	
K.CC.5. Count to answer "how many?" questions about as many as 20 things arranged in a line, a rectangular array, or a circle, or as many as 10 things in a scattered configuration; given a number from 1–20, count out that many objects. ****DGK-S1-C1-DPO1*** Make a model to represent a given whole number 0-31. ****DGK-S1-C2-DPO2*** Count by 2's, 5's and 10's. Connections: K.RI.4; ET00-S1C4-01; ET00-S2C1-01	• Reason abstractly and quantitatively. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.
K.CC.6. Identify whether the number of objects in one group is greater than, less than, or equal to the number of objects in another group, e.g., by using matching and counting strategies. (Include groups with up to ten objects) ***DGK-S1-C1-DPO4*** Understand concepts: few, many, more, less, equal, zero. ***DGK-S1-C1-PO6*** Construct equivalent forms of whole numbers, using manipulatives, through 10. ***DGK-S1-C1-PO7*** Compare two whole numbers through 20. ***DGK-S1-C1-PO9*** Order three or more whole numbers through 20 (least to greatest or greatest to least). Connections: K.RI.3	• Reason abstractly and quantitatively. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.
K.CC.7. Compare two numbers between 1 and 10 presented as written numerals. ***DGK-S1-C1-PO5*** Write whole numbers through 20 in or out of order. ***DGK-S1-C1-PO7*** Compare two whole numbers through 20. Connections: K.RI.3	• Reason abstractly and quantitatively.

(***DGK-S1-C1-PO4*** – Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Kindergarten

Operations and Algebraic Thinking Understanding addition as putting together and adding to, and understand subtraction as taking apart and taking from.	
Standards	*Performance Objectives*
Students are expected to:	
K.0A.1. Represent addition and subtraction with objects, fingers, mental images, drawings, sounds (e.g., claps), acting out situations, verbal explanations, expressions, or equations. (Drawings need not show details, but should show the mathematics in the problems. This applies wherever drawings are mentioned in the Standards.) ***DGK-S1-C2-PO1*** Model addition through sums of 10 using manipulatives. ***DGK-S3-C1-DPO1*** Create, describe and extend a variety of patterns, using concrete objects. Connections: K.O.A.2; K.W.2; K.SL.2; ET00-S1-C4-01; ET00-S2C1-01	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Kindergarten

Operations and Algebraic Thinking Understanding addition as putting together and adding to, and understand subtraction as taking apart and taking from.	
Standards	*Performance Objectives*
Students are expected to:	
K.0A.2. Solve addition and subtraction word problems, and add and subtract within 10, e.g., by using objects or drawings to represent the problem. ***DGK-S1-C2-PO1*** Model addition through sums of 10 using manipulatives. ***DGK-S1-C2-PO2*** Model subtraction through minuends of 10 using manipulatives. ***DGK-S1-C2-PO3*** Select the operation to solve word problems using numbers 0 through 9. ***DGK-S1-C2-PO4*** Solve word problems presented orally using addition or subtraction with numbers through 9. ***DGK-S1-C2-PO5*** Identify the symbols: +, -, =, . ***DGK-S1-C2-PO6*** Use grade-level appropriate mathematical terminology. ***DGK-S1-C2-DPO1*** Understand concepts: minus, plus. Connections: K.OA.1; K.RI.4; K.W.2; K.SL.2: ET00-S1C4-01; ET00-S2C1-01	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically.

(***DGK-S1-C1-PO4*** – Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Kindergarten

Operations and Algebraic Thinking Understanding addition as putting together and adding to, and understand subtraction as taking apart and taking from.	
Standards	*Performance Objectives*
Students are expected to:	
K.0A.3. Decompose numbers less than or equal to 10 into pairs in more than one way, e.g., by using objects or drawings, and record each decomposition by a drawing or equation (e.g., 5 = 2 + 3 and 5 = 4 + 1). ***DG1-S1-C2-PO3*** State addition facts for sums through 18 and subtraction for differences with minuends through 9 or less. ***DG1-S1-C2-PO9*** Demonstrate families of equations for addition and subtraction through 18. Connections: K.RI.3; K.W.2	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Model with mathematics. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.
K.0A.4. For any number from 1 to 9, find the number that makes 10 when added to the given number, e.g., by using objects or drawings, and record the answer with a drawing or equation. ***DG1-S1-C2-PO3*** State addition facts for sums through 18 and subtraction for differences with minuends through 9 or less. ***DG1-S1-C2-PO9*** Demonstrate families of equations for addition and subtraction through 18. ***DG1-S1-C2-DPO1*** Write Equations. Connections: K.RI.3; K.W.2; ET00-S1C4-01	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Model with mathematics. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-PO4*** – Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Kindergarten

Operations and Algebraic Thinking Understanding addition as putting together and adding to, and understand subtraction as taking apart and taking from	
Standards	*Performance Objectives*
Students are expected to:	
K.0A.5. Fluently add and subtract within 5. ***DG1-S1-C2-PO1*** Demonstrate the process of addition through sums of 20 using manipulatives. ***DG1-S1-C2-PO2*** Demonstrate the process of subtraction with minuends of 20 using manipulatives. Connections: ET00-S1C4-01; ET00-S2C1-01	• Reason abstractly and quantitatively. • Look for and make use of structure. • Look for and express regularity in repeated reasoning**.**

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Kindergarten

Numbers and Operations in Base Ten Work with numbers 11-19 to gain foundations for place value.	
Standards	*Performance Objectives*
Students are expected to:	
K.NBT.1Compose and decompose numbers from 11 to 19 into ten ones and some further ones, e.g., by using objects or drawings, and record each composition or decomposition by a drawing or equation (e.g., 18 = 10 + 8); understand that these numbers are composed of ten ones and one, two, three, four, five, six, seven, eight, or nine ones. ***DG1-S1-C1- PO6*** Construct equivalent forms of whole numbers using manipulatives or symbols through 99. Connections: K.CC.3; K.RI.3; K.W.2	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Model with mathematics. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Kindergarten

Measurement and Data Describe and compare measurable attributes.	
Standards	*Performance Objectives*
Students are expected to:	
K.MD.1. Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object. ***DGK-S4-C4-DPO1*** Recognize that a single object has different attributes (e.g., length, color, size, texture) that can be measured in different ways. ***DGK-S4-C4-DPO2*** Verbally and physically compare objects according to observable and measurable attributes. ***DGK-S4-C4-DPO3*** Compare capacity, sizes, temperatures, and weights. Connections: K.RI.3; K.SL.2; SC00-S5C1-01; ET00-S1C2-02	• Look for and make use of structure.
K.MD.2. Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference. *For example, directly compare the heights of two children and describe one child as taller/shorter.* ***DGK-S4-C4-PO3*** Order objects according to observable and measurable attributes. Connections: K.RI.3; K.SL.2; ET00-S1C4-01; ET00-S2C1-01; SC00-S1C3-02; SC00-S5C1-02	• Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** – Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level

Kindergarten

Measurement and Data Describe and compare measurable attributes.	
Standards	*Performance Objectives*
Students are expected to:	
K.MD.3. Classify objects into given categories; count the numbers of objects in each category and sort the categories by count. (Limit category counts to be less than or equal to 10). ***DGK-S1-C1-DPO6*** Count objects to 100. Connections: K.CC.3; K.CC.4; K.CC.5; K.CC.6; K.CC.7; K.G.1; K.RI.3; SC00-S1C3-01	• Reason abstractly and quantitatively. • Look for and make use of structure.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Kindergarten

Geometry Identify and decide shapes (squares, circles, triangles, rectangles, hexagons, cubes, cones, cylinders, and spheres).	
Standards	*Performance Objectives*
Students are expected to:	
K.G.1. Describe objects in the environment using names of shapes, and describe the relative positions of these objects using terms such as *above*, *below*, *beside*, *in front of*, *behind*, and *next to*. ***DGK-S4-C1-PO3*** Identify shapes in different environments (e.g. nature, buildings, classroom). Connections: K.MD.3; K.G.4; K.RI.3; K.RI.2; K.SL.2;	• Look for and make use of structure.
K.G.2. Correctly name shapes regardless of their orientations or overall size. ***DGK-S4-C1-PO2*** Identify concepts and terms of position and size in contextual situations: • Inside/outside, • Above/below/between • Smaller/larger, and • Longer/shorter.	• Look for and make use of structure.
K.G.3. Identify shapes as two-dimensional (lying in a plane, "flat") or three-dimensional ("solid"). • DGK-S4-C1-PO2 Identify concepts and terms of position and size in contextual situations: • Inside/outside, • Above/below/between • Smaller/larger, and • Longer/shorter. **(2D only)** • DG3-S4-C1-PO2 Name concrete objects and pictures of 3-dimensional solids (cones, spheres, and cubes). (3D)	• Look for and make use of structure.

(***DGK-S1-C1-PO4*** – Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Kindergarten

Geometry Identify and decide shapes (squares, circles, triangles, rectangles, hexagons, cubes, cones, cylinders, and spheres).	
Standards	*Performance Objectives*
Students are expected to:	
K.G.4. Analyze and compare two- and three-dimensional shapes, in different sizes and orientations, using informal language to describe their similarities, differences, parts (e.g., number of sides and vertices/"corners") and other attributes (e.g., having sides of equal length). ***DGK-S4-C1-DPO1*** (not 3D) Compare, classify, draw and make models of shapes. Connections: K.MD.3; K.G.1; K.G.2; K.G.3; K.RI.3; K.W.2; K.SL.2	• Attend to precision. • Look for and make use of structure.
K.G.5. Model shapes in the world by building shapes from components (e.g., sticks and clay balls) and drawing shapes. ***DGK-S4-C1-DPO2 (make models)*** Recognize geometry in their surroundings • Identify days, weeks, months on calendar • Understand concepts: yesterday, today, tomorrow, last night, etc. • Tell time to the hour.	• Make sense of problems and persevere in solving them. • Model with mathematics. • Look for and make use of structure.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Kindergarten

Geometry Identify and decide shapes (squares, circles, triangles, rectangles, hexagons, cubes, cones, cylinders, and spheres).	
Standards	*Performance Objectives*
Students are expected to:	
K.G.6. Compose simple shapes to form larger shapes. For example*, "Can you join these two triangles with full sides touching to make a rectangle?"* ***DGK-S4-C1-DPO2 (make models)*** Recognize geometry in their surroundings • Identify days, weeks, months on calendar • Understand concepts: yesterday, today, tomorrow, last night, etc. • Tell time to the hour. Connections: K.RI.3; ET00-S1C4-01; ET00-S2C1-01	• Make sense of problems and persevere in solving them. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Look for and make use of structure.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Kindergarten

Standards for Mathematical Practice	
Standards	
Students are expected to:	Performance Objectives are listed throughout the grade level document in the 2nd column to reflect the need to connect the mathematical practices to mathematical content in instruction.
K.MP.1. Make sense of problems and persevere in solving them.	
K.MP.2. Reason abstractly and quantitatively.	
K.MP.3. Construct viable arguments and critique the reasoning of others.	
K.MP.4. Model with mathematics.	
K.MP.5. Use appropriate tools strategically.	
K.MP.6. Attend to precision.	
K.MP.7. Look for and make use of structure.	
K.MP.8. Look for and express regularity in repeated reasoning.	

Diocese of Phoenix Mathematics Standards Articulated by Grade Level

Kindergarten

Table 1. Common addition and subtraction situations.[6]

	Result Unknown	Change Unknown	Start Unknown
Add to	Two bunnies sat on the grass. Three more bunnies hopped there. How many bunnies are on the grass now? 2 + 3 = ?	Two bunnies were sitting on the grass. Some more bunnies hopped there. Then there were five bunnies. How many bunnies hopped over to the first two? 2 + ? = 5	Some bunnies were sitting on the grass. Three more bunnies hopped there. Then there were five bunnies. How many bunnies were on the grass before? ? + 3 = 5
Take from	Five apples were on the table. I ate two apples. How many apples are on the table now? 5 – 2 = ?	Five apples were on the table. I ate some apples. Then there were three apples. How many apples did I eat? 5 – ? = 3	Some apples were on the table. I ate two apples. Then there were three apples. How many apples were on the table before? ? – 2 = 3
	Total Unknown	**Addend Unknown**	**Both Addends Unknown[1]**
Put Together / Take Apart[2]	Three red apples and two green apples are on the table. How many apples are on the table? 3 + 2 = ?	Five apples are on the table. Three are red and the rest are green. How many apples are green? 3 + ? = 5, 5 – 3 = ?	Grandma has five flowers. How many can she put in her red vase and how many in her blue vase? 5 = 0 + 5, 5 = 5 + 0 5 = 1 + 4, 5 = 4 + 1 5 = 2 + 3, 5 = 3 + 2
	Difference Unknown	**Bigger Unknown**	**Smaller Unknown**
Compare[3]	(“How many more?” version): Lucy has two apples. Julie has five apples. How many more apples does Julie have than Lucy? (“How many fewer?” version): Lucy has two apples. Julie has five apples. How many fewer apples does Lucy have than Julie? 2 + ? = 5, 5 – 2 = ?	(Version with “more”): Julie has three more apples than Lucy. Lucy has two apples. How many apples does Julie have? (Version with “fewer”): Lucy has 3 fewer apples than Julie. Lucy has two apples. How many apples does Julie have? 2 + 3 = ?, 3 + 2 = ?	(Version with “more”): Julie has three more apples than Lucy. Julie has five apples. How many apples does Lucy have? (Version with “fewer”): Lucy has 3 fewer apples than Julie. Julie has five apples. How many apples does Lucy have? 5 – 3 = ?, ? + 3 = 5

[6]Adapted from Box 2-4 of Mathematics Learning in Early Childhood, National Research Council (2009, pp. 32, 33).

[1]These take apart situations can be used to show all the decompositions of a given number. The associated equations, which have the total on the left of the equal sign, help children understand that the = sign does not always mean makes or results in but always does mean is the same number as.

[2]Either addend can be unknown, so there are three variations of these problem situations. Both Addends Unknown is a productive extension of this basic situation, especially for small numbers less than or equal to 10.

[3]For the Bigger Unknown or Smaller Unknown situations, one version directs the correct operation (the version using more for the bigger unknown and using less for the smaller unknown). The other versions are more difficult.

MATHEMATICS

Diocese of Phoenix Catholic Schools Academic Content Standards

Grade 1

Aligned and Adapted by Diocese of Phoenix Catholic Schools
November 2013

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 1

Grade 1 Overview

Operations and Algebraic Thinking (OA)

- Represent and solve problems involving addition and subtraction.
- Understand and apply properties of operations and the relationship between addition and subtraction.
- Add and subtract within 20.
- Work with addition and subtraction equations.

Number and Operations in Base Ten (NBT)

- Extend the counting sequence.
- Understand place value.
- Use place value understanding and properties of operations to add and subtract.

Measurement and Data (MD)

- Measure lengths indirectly and by iterating length units.
- Tell and write time.
- Represent and interpret data.

Geometry (G)

- Reason with shapes and their attributes.

Performance Objectives

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 1

In Grade 1, instructional time should focus on four critical areas: (1) developing understanding of addition, subtraction, and strategies for addition and subtraction within 20; (2) developing understanding of whole number relationships and place value, including grouping in tens and ones; (3) developing understanding of linear measurement and measuring lengths as iterating length units; and (4) reasoning about attributes of, and composing and decomposing geometric shapes.

(1) Students develop strategies for adding and subtracting whole numbers based on their prior work with small numbers. They use a variety of models, including discrete objects and length-based models (e.g., cubes connected to form lengths), to model add-to, take-from, put-together, take-apart, and compare situations to develop meaning for the operations of addition and subtraction, and to develop strategies to solve arithmetic problems with these operations. Students understand connections between counting and addition and subtraction (e.g., adding two is the same as counting on two). They use properties of addition to add whole numbers and to create and use increasingly sophisticated strategies based on these properties (e.g., “making tens”) to solve addition and subtraction problems within 20. By comparing a variety of solution strategies, children build their understanding of the relationship between addition and subtraction.

(2) Students develop, discuss, and use efficient, accurate, and generalizable methods to add within 100 and subtract multiples of 10. They compare whole numbers (at least to 100) to develop understanding of and solve problems involving their relative sizes. They think of whole numbers between 10 and 100 in terms of tens and ones (especially recognizing the numbers 11 to 19 as composed of a ten and some ones). Through activities that build number sense, they understand the order of the counting numbers and their relative magnitudes.

(3) Students develop an understanding of the meaning and processes of measurement, including underlying concepts such as iterating (the mental activity of building up the length of an object with equal-sized units) and the transitivity principle for indirect measurement. (Students should apply the principle of transitivity of measurement to make indirect comparisons, but they need not use this technical term.)

(4) Students compose and decompose plane or solid figures (e.g., put two triangles together to make a quadrilateral) and build understanding of part-whole relationships as well as the properties of the original and composite shapes. As they combine shapes, they recognize them from different perspectives and orientations, describe their geometric attributes, and determine how they are alike and different, to develop the background for measurement and for initial understandings of properties such as congruence and symmetry.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 1

Operations and Algebraic Thinking (OA) Represent and solve problems involving addition and subtraction	
Standards	*Performance Objectives*
Students are expected to:	
1.OA.1. Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem. (See Table 1.) ***DG1-S3-C3-PO1*** Use variables in contextual situations. ***DG1-S1-C2-PO6*** Select the grade level appropriate operation to solve word problems. Connections: 1.OA.2; 1OA.3; 1OA.6; 1.RI.3; ET01-S1C4-01; ET01-S2C1-01	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Look for and express regularity in repeated reasoning.
1.OA.2. Solve word problems that call for addition of three whole numbers whose sum is less than or equal to 20, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem. Connections: 1.OA.1; 1.OA.3; 1.OA.6; 1.RI.3; ET01-S1C4-01; ET01-S2C1-01	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. Look for and express regularity in repeated reasoning.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 1

Operations and Algebraic Thinking (OA) Represent and solve problems involving addition and subtraction	
Standards	*Performance Objectives*
Students are expected to:	
1.OA.3. Apply properties of operations as strategies to add and subtract. *Examples: If 8 + 3 = 11 is known, then 3 + 8 = 11 is also known. (Commutative property of addition.) To add 2 + 6 + 4, the second two numbers can be added to make a ten, so 2 + 6 + 4 = 2 + 10 = 12. (Associative property of addition.) (*Students need not use formal terms for these properties.) *DG1-S1-C2-PO10* Demonstrate the identity and commutative properties of addition through 18. Connections: 1.OA.1; 1.OA.2; 1.OA.7; 1.RI.3; ET01-S2-C1--01	• Reason abstractly and quantitatively. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.
1.OA.4. Understand subtraction as an unknown-addend problem. *For example, subtract 10 – 8 by finding the number that makes 10 when added to 8.* *DG1-S3-C3- DPO1* Find the missing elements in number sentences. Connections: 1.OA.5; 1.NBT.4; 1.RI.3	• Reason abstractly and quantitatively. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 1

Operations and Algebraic Thinking (OA) Add and subtract within 20.	
Standards	*Performance Objectives*
Students are expected to:	
1.OA.5. Relate counting to addition and subtraction (e.g., by counting on 2 to add 2). *DG1-S1-C2-PO8* to show +,- relationship Count by multiples to show the process of multiplication (2's, 5's, and 10's). Connections: 1.RI.3	• Look for and make use of structure. • Look for and express regularity in repeated reasoning.
1.OA.6. Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting on; making ten (e.g., 8 + 6 = 8 + 2 + 4 = 10 + 4 = 14); decomposing a number leading to a ten (e.g., 13 – 4 = 13 – 3 – 1 = 10 – 1 = 9); using the relationship between addition and subtraction (e.g., knowing that 8 + 4 = 12, one knows 12 – 8 = 4); and creating equivalent but easier or known sums (e.g., adding 6 + 7 by creating the known equivalent 6 + 6 + 1 = 12 + 1 = 13). *DG1-S1-C2-PO1,PO2,PO3,PO4,PO5* Demonstrate the process of addition through sums of 20 using manipulatives; Demonstrate the process of subtraction with minuends of 20 using manipulatives; State addition facts for sums through 18 and subtraction for differences with minuends through 9 or less; Add one and two digit whole numbers without regrouping; Subtract one and two digit whole numbers without regrouping. Connections: 1.OA.1; 1.OA.2; 1.OA.3; 1.OA.4; 1.OA.5; ET01-S1-C2—02	• Reason abstractly and quantitatively. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 1

Operations and Algebraic Thinking (OA) Work with addition and subtraction equations.	
Standards	*Performance Objectives*
Students are expected to:	
1.OA.7. Understand the meaning of the equal sign, and determine if equations involving addition and subtraction are true or false. *For example, which of the following equations are true and which are false? 6 = 6, 7 = 8 – 1, 5 + 2 = 2 + 5, 4 + 1 = 5 + 2.* ***DG1-S1-C2-PO12*** Apply the symbols: +, -, =. Connections: 1.NBT.3; 1.RI.3; 1.SL.1; ET01-S1-C2--02; ET01-S2-C1--01	• Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Attend to precision. • Look for and make use of structure.
1.OA.8. Determine the unknown whole number in an addition or subtraction equation relating three whole numbers. *For example, determine the unknown number that makes the equation true in each of the equations: 8 + ? = 11,* *5 = – 3, 6 + 6 = .* ***DG1-S3-C3- PO1, DPO1*** Use variables in contextual situations; Find the missing elements in number sentences. Connections: 1.OA.1; 1.OA.3; 1.OA.5; 1.OA.6; 1.NBT.4; 1.RI.3; ET01-S1-C2--02; ET01-S2-C1—01	• Reason abstractly and quantitatively. • Attend to precision. • Look for and make use of structure.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 1

Number and Operations in Base Ten (NBT) Extend the counting sequence	
Standards	*Performance Objectives*
Students are expected to:	
1.NBT.1. Count to 120, starting at any number less than 120. In this range, read and write numerals and represent a number of objects with a written numeral. ***DG1-S1-C1- PO2, PO3,PO4,PO5*** *but to 120* Identify a whole number represented by a model with a word name and symbol 0 to 100; Count aloud forward or backward in consecutive order (0 through 100); Identify whole numbers through 100 in or out of order; Write whole numbers through 100 in or out of order. Connections: 1.NBT.2; 1.RT.3; 1.SL.1; 1.W.2	• Reason abstractly and quantitatively. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.
1.NBT.2 Understand that the two digits of a two-digit number represent amounts of tens and ones. Understand the following as special cases: a. 10 can be thought of as a bundle of ten ones — called a "ten." b. The numbers from 11 to 19 are composed of a ten and one, two, three, four, five, six, seven, eight, or nine ones. c. The numbers 10, 20, 30, 40, 50, 60, 70, 80, 90 refer to one, two, three, four, five, six, seven, eight, or nine tens (and 0 ones). ***DG1-S1-C1- DPO3,DPO4,DPO5,PO8,PO9*** Name digits in ones and tens place; Round numbers to nearest ten; Write whole numbers in expanded notation; Construct models to represent place value concepts for the ones and tens places; Apply expanded notation to model place value through 99. Connections: ET01-S1-C2-02; ET01-S2-C1-01	• Reason abstractly and quantitatively. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 1

Number and Operations in Base Ten (NBT) Extend the counting sequence	
Standards	*Performance Objectives*
Students are expected to:	
1.NBT.3. Compare two two-digit numbers based on meanings of the tens and ones digits, recording the results of comparisons with the symbols >, =, and <. ***DG1-S1-C1-PO11*** Compare two whole numbers through 100. ***DG1-S1-C2-DPO2*** Use the symbols <, >, = to compare whole numbers. Connections: 1.RI.3; 1.SL.1; 1.W.2	• Reason abstractly and quantitatively. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.
1.NBT.4. Add within 100, including adding a two-digit number and a one-digit number, and adding a two-digit number and a multiple of 10, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. Understand that in adding two-digit numbers, one adds tens and tens, ones and ones; and sometimes it is necessary to compose a ten. ***DG1-S1-C1-PO8*** Construct models – not addition, needs to be amended Connections: 1.OA.1; 1.OA.2; 1.OA.3; 1.OA.5; 1.OA.6; 1.NBT.2; 1.NBT.5; 1. SL.1; 1.W.2	• Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 1

Number and Operations in Base Ten (NBT) Extend the counting sequence	
Standards	*Performance Objectives*
Students are expected to:	
1.NBT.5. Given a two-digit number, mentally find 10 more or 10 less than the number, without having to count; explain the reasoning used. Connections: 1.NBT.2; ET01-S1-C2--02	• Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.
1.NBT.6. Subtract multiples of 10 in the range 10–90 from multiples of 10 in the range 10–90 (positive or zero differences), using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. Connections: 1.NBT.2; 1.NBT.5; 1.RI.3; 1.W.2; ET01-S1-C2-02	• Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 1

Measurement and Data (MD) Measure lengths indirectly and by iterating length units.	
Standards	*Performance Objectives*
Students are expected to:	
1.MD.1. Order three objects by length; compare the lengths of two objects indirectly by using a third object. ***DG1-S4- C4- DPO1*** *includes standard below* Measure a given characteristic of an object using non-standard units of measure. Connections: 1.RI.3; SC01-S1-C2--01; SC01-S1-C3--01; SC01-S5-C1--01; SC01-S1-C2--03; ET01-S2-C1--01; ET01-S1-C2--02	• Attend to precision. • Look for and make use of structure.
1.MD.2. Express the length of an object as a whole number of length units, by laying multiple copies of a shorter object (the length unit) end to end; understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps. Limit to contexts where the object being measured is spanned by a whole number of length units with no gaps or overlaps. Connections: 1.SL.1; 1.RI.3; ET01-S1-C2--02	• Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.
1.MD.3. Tell and write time in hours and half-hours using analog and digital clocks. ***DG1-S4-C4- PO3*** *needs to add to the half hour* Tell time to the hour using analog and digital clocks. Connections: 1 SL.1; 1LRI.3; ET01-S1-C2--02; ET01-S2-C1--01	• Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 1

Measurement and Data (MD) Represent and interpret data.	
Standards	*Performance Objectives*
Students are expected to:	
1.MD.4. Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another. ***DG1-S2-C1-PO1-6 DPO1-DPO4*** Formulate questions to collect data in contextual situations; Make a simple pictograph or tally chart with appropriate labels from organized data; Interpret pictographs using terms such as most, least, equal, more than, less than, and greatest; Answer questions about pictographs using terms such as most, least, equal, more than, less than, and greatest; Formulate questions based on graphs, charts, and tables; Solve problems using graphs, charts, and tables; Collect and record data from surveys or experiments; Organize information from surveys or experiments, write a title to represent the main idea of a graph; Locate points on a line graph using ordered pairs; Draw conclusions from graphed data. Connections: 1.RI.4; 1.SL.2; 1.SL.3; 1.W.2; ET01-S4-C2--02; ET01-S2-C1--01; SC01-S1-C3--03; SC01-S1-C3--04	• Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 1

Geometry (G) Reason with shapes and their attributes	
Standards	*Performance Objectives*
Students are expected to:	
1.G.1. Distinguish between defining attributes (e.g., triangles are closed and three-sided) versus non-defining attributes (e.g., color, orientation, overall size); build and draw shapes to possess defining attributes. ***DG1-S4-C1-PO1,PO2,DPO1,DPO2*** Use the words vertex and side when describing simple 2-demensional geometric shapes; Identify 2-demensional shapes by attribute; Identify 3-demensional figures by name or attributes; Compare attributes of 2-dimensional shapes. Connections: 1.RI.3; 1.SL.1; 1.SL.2; ET01-S2-C1--01; SC01-S5-C1--01	• Make sense of problems and persevere in solving them. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Look for and make use of structure.
1.G.2. Compose two-dimensional shapes (rectangles, squares, trapezoids, triangles, half-circles, and quarter-circles) or three-dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape, and compose new shapes from the composite shape. (Students do not need to learn formal names such as “right rectangular prism.”) ***DG1-S4-C1-PO5*** Draw 2-demensional shapes. Connections: 1.RI.3; 1.SL.1; ET01-S2-C1--01	• Make sense of problems and persevere in solving them. • Model with mathematics. • Look for and make use of structure.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 1

Geometry (G) Reason with shapes and their attributes	
Standards	*Performance Objectives*
Students are expected to:	
1.G.3. Partition circles and rectangles into two and four equal shares, describe the shares using the words *halves*, *fourths*, and *quarters*, and use the phrases *half of*, *fourth of*, and *quarter of*. Describe the whole as two of, or four of the shares. 1.G.3. (Continued) Understand for these examples that decomposing into more equal shares creates smaller shares. ***DG1-S1-C1-DPO1,DPO2*** Make models that represent given fractions. (halves, thirds, fourths, eighths and tenths); Connections: 1.RI.3; 1.RI.4; 1.SL.1; 1.SL.2; ET01-S2-C1--01	• Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Attend to precision. • Look for and make use of structure.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 1

Standards for Mathematical Practice	
Standards	
Students are expected to:	Mathematical Practices are listed throughout the grade level document in the 2nd column to reflect the need to connect the mathematical practices to mathematical content in instruction.
1.MP.1. Make sense of problems and persevere in solving them.	
1.MP.2. Reason abstractly and quantitatively.	
1.MP.3. Construct viable arguments and critique the reasoning of others.	
1.MP.4. Model with mathematics.	
1.MP.5. Use appropriate tools strategically.	
1.MP.6. Attend to precision.	
1.MP.7. Look for and make use of structure.	
1.MP.8. Look for and express regularity in repeated reasoning.	

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 1

Table 1. Common addition and subtraction situations.

[6]Adapted from Box 2-4 of Mathematics Learning in Early Childhood, National Research Council (2009, pp. 32, 33).

	Result Unknown	Change Unknown	Start Unknown
Add to	Two bunnies sat on the grass. Three more bunnies hopped there. How many bunnies are on the grass now? 2 + 3 = ?	Two bunnies were sitting on the grass. Some more bunnies hopped there. Then there were five bunnies. How many bunnies hopped over to the first two? 2 + ? = 5	Some bunnies were sitting on the grass. Three more bunnies hopped there. Then there were five bunnies. How many bunnies were on the grass before? ? + 3 = 5
Take from	Five apples were on the table. I ate two apples. How many apples are on the table now? 5 – 2 = ?	Five apples were on the table. I ate some apples. Then there were three apples. How many apples did I eat? 5 – ? = 3	Some apples were on the table. I ate two apples. Then there were three apples. How many apples were on the table before? ? – 2 = 3
	Total Unknown	**Addend Unknown**	**Both Addends Unknown[1]**
Put Together / Take Apart[2]	Three red apples and two green apples are on the table. How many apples are on the table? 3 + 2 = ?	Five apples are on the table. Three are red and the rest are green. How many apples are green? 3 + ? = 5, 5 – 3 = ?	Grandma has five flowers. How many can she put in her red vase and how many in her blue vase? 5 = 0 + 5, 5 = 5 + 0 5 = 1 + 4, 5 = 4 + 1 5 = 2 + 3, 5 = 3 + 2
	Difference Unknown	**Bigger Unknown**	**Smaller Unknown**
Compare[3]	(“How many more?” version): Lucy has two apples. Julie has five apples. How many more apples does Julie have than Lucy? (“How many fewer?” version): Lucy has two apples. Julie has five apples. How many fewer apples does Lucy have than Julie? 2 + ? = 5, 5 – 2 = ?	(Version with “more”): Julie has three more apples than Lucy. Lucy has two apples. How many apples does Julie have? (Version with “fewer”): Lucy has 3 fewer apples than Julie. Lucy has two apples. How many apples does Julie have? 2 + 3 = ?, 3 + 2 = ?	(Version with “more”): Julie has three more apples than Lucy. Julie has five apples. How many apples does Lucy have? (Version with “fewer”): Lucy has 3 fewer apples than Julie. Julie has five apples. How many apples does Lucy have? 5 – 3 = ?, ? + 3 = 5

[1]These take apart situations can be used to show all the decompositions of a given number. The associated equations, which have the total on the left of the equal sign, help children understand that the = sign does not always mean makes or results in but always does mean is the same number as.
[2]Either addend can be unknown, so there are three variations of these problem situations. Both Addends Unknown is a productive extension of this basic situation, especially for small numbers less than or equal to 10.
[3]For the Bigger Unknown or Smaller Unknown situations, one version directs the correct operation (the version using more for the bigger unknown and using less for the smaller unknown). The other versions are more difficult.

MATHEMATICS

Diocese of Phoenix Catholic Schools Academic Content Standards

Grade 2

Aligned and Adapted by Diocese of Phoenix Catholic Schools
Updated November 2013

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 2

Grade 2 Overview

Operations and Algebraic Thinking (OA)

- Represent and solve problems involving addition and subtraction.
- Add and subtract within 20.
- Work with equal groups of objects to gain foundations for multiplication.

Number and Operations in Base Ten (NBT)

- Understand place value.
- Use place value understanding and properties of operations to add and subtract.

Measurement and Data (MD)

- Measure and estimate lengths in standard units.
- Relate addition and subtraction to length.
- Work with time and money.
- Represent and interpret data.

Geometry (G)

- Reason with shapes and their attributes.

Performance Objectives

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 2

In Grade 2, instructional time should focus on four critical areas: (1) extending understanding of base-ten notation; (2) building fluency with addition and subtraction; (3) using standard units of measure; and (4) describing and analyzing shapes.

(1) Students extend their understanding of the base-ten system. This includes ideas of counting in fives, tens, and multiples of hundreds, tens, and ones, as well as number relationships involving these units, including comparing. Students understand multi-digit numbers (up to 1000) written in base-ten notation, recognizing that the digits in each place represent amounts of thousands, hundreds, tens, or ones (e.g., 853 is 8 hundreds + 5 tens + ones).

(2) Students use their understanding of addition to develop fluency with addition and subtraction within 100. They solve problems within 1000 by applying their understanding of models for addition and subtraction, and they develop, discuss, and use efficient, accurate, and generalized methods compute sums and differences of whole numbers in base-ten notation, using their understanding of place value and the properties of operations. They select an accurately apply methods that are appropriate for the context and the numbers involved to mentally calculate sums and differences for numbers with only tens or only hundreds.

(3) Students recognize the need for standard units of measure (centimeter and inch) and they use rulers and other measurement tools with the understanding that linear measure involves a iteration of units. They recognize that the smaller the unit, the more iterations they need to cover a given length.

(4) Students describe and analyze shapes by examining their sides and angles. Students investigate, describe, and reason about decomposing and combining shapes to make other shapes. Through building, drawing, and analyzing two-and-three dimensional shapes, students develop a foundation for understanding area, volume, congruence, similarity, and symmetry in later grades.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 2

Operations and Algebraic Thinking (OA) Represent and solve problems involving addition and subtraction.	
Standards	*Performance Objectives*
Students are expected to:	
2.OA.1. Use addition and subtraction within 100 to solve one- and two-step word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem. (See Table 1.) ***DG2-S1-C2-DPO1*** Solve word problems using addition and subtraction of two 2 and 3 digit numbers, with regrouping. ***DG2-S3-C3-PO2*** Find the missing element (addend, subtrahend, minuend, sum, difference) in addition and subtraction number sentences for sums through 18 and minuends through 9. ***DG4-S1-C1-DPO9*** Compare and order decimals using concrete and illustrated models. (thousandths) Connections: 2.NBT.5; 2.RI.3; 2.RI.4; 2.SL.2; ET02-S2C1-01	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Look for and express regularity in repeated reasoning.
2.OA.2 Fluently add and subtract within 20 using mental strategies. By end of Grade 2, know from memory all sums of two one-digit numbers. (See standard 1.OA.6 for a list of mental strategies.) ***DG2-S1-C2-PO3*** State addition and subtraction facts for sums. ***DG2-S1-C2-PO4*** Add one and two digit whole numbers without regrouping. ***DG2-S1-C2-PO5*** Subtract one and two digit whole numbers without regrouping. ***DG2-S1-C2-PO6*** Add three one or two digit addends. Connections: 2.NBT.5; 2.NBT.9; ET02-S2C1-01	• Reason abstractly and quantitatively. • Look for and make use of structure. • Look for and express regularity in repeated reasoning..

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 2

Operations and Algebraic Thinking (OA) Represent and solve problems involving addition and subtraction.	
Standards	*Performance Objectives*
Students are expected to:	
2.OA.3. Determine whether a group of objects (up to 20) has an odd or even number of members, e.g., by pairing objects or counting them by 2s; write an equation to express an even number as a sum of two equal addends. Connections: 2.OA.4; 2.RI.3; 2.RI.4; ET02-S1C1-01; ET02-S2C1-01 ***DG2-S1-C1-PO10*** Identify odd and even whole numbers (including 0) through 999.	• Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.
2.OA.4. Use addition to find the total number of objects arranged in rectangular arrays with up to 5 rows and up to 5 columns; write an equation to express the total as a sum of equal addends. ***DG2-S1-C2-DPO2 (ARRAYS)*** Demonstrate with models to show the process used in multiplication (uses repeated addition, counts by multiples, combines things that come in groups of equal size, make arrays, uses area models). ***DG5-S3-C3-DPO1 (CREATE EQUATION)*** Create numerical and algebraic expressions and equations using contextual situations. Connections: 2.OA.3, 2.RI.3; ET02-S1C2-01; ET02-S1C2-02; ET02-S2C1-01	• Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 2

Number and Operation in Base Ten (NBT) *Understand place value.*	
Standards	*Performance Objectives*
Students are expected to:	
2.NBT.1. Understand that the three digits of a three-digit number represent amounts of hundreds, tens, and ones; e.g., 706 equals 7 hundreds, 0 tens, and 6 ones. Understand the following as special cases: a. 100 can be thought of as a bundle of ten tens—called a "hundred." b. The numbers 100, 200, 300, 400, 500, 600, 700, 800, 900 refer to one, two, three, four, five, six, seven, eight, or nine hundreds (and 0 tens and 0 ones). ***DG2-S1-C1-DPO1*** State verbally and write whole numbers through 999 using correct place value. Connections: 2.NBT.5; 2.RI.3; 2.RI.4; 2.SL.3; ET02-S1C2-01; ET02-S1C2-01; ET02-S2C1-01	• Reason abstractly and quantitatively. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.
2.NBT.2. Count within 1000; skip-count by 5s, 10s, and 100s. ***DG2-S1-C1-PO3*** Count aloud forward or backward in consecutive order (0 through 999) ***DG3-S1-C1-PO21*** Determine multiples of a given whole number with products through 24 (skip counting). Connections: 2.NBT.8; ET02-S1C3-01	• Reason abstractly and quantitatively. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.
2.NBT.3. Read and write numbers to 1000 using base-ten numerals, number names, and expanded form. ***DG2-S1-C1-DPO1*** *(Read and Write)* State verbally and write whole numbers through 999 using correct place value ***DG2-S1-C1-PO9*** *(Expanded Form)* Apply expanded notation to model place value through 999. Connections: 2.SL.2; 2.RI.3	• Reason abstractly and quantitatively. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

*(**DGK-S1-C1-P04 –*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 2

Number and Operation in Base Ten (NBT) Understand place value.	
Standards	*Performance Objectives*
Students are expected to:	
2.NBT.4. Compare two three-digit numbers based on meanings of the hundreds, tens, and ones digits, using >, =, and < symbols to record the results of comparisons. ***DG2-S1-C1-DPO2*** *(Compare)* Compare and order whole numbers through 1,000. ***DG2-S1-C2-DPO13*** *(Use Symbols)* Apply symbols: +, -, x, ÷, =, ≠, <, >, % Connections: 2.NBT.03; 2.RI.3; ET02-S1C2-02	• Reason abstractly and quantitatively. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.
2.NBT.5. Fluently add and subtract within 100 using strategies based on place value, properties of operations, and/or the relationship between addition and subtraction. ***DG2-S1-C2-PO3*** State addition and subtraction facts for sums. ***DG2-S1-C2-PO4*** Add one and two digit whole numbers without regrouping. ***DG2-S1-C2-PO5*** Subtract one and two digit whole numbers without regrouping. ***DG2-S1-C2-PO6*** Add three one or two digit addends. Connections: 2.OA.2; 2.NBT.1; 2.NBT.3; 2.RI.3; 2.W.2; 2.SL.3	• Reason abstractly and quantitatively. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 2

Number and Operation in Base Ten (NBT) Understand place value	
Standards	*Performance Objectives*
Students are expected to:	
2.NBT.6. Add up to four two-digit numbers using strategies based on place value and properties of operations. ***DG3-S1-C2-PO4*** Add a column of numbers. Connections: 2.NBT.5; 2.RI.3; 2.W.2; 2.SL.2; ET02-S2C1-01	• Reason abstractly and quantitatively. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.
2.NBT.7. Add and subtract within 1000, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method. Understand that in adding or subtracting three-digit numbers, one adds or subtracts hundreds and hundreds, tens and tens, ones and ones; and sometimes it is necessary to compose or decompose tens or hundreds. ***DG3-S1-C2-PO2*** Add two three-digit whole numbers. ***DG3-S1-C2-PO1*** Demonstrate the process of subtraction using manipulatives through three-digit whole numbers. Connections: 2.NBT.5; 2.NBT.6; 2.RI.3; 2.SL.3; 2.W.2; ET02-S1C2-01; ET02-S2C1-01	• Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 2

Number and Operation in Base Ten (NBT) Understand place value	
Standards	*Performance Objectives*
Students are expected to:	
2.NBT.8. Mentally add 10 or 100 to a given number 100–900, and mentally subtract 10 or 100 from a given number 100–900. ***DG2-S1-C3-PO1*** (mental computations) Solve problems using a variety of mental computations and reasonable estimation. Connections: 2.RI.3; 2.SL.1; 2.SL.2; 2.SL.3; ET02-S2C1-01	• Reason abstractly and quantitatively. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.
2.NBT.9. Explain why addition and subtraction strategies work, using place value and the properties of operations. (Explanations may be supported by drawings or objects.) Connections: 2.NBT.1; 2.RI.3; 2.RI.4; 2.W.2; 2.SL.2; 2.SL.3; ET02-S2C1-01	• Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 2

Measurement and Data (MD) Measure and estimate lengths in standard units.	
Standards	*Performance Objectives*
Students are expected to:	
2.MD.1. Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes. ***DG2-S4-C4-PO6*** Measure a given object using the appropriate unit of measure (length: inches, miles; Capacity/Volume: pints, quarts; Mass/ Weight: ounces). Connections: 2.SL.3; SC02-S1C2-03	• Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.
2.MD.2. Measure the length of an object twice, using length units of different lengths for the two measurements; describe how the two measurements relate to the size of the unit chosen. Connections: 2.MD.1; 2.MD.3; 2.MD.4; 2.RI.3; 2.RI.4; 2.W.2; 2.SL.3; SC02-S1C2-03; ET02-S2C1-02	• Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.
2.MD.3. Estimate lengths using units of inches, feet, centimeters, and meters. ***DG2-S1-C3-PO2*** Estimate the measurement of an object using U.S. customary standard and non-standard units of measurement. Connections: 2.MD.1; 2.W.2; 2.SL.3	• Use appropriate tools strategically. • Attend to precision.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 2

Measurement and Data (MD) Measure and estimate lengths in standard units.	
Standards	*Performance Objectives*
Students are expected to:	
2.MD.4. Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard length unit. ***DG3-S4-C4-PO6*** Compare units of measure to determine more or less relationships for: • length – inches to feet, centimeters to meters, • time – minutes to hours; hours to days; days to weeks; months to years, and • money – pennies, nickels, dimes, quarters, and dollars. Connections: 2.MD.1; 2.RI.3; 2.RI.4; 2.W.2; 2.SL.3; ET02-S2C1-01; SC02-S1C1-03	• Use appropriate tools strategically. • Attend to precision.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 2

Measurement and Data (MD) Relate addition and subtraction to length.	
Standards	*Performance Objectives*
Students are expected to:	
2.MD.5. Use addition and subtraction within 100 to solve word problems involving lengths that are given in the same units, e.g., by using drawings (such as drawings of rulers) and equations with a symbol for the unknown number to represent the problem. ***DG4-S3-C3-PO3*** (solve one step equations) Solve one-step equations with one variable represented by a letter or symbol using multiplication of whole numbers (e.g., 12 = *n* x 4). Connections: 2.OA.1; 2.NBT.5; 2.RI.3; 2.W.2; 2.SL.2; 2.SL.3; ET02-S1C2-02	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Look for and express regularity in repeated reasoning.
2.MD.6. Represent whole numbers as lengths from 0 on a number line diagram with equally spaced points corresponding to the numbers 0, 1, 2, …, and represent whole-number sums and differences within 100 on a number line diagram. Connections: 2.NBT.2; 2.OA.1; 2.MD.5; 2.RI.3; 2.SL.3; ET02-S1C2-02	• Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 2

Measurement and Data (MD) Work with time and money.	
Standards	*Performance Objectives*
Students are expected to:	
2.MD.7. Tell and write time from analog and digital clocks to the nearest five minutes, using a.m. and p.m. ***DG2-S4-C4-DPO1*** (nearest minute) Tell time to the nearest minute using analog and digital clocks. Connections: 2.NBT.2; 2.RI.3; 2.W.2; 2.SL.2; ET02-S1C2-01; ET02-S1C2-02	• Use appropriate tools strategically. • Attend to precision.
2.MD.8. Solve word problems involving dollar bills, quarters, dimes, nickels, and pennies, using $ and ¢ symbols appropriately. *Example: If you have 2 dimes and 3 pennies, how many cents do you have?* ***DG2-S1-C2-PO17*** Add and subtract money without regrouping using manipulatives and paper and pencil through $5.00. Connections: 2.NBT.1; 2.NBT.5; 2.RI.3; 2.RI.4; 2.W.2; 2.SL.2; ET02-S1C2-01; ET02-S1C2-02	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Look for and express regularity in repeated reasoning.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 2

Measurement and Data (MD) Represent and interpret data	
Standards	*Performance Objectives*
Students are expected to:	
2.MD.9. Generate measurement data by measuring lengths of several objects to the nearest whole unit, or by making repeated measurements of the same object. Show the measurements by making a line plot, where the horizontal scale is marked off in whole-number units. ***DG5-S2-C1-PO2*** (construct line plot) Construct a double-bar graph, line plot, frequency table, or three-set Venn diagram with appropriate labels and title from organized data. Connections: 2.RI.3; 2.RI.4; 2.W.2; SC02-S1C2-04; SC02-S1C3-01; ET02-S2C1-01	• Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and express regularity in repeated reasoning.
2.MD.10. Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. (See Table 1.) ***DG2-S2-C1-DPO1 DG2-S2-C1-PO4*** Make a graph (horizontal bar, vertical bar, pictograph or tally chart) with appropriate labels from organized data. Connections: 2.RI.3; 2.RI.4; 2.W.2; 2.SL.2; 2.SL.3; SC02-S1C2-04; SC02-S1C3-01; SC02-S1C3-03; ET02-S2C1-01	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and express regularity in repeated reasoning.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 2

Geometry (G) Reason with shapes and their attributes	
Standards	*Performance Objectives*
Students are expected to:	
2.G.1. Recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces. Identify triangles, quadrilaterals, pentagons, hexagons, and cubes. (Sizes are compared directly or visually, not compared by measuring.) ***DG2-S4-C1-DPO1*** Identify draw and compare two and three dimensional shapes by name and attributes. ***DG2-S4-C2-PO1*** Recognize the same shape in different positions. Connections: 2.RI.3; 2.RI.4; 2.W.2; 2.SL.2; 2.SL.3; SC02-S5C1-01; ET02-S2C1-01	• Model with mathematics. • Look for and make use of structure.
2.G.2. Partition a rectangle into rows and columns of same-size squares and count to find the total number of them. ***DG3-S1-C2-PO7*** (make arrays) Demonstrate the process of multiplication as repeatedly adding the same number, counting by multiples, combining equal sets, and making arrays. Connections: 2.OA.4; 2.SL.2; 2.RI.3; ET02-S1C2-02	• Reason abstractly and quantitatively. • Attend to precision. • Look for and express regularity in repeated reasoning.
2.G.3. Partition circles and rectangles into two, three, or four equal shares, describe the shares using the words *halves*, *thirds*, *half of*, *a third of*, etc., and describe the whole as two halves, three thirds, four fourths. Recognize that equal shares of identical wholes need not have the same shape. Connections: 2.RI.3; 2.RI.4; 2.W.2; 2.SL.2; 2.SL.3; ET02-S1C2-02	• Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Attend to precision. • Look for and express regularity in repeated reasoning.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 2

Standards for Mathematical Practice (MP)	
Standards	
Students are expected to:	Mathematical Practices are listed throughout the grade level document in the 2nd column to reflect the need to connect the mathematical practices to mathematical content in instruction.
2.MP.1. Make sense of problems and persevere in solving them.	
2.MP.2. Reason abstractly and quantitatively.	
2.MP.3. Construct viable arguments and critique the reasoning of others.	
2.MP.4. Model with mathematics.	
2.MP.5. Use appropriate tools strategically.	
2.MP.6. Attend to precision.	
2.MP.7. Look for and make use of structure.	
2.MP.8. Look for and express regularity in repeated reasoning.	

Mathematics Standards Articulated by Grade Level
Grade 2

Table 1. Common addition and subtraction situations.[6]

	Result Unknown	Change Unknown	Start Unknown
Add to	Two bunnies sat on the grass. Three more bunnies hopped there. How many bunnies are on the grass now? 2 + 3 = ?	Two bunnies were sitting on the grass. Some more bunnies hopped there. Then there were five bunnies. How many bunnies hopped over to the first two? 2 + ? = 5	Some bunnies were sitting on the grass. Three more bunnies hopped there. Then there were five bunnies. How many bunnies were on the grass before? ? + 3 = 5
Take from	Five apples were on the table. I ate two apples. How many apples are on the table now? 5 – 2 = ?	Five apples were on the table. I ate some apples. Then there were three apples. How many apples did I eat? 5 – ? = 3	Some apples were on the table. I ate two apples. Then there were three apples. How many apples were on the table before? ? – 2 = 3
	Total Unknown	**Addend Unknown**	**Both Addends Unknown[1]**
Put Together / Take Apart[2]	Three red apples and two green apples are on the table. How many apples are on the table? 3 + 2 = ?	Five apples are on the table. Three are red and the rest are green. How many apples are green? 3 + ? = 5, 5 – 3 = ?	Grandma has five flowers. How many can she put in her red vase and how many in her blue vase? 5 = 0 + 5, 5 = 5 + 0 5 = 1 + 4, 5 = 4 + 1 5 = 2 + 3, 5 = 3 + 2
	Difference Unknown	**Bigger Unknown**	**Smaller Unknown**
Compare[3]	("How many more?" version): Lucy has two apples. Julie has five apples. How many more apples does Julie have than Lucy? ("How many fewer?" version): Lucy has two apples. Julie has five apples. How many fewer apples does Lucy have than Julie? 2 + ? = 5, 5 – 2 = ?	(Version with "more"): Julie has three more apples than Lucy. Lucy has two apples. How many apples does Julie have? (Version with "fewer"): Lucy has 3 fewer apples than Julie. Lucy has two apples. How many apples does Julie have? 2 + 3 = ?, 3 + 2 = ?	(Version with "more"): Julie has three more apples than Lucy. Julie has five apples. How many apples does Lucy have? (Version with "fewer"): Lucy has 3 fewer apples than Julie. Julie has five apples. How many apples does Lucy have? 5 – 3 = ?, ? + 3 = 5

[6]Adapted from Box 2-4 of Mathematics Learning in Early Childhood, National Research Council (2009, pp. 32, 33).
[1]These take apart situations can be used to show all the decompositions of a given number. The associated equations, which have the total on the left of the equal sign, help children understand that the = sign does not always mean makes or results in but always does mean is the same number as.
[2]Either addend can be unknown, so there are three variations of these problem situations. Both Addends Unknown is a productive extension of this basic situation, especially for small numbers less than or equal to 10.
[3]For the Bigger Unknown or Smaller Unknown situations, one version directs the correct operation (the version using more for the bigger unknown and using less for the smaller unknown.

MATHEMATICS

Diocese of Phoenix Catholic Schools Academic Content Standards

Grade 3

Aligned and Adapted by Diocese of Phoenix Catholic Schools
Updated November 2013

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 3

Grade 3 Overview

Operations and Algebraic Thinking (OA)

- Represent and solve problems involving multiplication and division.
- Understand properties of multiplication and the relationship between multiplication and division.
- Multiply and divide within 100.
- Solve problems involving the four operations, and identify and explain patterns in arithmetic.

Number and Operations in Base Ten (NBT)

- Use place value understanding and properties of operations to perform multi-digit arithmetic.

Number and Operations—Fractions (NF)

- Develop understanding of fractions as numbers.

Measurement and Data (MD)

- Solve problems involving measurement and estimation of intervals of time, liquid volumes, and masses of objects.
- Represent and interpret data.
- Geometric measurement: understand concepts of area and relate area to multiplication and to addition.
- Geometric measurement: recognize perimeter as an attribute of plane figures and distinguish between linear and area measures.

Geometry (G)

- Reason with shapes and their attributes.

Mathematical Practices (MP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

*(**DGK-S1-C1-P04 –*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 3

In Grade 3, instructional time should focus on four critical areas: (1) developing understanding of multiplication and division and strategies for multiplication and division within 100; (2) developing understanding of fractions, especially unit fractions (fractions with a numerator 1); (3) developing understanding of the structure of rectangular arrays and of area; and (4) describing and analyzing two-dimensional shapes.

(1) Students develop an understanding of the meanings of multiplication and division of whole numbers through activities and problems involving equal-sized groups, arrays, and area models; multiplication is finding an unknown product, and division is finding an unknown factor in these situations. For equal-sized group situations, division can require finding the unknown number of groups or the unknown group size. Students use properties of operations to calculate products of whole numbers, using increasingly sophisticated strategies based on these properties to solve multiplication and division problems involving single-digit factors. By comparing a variety of solution strategies, students learn the relationship between multiplication and division.

(2) Students develop an understanding of fractions, beginning with unit fractions. Students view fractions in general as being built out of unit fractions, and they use fractions along with visual fraction models to represent parts of a whole. Students understand that the size of a fractional part is relative to the size of the whole. For example, $1/2$ of the paint in a small bucket could be less paint than $1/3$ of the paint in a larger bucket, but $1/3$ of a ribbon is longer than $1/5$ of the same ribbon because when the ribbon is divided into 3 equal parts, the parts are longer than when the ribbon is divided into 5 equal parts. Students are able to use fractions to represent numbers equal to, less than, and greater than one. They solve problems that involve comparing fractions by using visual fraction models and strategies based on noticing equal numerators or denominators.

(3) Students recognize area as an attribute of two-dimensional regions. They measure the area of a shape by finding the total number of same-size units of area required to cover the shape without gaps or overlaps, a square with sides of unit length being the standard unit for measuring area. Students understand that rectangular arrays can be decomposed into identical rows or into identical columns. By decomposing rectangles into rectangular arrays of squares, students connect area to multiplication, and justify using multiplication to determine the area of a rectangle.

(4) Students describe, analyze, and compare properties of two-dimensional shapes. They compare and classify shapes by their sides and angles, and connect these with definitions of shapes. Students also relate their fraction work to geometry by expressing the area of part of a shape as a unit fraction of the whole.

*(**DGK-S1-C1-P04 –*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 3

Operations and Algebraic Thinking (OA) Represent and solve problems involving multiplication and division.	
Standards	*Performance Objectives*
Students are expected to:	
3.OA.1. Interpret products of whole numbers, e.g., interpret 5 × 7 as the total number of objects in 5 groups of 7 objects each. *For example, describe a context in which a total number of objects can be expressed as 5 × 7.* ***DG3-S1-C2-PO7*** Demonstrate the process of multiplication as repeatedly adding the same number, counting by multiples, combining equal sets, and making arrays. Connections: 3.OA.3; 3.SL.1; ET03-S1C4-01	• Make sense of problems and persevere in solving them. • Model with mathematics. • Look for and make use of structure.
3.OA.2. Interpret whole-number quotients of whole numbers, e.g., interpret 56 ÷ 8 as the number of objects in each share when 56 objects are partitioned equally into 8 shares, or as a number of shares when 56 objects are partitioned into equal shares of 8 objects each. *For example, describe a context in which a number of shares or a number of groups can be expressed as 56 ÷ 8.* ***DG3-S1-C2-PO8*** Demonstrate the process of division with one-digit divisors (separating elements of a set into smaller equal sets, sharing equally, or repeatedly subtracting the same number). Connections: 3.OA.3; 3.SL.1; ET03-S1C4-01	• Make sense of problems and persevere in solving them. • Model with mathematics. • Look for and make use of structure.

(***DGK-S1-C1-P04 –*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 3

Operations and Algebraic Thinking (OA) Represent and solve problems involving multiplication and division.	
Standards	*Performance Objectives*
Students are expected to:	
3.OA.3. Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem. (See Table 2.) ***DG3-S1-C2-PO6 (word problem)*** Solve word problems using grade-level appropriate operations and numbers. ***DG3-S1-C2-PO7 (through 12)*** Demonstrate the process of multiplication as repeatedly adding the same number, counting by multiples, combining equal sets, and making arrays. ***DG3-S1-C2-P10 (through 9)*** State multiplication and division facts through 9s. Connections: 3.RI.7; ET03-S1C1-01	• Make sense of problems and persevere in solving them. • Model with mathematics. • Look for and make use of structure.
3.OA.4. Determine the unknown whole number in a multiplication or division equation relating three whole numbers. *For example, determine the unknown number that makes the equation true in each of the equations 8 × ? = 48, 5 = ÷ 3, 6 × 6 = ?.* ***DG3-S3-C3-DPO1*** Find missing number in adding, subtracting, multiplying, dividing number sentences. Connections: 3.AO.3; 3.RI.3; 3.SL.1; ET03-S1C4-01	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-P04 –*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 3

Operations and Algebraic Thinking (OA) Understand properties of multiplication and the relationship between multiplication and division.	
Standards	*Performance Objectives*
Students are expected to:	
3.OA.5. Apply properties of operations as strategies to multiply and divide. (Students need not use formal terms for these properties.) *Examples: If 6 × 4 = 24 is known, then 4 × 6 = 24 is also known. (Commutative property of multiplication.) 3 × 5 × 2 can be found by 3 × 5 = 15, then 15 × 2 = 30, or by 5 × 2 = 10, then 3 × 10 = 30. (Associative property of multiplication.) Knowing that 8 × 5 = 40 and 8 × 2 = 16, one can find 8 × 7 as 8 × (5 + 2) = (8 × 5) + (8 × 2) = 40 + 16 = 56. (Distributive property.)* ***DG3-S1-C2-PO11 (commutative)*** Demonstrate the commutative and identity properties of multiplication. ***DG3-S1-C2-PO13 (grade level properties)*** Apply grade-level appropriate properties to assist in computation. ***DG4-S1-C2-PO8 (associative)*** Demonstrate the associative property of multiplication. ***DG4-S1-C2-PO9 (grade level properties)*** Apply grade-level appropriate properties to assist in computation. ***DG5-S1-C2-PO5 (distributive)*** Demonstrate the distributive property of multiplication over addition. *Connections:* 3.OA.1; 3.OA.3; 3.RI 4; 3.RI.7; 3.W.2; ET03-S1C4-01	• Make sense of problems and persevere in solving them. • Model with mathematics. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-P04 –*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 3

Operations and Algebraic Thinking (OA) Understand properties of multiplication and the relationship between multiplication and division.	
Standards	*Performance Objectives*
Students are expected to:	
3.OA.6. Understand division as an unknown-factor problem. *For example, find 32 ÷ 8 by finding the number that makes 32 when multiplied by 8.* ***DG3-S1-C2-PO12 (inverse)*** Identify multiplication and division as inverse operations. Connections: 3.OA.4; 3.RI.3	• Make sense of problems and persevere in solving them. • Look for and make use of structure.

Operations and Algebraic Thinking (OA) Multiply and divide within 100	
Standards	*Performance Objectives*
Students are expected to:	
3.OA.7. Fluently multiply and divide within 100, using strategies such as the relationship between multiplication and division (e.g., knowing that 8 × 5 = 40, one knows 40 ÷ 5 = 8) or properties of operations. By the end of Grade 3, know from memory all products of two one-digit numbers. ***DG3-S1-C2-PO10*** State multiplication and division facts through 9s. Connections: 3.OA.3; 3.OA.5	• Reason abstractly and quantitatively. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-P04 –*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 3

Operations and Algebraic Thinking (OA) Solve problems involving the four operations, and identify and explain patterns in arithmetic.	
Standards	*Performance Objectives*
Students are expected to:	
3.OA.8. Solve two-step word problems using the four operations. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding. (This standard is limited to problems posed with whole numbers and having whole-number answers; students should know how to perform operations in the conventional order when there are no parentheses to specify a particular order (Order of Operations). Connections: 3.OA.4; 3.OA.5; 3.OA.6; 3.OA.7; 3.RI.7 ***DG7-S3-C3-DPO1*** Translate a written sentence into a two-step, one-variable algebraic equation.	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically.
3.OA.9. Identify arithmetic patterns (including patterns in the addition table or multiplication table), and explain them using properties of operations. *For example, observe that 4 times a number is always even, and explain why 4 times a number can be decomposed into two equal addends.* ***DG3-S3-C1-PO1*** Communicate orally or in written form the repetition of objects in a pattern and occurring in a sequence of numbers. Connections: 3.SL.1; ET03-S1.C3.01	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-P04 –*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 3

Number and Operations in Base Ten (NBT) Use place value understanding and properties of operations to perform multi-digit arithmetic. (A range of algorithms may be used.)	
Standards	*Performance Objectives*
Students are expected to:	
3.NBT.1. Use place value understanding to round whole numbers to the nearest 10 or 100. ***DG3-S3-C1-PO3*** Solve grade-level appropriate pattern problems. Connections: 3.OA.5; 3.SL.1; ET03-S1C4.01	• Use appropriate tools strategically. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.
3.NBT.2. Fluently add and subtract within 1000 using strategies and algorithms based on place value, properties of operations, and/or the relationship between addition and subtraction. ***DG3-S3-C1-PO2*** Extend a grade-level appropriate repetitive pattern (e.g., 5, 10, 15, 20, …rule: add five or count by five's). Connections: ET03-S1C1-01	• Reason abstractly and quantitatively. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.
3.NBT.3. Multiply one-digit whole numbers by multiples of 10 in the range 10–90 (e.g., 9 × 80, 5 × 60) using strategies based on place value and properties of operations. ***DG4-S1-C2-PO5*** Multiply multi-digit numbers by two digit numbers. Connections:; 3.NBT.1; 3NBT.5 (commutative property); 3.SL.1; ET03-S1C1-01	• Reason abstractly and quantitatively. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-P04 –*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 3

Number and Operations-Fractions (NF) (Grade 3 expectations in this domain are limited to fractions with denominators 2, 3, 4, 6, and 8.) Develop understanding of fractions as numbers.	
Standards	*Performance Objectives*
Students are expected to:	
3.NF.1. Understand a fraction 1/*b* as the quantity formed by 1 part when a whole is partitioned into *b* equal parts; understand a fraction *a*/*b* as the quantity formed by *a* parts of size 1/*b*. ***DG3-S1-C2-PO10*** State multiplication and division facts through 9s. ***DG3-S1-C2-PO11*** Demonstrate the commutative and identity properties of multiplication. Connections: ET03-S1C2-02; ET03-S1C4-02	• Make sense of problems and persevere in solving them. • Model with mathematics • Look for and make use of structure.
3.NF.2. Understand a fraction as a number on the number line; represent fractions on a number line diagram. a. Represent a fraction 1/*b* on a number line diagram by defining the interval from 0 to 1 as the whole and partitioning it into *b* equal parts. Recognize that each part has size 1/*b* and that the endpoint of the part based at 0 locates the number 1/*b* on the number line. b. Represent a fraction *a*/*b* on a number line diagram by marking off *a* lengths 1/*b* from 0. Recognize that the resulting interval has size *a*/*b* and that its endpoint locates the number *a*/*b* on the number line. ***DG3-S1-C1-DPO4 ("model")*** Identify the fraction represented by a model with a word name and symbol. Connections: 3.RI.7; 3.SL.1; ET03-S1C4-01	• Make sense of problems and persevere in solving them. • Model with mathematics • Look for and make use of structure.

(***DGK-S1-C1-P04 –*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 3

Number and Operations-Fractions (NF) (Grade 3 expectations in this domain are limited to fractions with denominators 2, 3, 4, 6, and 8.) Develop understanding of fractions as numbers.	
Standards	*Performance Objectives*
Students are expected to:	
3.NF.3. Explain equivalence of fractions in special cases, and compare fractions by reasoning about their size. a. Understand two fractions as equivalent (equal) if they are the same size, or the same point on a number line. ***DG3-S1-C1-PO19*** Determine the equivalency among decimals, fractions, and percents (e.g., half-dollar = 50¢ = 50% and ¼ = 0.25 = 25%). b. Recognize and generate simple equivalent fractions, e.g., 1/2 = 2/4, 4/6 = 2/3). Explain why the fractions are equivalent, e.g., by using a visual fraction model. ***DG3-S1-C1-PO19*** Determine the equivalency among decimals, fractions, and percents (e.g., half-dollar = 50¢ = 50% and ¼ = 0.25 = 25%). c. Express whole numbers as fractions, and recognize fractions that are equivalent to whole numbers. *Examples: Express 3 in the form 3 = 3/1; recognize that 6/1 = 6; locate 4/4 and 1 at the same point of a number line diagram.* d. Compare two fractions with the same numerator or the same denominator by reasoning about their size. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with the symbols >, =, or <, and justify the conclusions, e.g., by using a visual fraction model. ***DG3-S1-C1-PO13*** Compare two proper fractions with like denominators. Connections: 3.NF.1; 3NF.2; 3.RI.3; 3.SL.1; 3.SL.3; ET03-S1C4-01	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-P04 –*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 3

Measurement and Data (MD) Solve problems involving measurement and estimation of intervals of time, liquid volumes, and masses of objects.	
Standards	*Performance Objectives*
Students are expected to:	
3.MD.1. Tell and write time to the nearest minute and measure time intervals in minutes. Solve word problems involving addition and subtraction of time intervals in minutes, e.g., by representing the problem on a number line diagram. ***DG3-S4-C4-PO2*** Tell time with one-minute precision (analog). ***DG3-S4-C4-DPO1*** Tell time to the nearest minute on digital clocks. Connections: 3.RI.3; 3.RI.7; ET03-S1C4-01	• Make sense of problems and persevere in solving them. • Model with mathematics. • Attend to precision.
3.MD.2. Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). (Excludes compound units such as cm^3 and finding the geometric volume of a container.) Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem. Excludes multiplicative comparison problems (problems involving notions of "times as much"; see Table 2). ***DG3-S4-C4-PO4 Measure a given object using the appropriate unit of measure:*** • Length – centimeters, millimeters, meters, kilometers, • Capacity/volume – liters • Mass/weight - grams Connections: SC03-S1C2-04; 3.RI.3; 3.RI.4; 3.SL.3;	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively, • Model with mathematics. • Use appropriate tools strategically. • Attend to precision.

(***DGK-S1-C1-P04 –*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 3

Measurement and Data (MD) Solve problems involving measurement and estimation of intervals of time, liquid volumes, and masses of objects.	
Standards	*Performance Objectives*
Students are expected to:	
3.MD.3. Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs. *For example, draw a bar graph in which each square in the bar graph might represent 5 pets.* Connections: 3.OA.1; 3.SL.2; ET03-S1C3-01	• Make sense of problems and persevere in solving them. • Model with mathematics. • Attend to precision. • Look for and make use of pattern.
3.MD.4. Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units— whole numbers, halves, or quarters. Connections: 3.NF.2; 3.SL.2; ET03-S1C4-01	• Make sense of problems and persevere in solving them. • Model with mathematics. • Attend to precision.

(***DGK-S1-C1-P04 –*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 3

Measurement and Data (MD) Geometric measurement: understand concepts of area and relate area to multiplication and to addition.	
Standards	*Performance Objectives*
Students are expected to:	
3.MD.5. Recognize area as an attribute of plane figures and understand concepts of area measurement. a. A square with side length 1 unit, called "a unit square," is said to have "one square unit" of area, and can be used to measure area. b. A plane figure which can be covered without gaps or overlaps by *n* unit squares is said to have an area of *n* square units. ***DG4-S4-C4-PO2*** Compute elapsed time using a clock (e.g., hours and minutes since or until…) or a calendar (e.g., days, weeks, years since or until…). Connections: 3.RI.4; 3.RI.7; ET03-S1C1-01	• Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision.
3.MD.6. Measure areas by counting unit squares (square cm, square m, square in, square ft, and improvised units). ***DG4-S4-C4-PO1*** Identify the appropriate measure of accuracy for the area of an object (e.g., sq. feet or sq. miles). Connections: ET03-S1C1-01	• Use appropriate tools strategically. • Attend to precision.
MD.7. Relate area to the operations of multiplication and addition. a. Find the area of a rectangle with whole-number side lengths by tiling it, and show that the area is the same as would be found by multiplying the side lengths. b. Multiply side lengths to find areas of rectangles with whole-number side lengths in the context of solving real world and mathematical problems, and represent whole-number products as rectangular areas in mathematical reasoning. c. Use tiling to show in a concrete case that the area of a rectangle with whole-number side lengths a and $b + c$ is the sum of $a \times b$ and $a \times c$. Use area models to represent the distributive property in mathematical reasoning. d. Recognize area as additive. Find areas of rectilinear figures by decomposing them into non-overlapping rectangles and adding the areas of the non-overlapping parts, applying this technique to solve real world problems. ***DG4-S4-C4-DPO2*** Solve problems using given formulas for simple area and perimeter. Connections: 3>OA.5; 3.OA.7; 3.RI.3; 3.RI.4; 3.RI.7; 3.SL.1; ET03-s1C4-01	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision.

(***DGK-S1-C1-P04 –*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 3

Measurement and Data (MD) Geometric measurement: recognize perimeter as an attribute of plane figures and distinguish between linear and area measures.	
Standards	*Performance Objectives*
Students are expected to:	
3.MD.8. Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters. ***DG3-S1-C2-DPO4 (real world operations)*** Connections: 3.RI.3; 3.RI.4; 3.RI.7; ET03-S1C3-01; ET03-S1C2-01; ET03-S1C2-02	• Make sense of problems and persevere in solving them. • Model with mathematics. • Look for and make use of structure.

(***DGK-S1-C1-P04 –*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Mathematics Standards Articulated by Grade Level
Grade 3

Geometry (G) Reason with shapes and their attributes.	
Standards	*Performance Objectives*
Students are expected to:	
3.G.1. Understand that shapes in different categories (e.g., rhombuses, rectangles, and others) may share attributes (e.g., having four sides), and that the shared attributes can define a larger category (e.g., quadrilaterals). Recognize rhombuses, rectangles, and squares as examples of quadrilaterals, and draw examples of quadrilaterals that do not belong to any of these subcategories. ***DG3-S4-S1-DPO2*** Compare attributes of 2 and 3 dimensional figures. Connections: 3.RI.3; 3.RI.4; ET03-S2C2-01	• Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.
3.G.2. Partition shapes into parts with equal areas. Express the area of each part as a unit fraction of the whole. *For example, partition a shape into 4 parts with equal area, and describe the area of each part as 1/4 of the area of the shape.* ***DG3-S4-S1-DPO1*** Predict how shapes can be changed by combining or dividing them. Connections: 3.MD.7; 3.NF.1; 3.RI.7; ET03-S1C1-01	• Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically.

(***DGK-S1-C1-P04 –*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Mathematics Standards Articulated by Grade Level
Grade 3

Standards for Mathematical Practice	
Standards	
Students are expected to:	Mathematical Practices are listed throughout the grade level document in the 2nd column to reflect the need to connect the mathematical practices to mathematical content in instruction.
3.MP.1. Make sense of problems and persevere in solving them.	
3.MP.2. Reason abstractly and quantitatively.	
3.MP.3. Construct viable arguments and critique the reasoning of others.	
3.MP.4. Model with mathematics.	
3.MP.5. Use appropriate tools strategically.	
3.MP.6. Attend to precision.	
3.MP.7. Look for and make use of structure.	
3.MP.8. Look for and express regularity in repeated reasoning.	

(***DGK-S1-C1-P04 –*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Mathematics Standards Articulated by Grade Level
Grade 3

Table 2. Common multiplication and division situations.[7]

	Unknown Product	**Group Size Unknown** (“How many in each group?” Division)	**Number of Groups Unknown** (“How many groups?” Division)
	3 x 6 = ?	**3 x ? = 18, and 18 ÷ 3 = ?**	**? x 6 = 18, and 18 ÷ 6 = ?**
Equal Groups	There are 3 bags with 6 plums in each bag. How many plums are there in all? *Measurement example*. You need 3 lengths of string, each 6 inches long. How much string will you need altogether?	If 18 plums are shared equally into 3 bags, then how many plums will be in each bag? *Measurement example*. You have 18 inches of string, which you will cut into 3 equal pieces. How long will each piece of string be?	If 18 plums are to be packed 6 to a bag, then how many bags are needed? *Measurement example*. You have 18 inches of string, which you will cut into pieces that are 6 inches long. How many pieces of string will you have?
Arrays,[4] Area[5]	There are 3 rows of apples with 6 apples in each row. How many apples are there? *Area example*. What is the area of a 3 cm by 6 cm rectangle?	If 18 apples are arranged into 3 equal rows, how many apples will be in each row? *Area example*. A rectangle has area 18 square centimeters. If one side is 3 cm long, how long is a side next to it?	If 18 apples are arranged into equal rows of 6 apples, how many rows will there be? *Area example*. A rectangle has area 18 square centimeters. If one side is 6 cm long, how long is a side next to it?
Compare	A blue hat costs $6. A red hat costs 3 times as much as the blue hat. How much does the red hat cost? *Measurement example*. A rubber band is 6 cm long. How long will the rubber band be when it is stretched to be 3 times as long?	A red hat costs $18 and that is 3 times as much as a blue hat costs. How much does a blue hat cost? *Measurement example*. A rubber band is stretched to be 18 cm long and that is 3 times as long as it was at first. How long was the rubber band at first?	A red hat costs $18 and a blue hat costs $6. How many times as much does the red hat cost as the blue hat? *Measurement example*. A rubber band was 6 cm long at first. Now it is stretched to be 18 cm long. How many times as long is the rubber band now as it was at first?
General	$a \times \square b = ?$	$a \times \square ? = p$, and $p \div \square a = ?$	$? \times \square b = p$, and $p \div \square b = ?$

[7]The first examples in each cell are examples of discrete things. These are easier for students and should be given before the measurement examples.
[4]The language in the array examples shows the easiest form of array problems. A harder form is to use the terms rows and columns: The apples in the grocery window are in 3 rows and 6 columns. How many apples are in there? Both forms are valuable.
[5]Area involves arrays of squares that have been pushed together so that there are no gaps or overlaps, so array problems include these especially important measurement situations.

MATHEMATICS

Diocese of Phoenix Catholic Schools Academic Content Standards

Grade 4

Aligned and Adapted by Diocese of Phoenix Catholic Schools
Updated November 2013

(***DGK-S1-C1-PO4***-Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 4

Overview

Operations and Algebraic Thinking (OA)

- Use the four operations with whole numbers to solve problems.
- Gain familiarity with factors and multiples.
- Generate and analyze patterns.

Number and Operations in Base Ten (NBT)

- Generalize place value understanding for multidigit whole numbers.
- Use place value understanding and properties of operations to perform multi-digit arithmetic.

Number and Operations—Fractions (NF)

- Extend understanding of fraction equivalence and ordering.
- Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers.
- Understand decimal notation for fractions, and compare decimal fractions.

Measurement and Data (MD)

- Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.
- Represent and interpret data.
- Geometric measurement: understand concepts of angle and measure angles.

Geometry (G)

- Draw and identify lines and angles, and classify shapes by properties of their lines and angles.

Mathematical Practices (MP)

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-PO4***-Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 4

In Grade 4, instructional time should focus on three critical areas: (1) developing understanding and fluency with multi-digit multiplication, and developing understanding of dividing to find quotients involving multi-digit dividends; (2) developing an understanding of fraction equivalence, addition and subtraction of fractions with like denominators, and multiplication of fractions by whole numbers; (3) understanding that geometric figures can be analyzed and classified based on their properties, such as having parallel sides, perpendicular sides, particular angle measures, and symmetry.

(1) Students generalize their understanding of place value to 1,000,000, understanding the relative sizes of numbers in each place. They apply their understanding of models for multiplication (equal-sized groups, arrays, area models), place value, and properties of operations, in particular the distributive property, as they develop, discuss, and use efficient, accurate, and generalizable methods to compute products of multi-digit whole numbers. Depending on the numbers and the context, they select and accurately apply appropriate methods to estimate or mentally calculate products. They develop fluency with efficient procedures for multiplying whole numbers; understand and explain why the procedures work based on place value and properties of operations; and use them to solve problems. Students apply their understanding of models for division, place value, properties of operations, and the relationship of division to multiplication as they develop, discuss, and use efficient, accurate, and generalizable procedures to find quotients involving multi-digit dividends. They select and accurately apply appropriate methods to estimate and mentally calculate quotients, and interpret remainders based upon the context.

(2) Students develop understanding of fraction equivalence and operations with fractions. They recognize that two different fractions can be equal (e.g., $15/9 = 5/3$), and they develop methods for generating and recognizing equivalent fractions. Students extend previous understandings about how fractions are built from unit fractions, composing fractions from unit fractions, decomposing fractions into unit fractions, and using the meaning of fractions and the meaning of multiplication to multiply a fraction by a whole number.

(3) Students describe, analyze, compare, and classify two-dimensional shapes. Through building, drawing, and analyzing two-dimensional shapes, students deepen their understanding of properties of two-dimensional objects and the use of them to solve problems involving symmetry.

(***DGK-S1-C1-PO4***-Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 4

Operations and Algebraic Thinking (OA) Reason with shapes and their attributes. Use the four operations with whole numbers to solve problems.	
Standards	*Performance Objectives*
Students are expected to:	
4.OA.1. Interpret a multiplication equation as a comparison, e.g., interpret 35 = 5 × 7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations. Connections: 4.OA.3; 4.SL.1d; ET04-S1C2-01; ET04-S1C2-02	• Reason abstractly and quantitatively. • Model with mathematics.
4.OA.2. Multiply or divide to solve word problems involving multiplicative comparison, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem, distinguishing multiplicative comparison from additive comparison. (see Table 2) ***DG4-S1-C2-DPO2 (Multiplication as repeated addition)*** Represent the process of multiplication of whole numbers as repeated addition, using concrete or illustrative models. ***DG4-S1-C2-DPO4 (Division as repeated subtraction)*** Represent the process of division of whole numbers as repeated subtraction, partitioning a group and partitioning a whole, using concrete or illustrative models. ***DG4-S1-C2-DPO3*** Regroup in subtraction to the millions place. Connections: 4.RI.7; ET04-S1C2-01; ET04-S1C2-02	• Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Look for and make use of structure.

(***DGK-S1-C1-PO4***-Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 4

Operations and Algebraic Thinking (OA) Use the four operations with whole numbers to solve problems.	
Standards	*Performance Objectives*
Students are expected to:	
4.OA.3. Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding. ***DG4-S1-C2-PO3*** Select the grade-level appropriate operation to solve word problems. ***DG4-S1-C2-PO4*** Solve word problems using grade-level appropriate operations and numbers. ***DG4-S1-C3-PO1*** Solve grade-level appropriate problems using estimation. ***DG4-S1-C3-DPO1*** Apply the appropriate strategy when calculating to solve problems (estimation, approximation, rounding, exact number) ***DG4-S1-C3-PO2*** Use estimation to verify the reasonableness of a calculation (e.g., Is 3284 x 343 = 1200 reasonable?). Connections: 4.NBT.3; 4.NBT.4; 4.NBT.5; 4.NBT.6; ET04-S1C2-02	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure

(***DGK-S1-C1-PO4***-Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 4

Operations and Algebraic Thinking (OA) Use the four operations with whole numbers to solve problems.	
Standards	*Performance Objectives*
Students are expected to:	
AZ.4.OA.3.1 Solve a variety of problems based on the multiplication principle of counting. a. Represent a variety of counting problems using arrays, charts, and systematic lists, e.g., tree diagram. b. Analyze relationships among representations and make connections to the multiplication principle of counting. ***DG4-S1-C2-PO4*** Solve word problems using grade-level appropriate operations and numbers. ***DG4-S2-C3-PO1*** Find all possible combinations when one item is selected from each of two sets containing up to three objects (e.g., How many outfits can be made with 3 pants and 2 tee shirts?). ***DG4-S2-C1-PO7*** Solve contextual problems using graphs, charts, and tables. ***DG5-S2-C3-PO1*** Find all possible combinations when one item is selected from each of two sets of different items, using a systematic approach. (e.g., shirts: tee shirt, tank top, sweatshirt; pants: shorts, jeans). Connections: 4.RI.3; 4.RI.7; ET04-S1C2-01	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-PO4***-Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Operations and Algebraic Thinking (OA) Gain familiarity with factors and multiples.	
Standards	*Performance Objectives*
Students are expected to:	
4.OA.4. Find all factor pairs for a whole number in the range 1–100. Recognize that a whole number is a multiple of each of its factors. Determine whether a given whole number in the range 1–100 is a multiple of a given one-digit number. Determine whether a given whole number in the range 1–100 is prime or composite. ***DG4-S1-C1-PO18 (Through 144)*** Identify all whole number factors and pairs of factors for a given whole number through 144. ***DG4-S1-C1-DPO10*** State the factors for a given whole number. ***DG4-S1-C1-PO19 (multiples with products through 144)*** Determine multiples of a given whole number with products through 144.	• Reason abstractly and quantitatively. • Look for and make use of structure.
4.OA.5. Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself. *For example, given the rule "Add 3" and the starting number 1, generate terms in the resulting sequence and observe that the terms appear to alternate between odd and even numbers. Explain informally why the numbers will continue to alternate in this way.* ***DG4-S3-C1-DPO1*** Describe a rule for a grade-level appropriate iterative pattern, using symbols or numbers. ***DG4-S3-C1-DPO2*** Use grade-level appropriate mathematical terminology for patterns, algebra, and functions.	• Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Look for and make use of structure.

(***DGK-S1-C1-PO4***-Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 4

Number and Operations in Base Ten (NBT) (Grade 4 expectations in this domain are limited to whole numbers less than or equal to 1,000,000.) Generalize place value understanding for multi-digit whole numbers.	
Standards	*Performance Objectives*
Students are expected to:	
4.NBT.1. Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. *For example, recognize that 700 ÷ 70 = 10 by applying concepts of place value and division.*	• Reason abstractly and quantitatively. • Attend to precision. • Look for and make use of structure.
4.NBT.2. Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons. ***DG4-S1-C1-PO1 (Read in contextual situations)*** Read whole numbers in contextual situations. ***DG4-S1-C1-DPO-1 (Read and write using real world situations)*** Read and write whole numbers using real-world situations of whole to the millions place, using whole numbers. ***DG4-S1-C1-PO6*** Apply expanded notation to model place value (e.g., 203,495 = 200,000 + 3,000 + 400 + 90 + 5). ***DG4-S1-C1-PO7*** Compare two whole numbers. ***DG4-S1-C1-DPO4 (Compare and order using concrete and illustrated models)*** Compare and order using concrete and illustrated models of whole numbers to the millions place. Connections: 4.NBT.1	• Reason abstractly and quantitatively. • Model with mathematics. • Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** – Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 4

Number and Operations in Base Ten (NBT) (Grade 4 expectations in this domain are limited to whole numbers less than or equal to 1,000,000.) Generalize place value understanding for multi-digit whole numbers.	
Standards	*Performance Objectives*
Students are expected to:	
4.NBT.3. Use place value understanding to round multi-digit whole numbers to any place. ***DG4-S1-C1-PO4 (State place values for whole numbers)*** State place values for whole numbers (e.g., In the number 203,495 what is the value of the 2?). ***DG4-S1-C1-PO5 (Construct models to represent place value concepts for the one's, ten's, hundred's, and thousand's places.)*** Construct models to represent place value concepts for the one's, ten's, hundred's, and thousand's places. ***DG4-S1-C1-DPO2 (Represent place value using concrete or illustrated models)*** Represent place value using concrete or illustrated models of round whole numbers to millions place. Connections: 4.NBT.3; 4.RI.3	• Reason abstractly and quantitatively. • Attend to precision.
4.NBT.4. Fluently add and subtract multi-digit whole numbers using the standard algorithm. ***DG4-S1-C2-PO1 (Add)*** Add whole numbers. ***DG4-S1-C2-DPO1 (Regroup in addition)*** Regroup in addition to the millions place. ***DG4-S1-C2-PO2 (Subtract)*** Subtract whole numbers. ***DG4-S1-C2-DPO3 (Regroup in subtraction)*** Regroup in subtraction to the millions place. Connections: 4.NBT.2	• Reason abstractly and quantitatively. • Use appropriate tools strategically. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-PO4*** – Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 4

Number and Operations in Base Ten (NBT) (Grade 4 expectations in this domain are limited to whole numbers less than or equal to 1,000,000.) Generalize place value understanding for multi-digit whole numbers.	
Standards	*Performance Objectives*
Students are expected to:	
4.NBT.5. Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models. ***DG4-S1-C2-PO5*** Multiply multi-digit numbers by two-digit numbers. ***DG4-S1-C2-PO7*** **(State multiplication and division facts through 12's.)** State multiplication and division facts through 12s. ***DG4-S1-C2-PO8 (Associative Property)*** Demonstrate the associative property of multiplication. ***DG4-S1-C2-PO9 (Apply properties)*** Apply grade-level appropriate properties to assist in computation. Connections: 4.OA.2; 4.OA.3; 4.NBT.1; 4.RI.7; 4.W.2b; 4.W.2d; ET04-S1C2-01; ET04-S1C4-01	• Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** – Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 4

Number and Operations in Base Ten (NBT) (Grade 4 expectations in this domain are limited to whole numbers less than or equal to 1,000,000.) Generalize place value understanding for multi-digit whole numbers.	
Standards	*Performance Objectives*
Students are expected to:	
4.NBT.6. Find whole-number quotients and remainders with up to four-digit dividends and one-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models. ***DG4-S1-C2-PO6*** Divide with one-digit divisors. ***DG4-S1-C2-DPO5*** Divide with one digit divisors to find quotients with remainders. ***DG4-S1-C2-PO7 (State multiplication and division facts through 12s.)*** State multiplication and division facts through 12s. Connections: 4.OA.2; 4.OA.3; 4.NBT.1; 4.RI.7; 4.W.2b; 4.W.2d; ET04-S1C4-01	• Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** – Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 4

Number and Operation-Fractions (NF) (Grade 4 expectations in this domain are limited to fractions with denominators 2, 3, 4, 5, 6, 8, 10, 12 and 100.) Extend understanding of fraction equivalence and ordering.	
Standards	*Performance Objectives*
Students are expected to:	
4.NF.1. Explain why a fraction a/b is equivalent to a fraction (n x a)/(n x b) by using visual fraction models, with attention to how the number and size of the parts differ even though the two fractions themselves are the same size. Use this principle to recognize and generate equivalent fractions. ***DG4-S1-C1-DPO5 (Read and write fractions using real-world situations)*** Read and write fractions using real-world situations. ***DG4-S1-C1-DPO7*** Recognize fractions as division of the numerator by the denominator. Connections: 4.RI.7; 4.SL.1b; 4.SL.1c; 4.SL.1d; ET04-S1C2-02	• Reason abstractly and quantitatively. • Model with mathematics. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.
4.NF.2. Compare two fractions with different numerators and different denominators, e.g., by creating common denominators or numerators, or by comparing to a benchmark fraction such as $1/2$. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with symbols >, =, or <, and justify the conclusions, e.g., by using a visual fraction model. ***DG4-S1-C1-PO12*** Compare two unit fractions (e.g., ½ to 1/5) or proper or mixed numbers with like denominators. ***DG4-S1-C1-DPO6*** Compare and order fractions using concrete and illustrated models (e.g., halves, thirds, fourths, eighths) ***DG4-S1-C1-PO13 (Order 3 or more)*** Order three or more unit fractions or proper or improper fractions with like denominators. ***DG4-S1-C2-DPO6 (Simplify a fraction to lowest terms.)*** Simplify a fraction to lowest terms. Connection: 4.RI.5; ET04-S1C4-01	• Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** – Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 4

Number and Operation-Fractions (NF) (Grade 4 expectations in this domain are limited to fractions with denominators 2, 3, 4, 5, 6, 8, 10, 12 and 100.) Build fractions from unit fractions by applying and extending previous understandings	
Standards	*Performance Objectives*
Students are expected to:	
4.NF.3. Understand a fraction a/b with $a > 1$ as a sum of fractions $1/b$. a. Understand addition and subtraction of fractions as joining and separating parts referring to the same whole. b. Decompose a fraction into a sum of fractions with the same denominator in more than one way, recording each decomposition by an equation. Justify decompositions, e.g., by using a visual fraction model. *Examples:* $3/8=1/8+1/8+1/8$; $3/8=1/8+2/8$; $2\ 1/8=1+1+1/8=8/8+8/8+1/8$. c. Add and subtract mixed numbers with like denominators, e.g., by replacing each mixed number with an equivalent fraction, and/or by using properties of operations and the relationship between addition and subtraction. d. Solve word problems involving addition and subtraction of fractions referring to the same whole and having like denominators, e.g., by using visual fraction models and equations to represent the problem. ***DG4-S1-C1-PO9 (Make models that represent mixed numbers.)*** Make models that represent mixed numbers. ***DG4-S1-C1-PO10 (Identify symbols, words, or models that represent mixed numbers.)*** Identify symbols, words, or models that represent mixed numbers. ***DG4-S1-C1-PO11 (Use mixed numbers in contextual situations.)*** Use mixed numbers in contextual situations. ***DG4-S1-C1-PO12*** Compare two unit fractions (e.g., ½ to 1/5) or proper or mixed numbers with like denominators. Connections: 4.RI.7; 4.W.2b; ET04-S1C2-02; ET04-S1C4-01	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-PO4*** – Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 4

Number and Operation-Fractions (NF) (Grade 4 expectations in this domain are limited to fractions with denominators 2, 3, 4, 5, 6, 8, 10, 12 and 100.) Build fractions from unit fractions by applying and extending previous understandings	
Standards	*Performance Objectives*
Students are expected to:	
4.NF.4. Apply and extend previous understandings of multiplication to multiply a fraction by a whole number. a. Understand a fraction a/b as a multiple of $1/b$. *For example, use a visual fraction model to represent* $5/4$ *as the product* $5 \times (1/4)$*, recording the conclusion by the equation* $5/4 = 5 \times (1/4)$. b. Understand a multiple of a/b as a multiple of $1/b$, and use this understanding to multiply a fraction by a whole number. *For example, use a visual fraction model to express* $3 \times (2/5)$ as $6 \times (1/5)$*, recognizing this product as* $6/5$. (*In general,* $n \times (a/b) = (n \times a)/b$.) c. Solve word problems involving multiplication of a fraction by a whole number, e.g., by using visual fraction models and equations to represent the problem. *For example, if each person at a party will eat* $3/8$ *of a pound of roast beef, and there will be 5 people at the party, how many pounds of roast beef will be needed? Between what two whole numbers does your answer lie?* ***DG6-S1-C2-PO8*** Demonstrate the process of multiplication of proper fractions using models. ***DG6-S1-C2-PO9*** Multiply proper fractions. Connections: 4.RI.5; 4.W.2e; ET04-S1C2-02	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-PO4***-Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 4

Number and Operations—Fractions (NF) (Grade 4 expectations in this domain are limited to fractions with denominators 2, 3, 4, 5, 6, 8, 10, 12 and 100.) Understand decimal notation for fractions, and compare decimal fractions.and extending previous understandings	
Standards	*Performance Objectives*
Students are expected to:	
4.NF.5. Express a fraction with denominator 10 as an equivalent fraction with denominator 100, and use this technique to add two fractions with respective denominators 10 and 100. *For example, express $3/10$ as $30/100$, and add $3/10 + 4/100 = 34/100$. (*Students who can generate equivalent fractions can develop strategies for adding fractions with unlike denominators in general. But addition and subtraction with unlike denominators in general is not a requirement at this grade.)	• Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Look for and make use of structure.

(***DGK-S1-C1-PO4***-Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 4

Number and Operations—Fractions (NF) (Grade 4 expectations in this domain are limited to fractions with denominators 2, 3, 4, 5, 6, 8, 10, 12 and 100.) Understand decimal notation for fractions, and compare decimal fractions.and extending previous understandings	
Standards	*Performance Objectives*
Students are expected to:	
4.NF.6. Use decimal notation for fractions with denominators 10 or 100. *For example, rewrite 0.62 as $^{62}/_{100}$; describe a length as 0.62 meters; locate 0.62 on a number line diagram.* ***DG4-S1-C1-PO14*** Use decimals in contextual situations. ***DG4-S1-C1-DPO8*** Read and write decimals using real-world situations of fractions (halves, thirds, fourths, eighths). Connection: ET04-S1C2-03	• Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Look for and make use of structure..
4.NF.7. Compare two decimals to hundredths by reasoning about their size. Recognize that comparisons are valid only when the two decimals refer to the same whole. Record the results of comparisons with the symbols >, =, or <, and justify the conclusions, e.g., by using a visual model. Connections: 4.RI.7; 4.SL.1b; 4.SL.1c; 4.SL.1d; ET04-S1C2-02 ***DG4-S1-C1-PO15*** Compare two decimals. ***DG4-S1-C1-DPO9*** **(Compare and order: thousandths)** Compare and order decimals using concrete and illustrated models. (thousandths) ***DG4-S1-C1-PO16*** **(Order 3 or more decimals)** Order three or more decimals.	• Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Look for and make use of structure.

(***DGK-S1-C1-PO4***-Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 4

Measurement and Data (MD) Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.	
Standards	*Performance Objectives*
Students are expected to:	
4.MD.1. Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. *For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs* (*1, 12*), (*2, 24*), (*3, 36*), ***DG4-S4-C4-DPO3*** Measure length, volume and weight in both U.S. customary and metric units. ***DG4-S4-C4-PO5*** Compare units of measure to determine *more* or *less* relationships including: • length - yards and miles, meters and kilometers, • weight - pounds and tons, grams and kilograms. Connections: 4.OA.5; 4.NBT.5; ET04-S1C2-01; ET04-S1C2-02	• Reason abstractly and quantitatively. • Use appropriate tools strategically. • Attend to precision.

(***DGK-S1-C1-PO4***-Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Measurement and Data (MD) Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.	
Standards	*Performance Objectives*
Students are expected to:	
4.MD.2. Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale. ***DG4-S1-C2-PO4*** Solve word problems using grade-level appropriate operations and numbers. ***DG4-S4C4-PO2*** Compute elapsed time using a clock (e.g., hours and minutes since or until…) or a calendar (e.g., days, weeks, years since or until…). Connections: 4.OA.2; 4.OA.3; 4.NBT.4; 4.NF4.a; 4.NF.4c; 4.RI.5; 4.RI.7; 4.W.2e; ET04-S1C4-01	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision.
4.MD.3. Apply the area and perimeter formulas for rectangles in real world and mathematical problems. *For example, find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor.* ***DG4-S4-C4-DPO1*** Identify a variety of shapes having the same perimeter and area. ***DG4-S4-C4-DPO2*** Solve problems using given formulas for simple area and perimeter. ***DG4-S4-C4-PO9*** Determine the area of squares and rectangles. Connections**:** 4.NBT.5; ET04-S1C1-01	• Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** – Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 4

Measurement and Data (MD) Represent and interpret data.	
Standards	*Performance Objectives*
Students are expected to:	
4.MD.4. Make a line plot to display a data set of measurements in fractions of a unit ($1/2$, $1/4$, $1/8$). Solve problems involving addition and subtraction of fractions by using information presented in line plots. *For example, from a line plot find and interpret the difference in length between the longest and shortest specimens in an insect collection.* ***DG4-S2-C1-PO1 (Formulate questions to collect data in contextual situations.)*** Formulate questions to collect data in contextual situations. Connections: 4.NF.3d	• Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-PO4***-Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 4

Measurement and Data (MD) Geometric measurement: understand concepts of angle and measure angles.	
Standards	*Performance Objectives*
Students are expected to:	
4.MD.5. Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement: a. An angle is measured with reference to a circle with its center at the common endpoint of the rays, by considering the fraction of the circular arc between the points where the two rays intersect the circle. An angle that turns through $1/360$ of a circle is called a "one-degree angle," and can be used to measure angles. b. An angle that turns through *n* one-degree angles is said to have an angle measure of *n* degrees ***DG4-S4-C1-PO4 (Classify angles: right, acute, obtuse, straight)*** Classify angles (e.g., right, acute, obtuse, straight). Connection: ET04-S1C2-02	• Attend to precision. • Look for and make use of structure.
4.MD.6. Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure. ***DG6-S4-C4-PO2 (USE OF PROTRACTOR)*** Determine the appropriate tool needed to measure to the needed accuracy. Connections: 4.MD.5; 4.G.1; 4.G.2	• Reason abstractly and quantitatively. • Use appropriate tools strategically. • Attend to precision.
4.MD.7. Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure. Connections: 4.OA.3; 4.OA.4; 4.MD.5; 4.MD.6; 4.G.1; 4.G.2; ET04-S1C3-01	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Model with mathematics. • Attend to precision.

(***DGK-S1-C1-PO4***-Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Geometry (G) Draw and identify lines and angles, and classify shapes by properties of their lines and angles.	
Explanations and Examples	*Performance Objectives*
Students are expected to:	
4.G.1. Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures. ***DG4-S4-C1-PO3*** Draw points, lines, line segments (open or closed endpoints), rays, or angles. ***DG4-S4-C1-DPO2*** Identify lines that are parallel and perpendicular. Connections: 4.MD.5; 4.MD.6; 4.G.2; ET04-S1C4-01	• Use appropriate tools strategically. • Attend to precision.
4.G.2. Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size. Recognize right triangles as a category, and identify right triangles. ***DG4-S4-C1-PO1*** Identify the properties of 2-dimensional figures using appropriate terminology. ***DG4-S4-C1-DPO1*** Classify two-dimensional shapes and three-dimensional figures by their properties. ***DG4-S4-C1-PO5*** Classify triangles as right, acute, or obtuse. Connections: 4.MD.5; 4.MD.6; 4.G.1	

(***DGK-S1-C1-PO4***-Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Geometry (G) Draw and identify lines and angles, and classify shapes by properties of their lines and angles.	
Explanations and Examples	*Performance Objectives*
Students are expected to:	
4.G.3. Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry. ***DG4-S4-C1-DPO3*** Draw or build shapes that have symmetry and are congruent. ***DG4-S4-C1-PO8*** Draw a 2-dimensional shape that has line symmetry. ***DG4-S4-C2-DPO2*** Identify lines that are parallel and perpendicular.	• Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-PO4***-Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Mathematics Standards Articulated by Grade Level
Grade 4

Standards for Mathematical Practice	
Standards	
Students are expected to:	Mathematical Practices are listed throughout the grade level document in the 2nd column to reflect the need to connect the mathematical practices to mathematical content in instruction.
4.MP.1. Make sense of problems and persevere in solving them.	
4.MP.2. Reason abstractly and quantitatively.	
4.MP.3. Construct viable arguments and critique the reasoning of others.	
4.MP.4. Model with mathematics.	
4.MP.5. Use appropriate tools strategically.	
4.MP.6. Attend to precision.	
4.MP.7. Look for and make use of structure.	
4.MP.8. Look for and express regularity in repeated reasoning.	

(***DGK-S1-C1-PO4***-Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Table 2. Common multiplication and division situations.[7]

	Unknown Product	**Group Size Unknown** ("How many in each group?" Division)	**Number of Groups Unknown** ("How many groups?" Division)
	3 x 6 = ?	**3 x ? = 18, and 18 ÷ 3 = ?**	**? x 6 = 18, and 18 ÷ 6 = ?**
Equal Groups	There are 3 bags with 6 plums in each bag. How many plums are there in all? *Measurement example*. You need 3 lengths of string, each 6 inches long. How much string will you need altogether?	If 18 plums are shared equally into 3 bags, then how many plums will be in each bag? *Measurement example*. You have 18 inches of string, which you will cut into 3 equal pieces. How long will each piece of string be?	If 18 plums are to be packed 6 to a bag, then how many bags are needed? *Measurement example*. You have 18 inches of string, which you will cut into pieces that are 6 inches long. How many pieces of string will you have?
Arrays,[4] Area[5]	There are 3 rows of apples with 6 apples in each row. How many apples are there? *Area example*. What is the area of a 3 cm by 6 cm rectangle?	If 18 apples are arranged into 3 equal rows, how many apples will be in each row? *Area example*. A rectangle has area 18 square centimeters. If one side is 3 cm long, how long is a side next to it?	If 18 apples are arranged into equal rows of 6 apples, how many rows will there be? *Area example*. A rectangle has area 18 square centimeters. If one side is 6 cm long, how long is a side next to it?
Compare	A blue hat costs $6. A red hat costs 3 times as much as the blue hat. How much does the red hat cost? *Measurement example*. A rubber band is 6 cm long. How long will the rubber band be when it is stretched to be 3 times as long?	A red hat costs $18 and that is 3 times as much as a blue hat costs. How much does a blue hat cost? *Measurement example*. A rubber band is stretched to be 18 cm long and that is 3 times as long as it was at first. How long was the rubber band at first?	A red hat costs $18 and a blue hat costs $6. How many times as much does the red hat cost as the blue hat? *Measurement example*. A rubber band was 6 cm long at first. Now it is stretched to be 18 cm long. How many times as long is the rubber band now as it was at first?
General	*a x □b = ?*	*a x □? = p,* and *p ÷ □a = ?*	*? x □b = p,* and *p ÷ □b = ?*

[7]The first examples in each cell are examples of discrete things. These are easier for students and should be given before the measurement examples.
[4]The language in the array examples shows the easiest form of array problems. A harder form is to use the terms rows and columns: The apples in the grocery window are in 3 rows and 6 columns. How many apples are in there? Both forms are valuable.
[5]Area involves arrays of squares that have been pushed together so that there are no gaps or overlaps, so array problems include these especially important measurement situations.

(***DGK-S1-C1-PO4***-Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

MATHEMATICS

Diocese of Phoenix Catholic Schools Academic Content Standards

Grade 5

Aligned and Adapted by Diocese of Phoenix Catholic Schools
Updated November 2013

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 5

Grade 5 Overview

Operations and Algebraic Thinking (OA)
- Write and interpret numerical expressions.
- Analyze patterns and relationships.

Number and Operations in Base Ten (NBT)
- Understand the place value system.
- Perform operations with multi-digit whole numbers and with decimals to hundredths.

Number and Operations—Fractions (NF)
- Use equivalent fractions as a strategy to add and subtract fractions.
- Apply and extend previous understandings of multiplication and division to multiply and divide fractions.

Measurement and Data (MD)
- Convert like measurement units within a given measurement system.
- Represent and interpret data.
- Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition.

Geometry (G)
- Graph points on the coordinate plane to solve real-world and mathematical problems.
- Classify two-dimensional figures into categories based on their properties.

Performance Objectives
1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 5

In Grade 5, instructional time should focus on three critical areas: (1) developing fluency with addition and subtraction of fractions, and developing understanding of the multiplication of fractions and of division of fractions in limited cases (unit fractions divided by whole numbers and whole numbers divided by unit fractions); (2) extending division to 2-digit divisors, integrating decimal fractions into the place value system and developing understanding of operations with decimals to hundredths, and developing fluency with whole number and decimal operations; and (3) developing understanding of volume.

(1) Students apply their understanding of fractions and fraction models to represent the addition and subtraction of fractions with unlike denominators as equivalent calculations with like denominators. They develop fluency in calculating sums and differences of fractions, and make reasonable estimates of them. Students also use the meaning of fractions, of multiplication and division, and the relationship between multiplication and division to understand and explain why the procedures for multiplying and dividing fractions make sense. (Note: this is limited to the case of dividing unit fractions by whole numbers and whole numbers by unit fractions.)

(2) Students develop understanding of why division procedures work based on the meaning of base-ten numerals and properties of operations. They finalize fluency with multi-digit addition, subtraction, multiplication, and division. They apply their understandings of models for decimals, decimal notation, and properties of operations to add and subtract decimals to hundredths. They develop fluency in these computations, and make reasonable estimates of their results. Students use the relationship between decimals and fractions, as well as the relationship between finite decimals and whole numbers (i.e., a finite decimal multiplied by an appropriate power of 10 is a whole number), to understand and explain why the procedures for multiplying and dividing finite decimals make sense. They compute products and quotients of decimals to hundredths efficiently and accurately.

(3) Students recognize volume as an attribute of three-dimensional space. They understand that volume can be measured by finding the total number of same-size units of volume required to fill the space without gaps or overlaps. They understand that a 1-unit by 1-unit by 1-unit cube is the standard unit for measuring volume. They select appropriate units, strategies, and tools for solving problems that involve estimating and measuring volume. They decompose three-dimensional shapes and find volumes of right rectangular prisms by viewing them as decomposed into layers of arrays of cubes. They measure necessary attributes of shapes in order to determine volumes to solve real world and mathematical problems.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 5

Operations and Algebraic Thinking (OA) Write and interpret numerical expressions.	
Standards	*Performance Objectives*
Students are expected to:	
5.OA.1. Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols. ***DG5-S1-C2-PO15*** Simplify numerical expressions using the order of operations with grade-appropriate operations on number sets. Connections: 5.OA.2	• Make sense of problems and persevere in solving them. • Use appropriate tools strategically. • Look for and express regularity in repeated reasoning.
5.OA.2. Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them. *For example, express the calculation "add 8 and 7, then multiply by 2" as 2 × (8 + 7). Recognize that 3 × (18932 + 921) is three times as large as 18932 + 921, without having to calculate the indicated sum or product.*	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-PO4***-Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 5

Operations and Algebraic Thinking (OA) Analyze patterns and relationships.	
Standards	*Performance Objectives*
Students are expected to:	
5.OA.3. Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns, and graph the ordered pairs on a coordinate plane. *For example, given the rule "Add 3" and the starting number 0, and given the rule "Add 6" and the starting number 0, generate terms in the resulting sequences, and observe that the terms in one sequence are twice the corresponding terms in the other sequence. Explain informally why this is so.* ***DG4-S3-C1-DPO1*** Describe a rule for a grade-level appropriate iterative pattern, using symbols or numbers. ***DG5-S3-C1-PO1*** Communicate a grade-level appropriate iterative pattern, using symbols or numbers. ***DG5-S3-C1-PO2*** Extend a grade-level appropriate iterative pattern. ***DG5-S3-C1-DPO1*** Create simple geometric and number patterns and describe the rule. ***DG5-S3-C1-PO3*** Solve grade-level appropriate iterative pattern problems. Connections: 5.RI.3; 5.W.2a; 5.SL.1	• Reason abstractly and quantitatively. • Look for and make use of structure.

(***DGK-S1-C1-PO4***-Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 5

Number and Operations in Base Ten (NBT) Understand the place value system.	
Standards	*Performance Objectives*
Students are expected to:	
5.NBT.1. Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and $1/10$ of what it represents in the place to its left. Connections: 5.NBT.2; 5.RI.3; 5.W.2d	• Reason abstractly and quantitatively. • Attend to precision. • Look for and make use of structure.
5.NBT.2. Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10. Connections: 5.NBT.1; 5.RI.3; 5.W.2b ***DG7-S1-C2-DPO2*** Use mental math to multiply and divide decimals by powers of 10.	• Reason abstractly and quantitatively. • Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-PO4***-Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Number and Operations in Base Ten (NBT) Understand the place value system.	
Standards	*Performance Objective*
Students are expected to:	
5.NBT.3. Read, write, and compare decimals to thousandths. a. Read and write decimals to thousandths using base-ten numerals, number names, and expanded form, e.g., 347.392 = $3 \times 100 + 4 \times 10 + 7 \times 1 + 3 \times (1/10) + 9 \times (1/100) + 2 \times (1/1000)$. b. Compare two decimals to thousandths based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons. ***DG4-S1-C1-PO15*** Compare two decimals. ***DG4-S1-C1-DPO9*** Compare and order decimals using concrete and illustrated models. (thousandths) Connections: 5.RI.5; 5.SL.6	• Reason abstractly and quantitatively. • Model with mathematics.
5.NBT.4. Use place value understanding to round decimals to any place.	• Reason abstractly and quantitatively. • Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 5

Number and Operations in Base Ten (NBT) Perform operations with multi-digit whole numbers and with decimals to hundredths.	
Standards	*Performance Objectives*
Students are expected to:	
5.NBT.5. Fluently multiply multi-digit whole numbers using the standard algorithm. ***DG4-S1-C2-PO5*** Multiply multi-digit numbers by two-digit numbers.	• Reason abstractly and quantitatively. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.
5.NBT.6. Find whole-number quotients of whole numbers with up to four-digit dividends and two-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models. Connections: 5.RI.3; 5.W.2C; ET05-S1C2-02; ET05-S1C4-01	• Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Look for and make use of structure.
5.NBT.7. Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. ***DG5-S1-C2-PO12*** Add or subtract decimals. ***DG5-S1-C2-PO13*** Multiply decimals. ***DG5-S1-C2-PO14*** Divide decimals "to hundredths place". Connections: 5.RI.3; 5.W.2b; 5.W.2c; 5.SL.2; 5.SL.3; ET05-S1C2-02	• Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Look for and make use of structure

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 5

Number and Operations-Fractions (NF) Use equivalent fractions as a strategy to add and subtract fractions.	
Standards	*Performance Objectives*
Students are expected to:	
5.NF.1. Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators. *For example,* $2/3 + 5/4 = 8/12 + 15/12 = 23/12$. *(In general,* $a/b + c/d = (ad + bc)/bd$.*)* ***DG5-S1-C2-DPO7*** Add and subtract mixed fractions with unlike denominators. ***DG5-S1-C2-PO11*** Add or subtract proper fractions and mixed numbers with like denominators with regrouping. Connection: 5.NF.2	• Reason abstractly and quantitatively. • Model with mathematics. • Look for and make use of structure.
5.NF.2. Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators, e.g., by using visual fraction models or equations to represent the problem. Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers. *For example, recognize an incorrect result* $2/5 + 1/2 = 3/7$*, by observing that* $3/7 < 1/2$. ***DG5-S1-C1-DPO2*** Identify frequently used fraction, decimal and percent equivalents. Connections: 5.NF.1; 5.RI.7; 5.W.2c; 5.SL.2; 5.SL.3; ET05-S1C2-02	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 5

Number and Operations-Fractions (NF) Apply and extend previous understandings of multiplication and division to multiply and divide fractions.	
Standards	*Performance Objectives*
Students are expected to:	
5.NF.3. Interpret a fraction as division of the numerator by the denominator ($a/b = a \div b$). Solve word problems involving division of whole numbers leading to answers in the form of fractions or mixed numbers, e.g., by using visual fraction models or equations to represent the problem. *For example, interpret $3/4$ as the result of dividing 3 by 4, noting that $3/4$ multiplied by 4 equals 3, and that when 3 wholes are shared equally among 4 people each person has a share of size $3/4$. If 9 people want to share a 50-pound sack of rice equally by weight, how many pounds of rice should each person get? Between what two whole numbers does your answer lie?* ***DG4-S1-C1-DPO7*** Recognize fractions as division of the numerator by the denominator. Connection: 5.SL.1	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Look for and make use of structure.
5.NF.4. Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction. a. Interpret the product $(a/b) \times q$ as a parts of a partition of q into b equal parts; equivalently, as the result of a sequence of operations $a \times q \div b$. *For example, use a visual fraction model to show $(2/3) \times 4 = 8/3$, and create a story context for this equation. Do the same with $(2/3) \times (4/5) = 8/15$. (In general, $(a/b) \times (c/d) = ac/bd$.)* b. Find the area of a rectangle with fractional side lengths by tiling it with unit squares of the appropriate unit fraction side lengths, and show that the area is the same as would be found by multiplying the side lengths. Multiply fractional side lengths to find areas of rectangles, and represent fraction products as rectangular areas. ***DG6-S1-C2-PO9*** Multiply proper fractions. ***DG6-S1-C2-PO10*** Multiply mixed numbers. Connections:5.RI.3; 5.W.2b; 5.W.2d; 5.SL.1; ET05-S1C4-01; ET05-S1C4-02; ET05-S2C1-01	• Make sense of problems and persevere in solving them • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Number and Operations-Fractions (NF) Apply and extend previous understandings of multiplication and division to multiply and divide fractions.	
Standards	*Performance Objectives*
Students are expected to:	
5.NF.5. Interpret multiplication as scaling (resizing), by: a. Comparing the size of a product to the size of one factor on the basis of the size of the other factor, without performing the indicated multiplication. b. Explaining why multiplying a given number by a fraction greater than 1 results in a product greater than the given number (recognizing multiplication by whole numbers greater than 1 as a familiar case); explaining why multiplying a given number by a fraction less than 1 results in a product smaller than the given number; and relating the principle of fraction equivalence $a/b = (n \times a)/(n \times b)$ to the effect of multiplying a/b by 1. Connections: 5.RI.3; 5.RI.5; 5.W.2a; 5.W.2b; 5.W.2c; 5.W.2d; 5.W.2e; 5.SL.2; 5.SL.3	• Reason abstractly and quantitatively. • Model with mathematics. • Attend to precision. • Look for and make use of structure.
5.NF.6. Solve real world problems involving multiplication of fractions and mixed numbers, e.g., by using visual fraction models or equations to represent the problem. ***DG6-S1-C2-PO9*** Multiply proper fractions. ***DG6-S1-C2-PO10*** Multiply mixed numbers. ***DG6-S1-C2-PO14*** Solve problems involving fractions or decimals (including money) in contextual situations. Connections: 5.RI.7; 5.W.2e; ET05-S1C1-01; ET05-S1C2-02	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 5

Number and Operations-Fractions (NF) Apply and extend previous understandings of multiplication and division to multiply and divide fractions.	
Standards	*Performance Objectives*
Students are expected to:	
5.NF.7. Apply and extend previous understandings of division to divide unit fractions by whole numbers and whole numbers by unit fractions. (Students able to multiply fractions in general can develop strategies to divide fractions in general, by reasoning about the relationship between multiplication and division. But division of a fraction by a fraction is not a requirement at this grade.) a. Interpret division of a unit fraction by a non-zero whole number, and compute such quotients. *For example, create a story context for $(1/3) \div 4$, and use a visual fraction model to show the quotient. Use the relationship between multiplication and division to explain that $(1/3) \div 4 = 1/12$ because $(1/12) \times 4 = 1/3$.* b. Interpret division of a whole number by a unit fraction, and compute such quotients. *For example, create a story context for $4 \div (1/5)$, and use a visual fraction model to show the quotient. Use the relationship between multiplication and division to explain that $4 \div (1/5) = 20$ because $20 \times (1/5) = 4$.* c. Solve real world problems involving division of unit fractions by non-zero whole numbers and division of whole numbers by unit fractions, e.g., by using visual fraction models and equations to represent the problem. *For example, how much chocolate will each person get if 3 people share $1/2$ lb of chocolate equally? How many $1/3$-cup servings are in 2 cups of raisins?* Connections: 5.RI.3; 5.RI.7; 5.W.2a; 5.W.2c; 5.SL.6; ET05-S1C1-01; ET05-S1C4-01	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 5

Measurement and Data (MD) Convert like measurement units within a given measurement system.	
Standards	*Performance Objectives*
Students are expected to:	
5.MD.1. Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems. ***DG5-S4-C4-PO4*** Convert measurement units to equivalent units within a given system (U.S.customary and metric) (e.g., 12 inches = 1 foot; 10 decimeters = 1 meter). Connection: 5.NBT.7	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Use appropriate tools strategically. • Attend to precision.
5.MD.2. Make a line plot to display a data set of measurements in fractions of a unit ($1/2$, $1/4$, $1/8$). Use operations on fractions for this grade to solve problems involving information presented in line plots. *For example, given different measurements of liquid in identical beakers, find the amount of liquid each beaker would contain if the total amount in all the beakers were redistributed equally.* Connections:5.RI.7; 5.W.2d; ET05-S1C2-02	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Measurement and Data (MD) Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition.	
Standards	*Performance Objectives*
Students are expected to:	
5.MD.3. Recognize volume as an attribute of solid figures and understand concepts of volume measurement. a. A cube with side length 1 unit, called a "unit cube," is said to have "one cubic unit" of volume, and can be used to measure volume. b. A solid figure which can be packed without gaps or overlaps using *n* unit cubes is said to have a volume of *n* cubic units. ***DG7-S4-C4-PO1*** Identify the appropriate unit of measure for the volume of an object (e.g., cubic inches or cubic cm). Connections: 5.NBT.2; 5.RI.4; 5.W.2d; 5.SL.1c; 5.SL.1d	• Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.
5.MD.4. Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units. ***DG5-S4-C4-DPO5*** Develop strategies to determine the surface area and volume of rectangular solids. Connections: 5.MD.3; 5.RI.3; ET05-S1C2-02	• Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 5

Measurement and Data (MD) Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition.	
Standards	*Performance Objectives*
Students are expected to:	
5.MD.5. Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume. a. Find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes, and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent threefold whole-number products as volumes, e.g., to represent the associative property of multiplication. b. Apply the formulas $V = l \times w \times h$ and $V = b \times h$ for rectangular prisms to find volumes of right rectangular prisms with whole-number edge lengths in the context of solving real world and mathematical problems. c. Recognize volume as additive. Find volumes of solid figures composed of two non-overlapping right rectangular prisms by adding the volumes of the non-overlapping parts, applying this technique to solve real world problems. ***DG5-S4-C4-DPO4*** Measure length, volume, weight, and temperature in both U.S. customary and metric units. Connections: 5.RI.3; 5.W.2c; 5.W.2d; 5.SL.2; 5.SL.3	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Geometry (G) Graph points on the coordinate plane to solve real-world and mathematical problems.	
Standards	*Performance Objectives*
Students are expected to:	
5.G.1. Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., *x*-axis and *x*-coordinate, *y*-axis and *y*-coordinate). ***DG5-S4-C4-PO1*** State an appropriate measure of accuracy for a contextual situation (e.g., What unit of measurement would you use to measure the top of your desk?). Connections: 5.RI.4; 5.W.2d; 5.SL.6	• Model with mathematics. • Attend to precision. • Look for and make use of structure.
5.G.2. Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation. ***DG5-S4-C3-PO1*** Graph points in the first quadrant on a grid using ordered pairs. Connections: ET05-S1C2-01; ET05-S1C2-02; ET05-S1C2-03; ET05-S1C3-01; SC05-S5C2	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Geometry (G) Classify two-dimensional figures into categories based on their properties.	
Standards	*Performance Objectives*
Students are expected to:	
5.G.3. Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category. *For example, all rectangles have four right angles and squares are rectangles, so all squares have four right angles.* ***DG5-S4-C1-PO2*** Draw 2-dimensional figures by applying significant properties of each (e.g., Draw a quadrilateral with two sets of parallel sides and four right angles.). ***DG5-S4-C1-PO4*** Identify the properties of 2- and 3-dimensional geometric figures using appropriate terminology and vocabulary. (parallelism, perpendicularity, congruency, similarity). ***DG5-S4-C1-PO13*** Identify the lines of symmetry in a 2-dimensional shape. ***DG5-S4-C1-DPO3*** Draw or build a shape that has symmetry. ***DG5-S4-C1-DPO4*** Use grade-level appropriate mathematical terminology for geometry and measurement. Connections: 5.RI.3; 5.RI.4; 5.RI.5; 5.W.2b; 5.W.2c; 5.W.2d; 5.SL.1; ET05-S1C2-02	• Reason abstractly and quantitatively. • Attend to precision. • Look for and make use of structure.
5.G.4. Classify two-dimensional figures in a hierarchy based on properties. ***DG5-S4-C1-PO5*** Draw points, lines, line segments, rays, and angles with appropriate labels. ***DG5-S4-C1-PO6*** Recognize that all pairs of vertical angles are congruent. ***DG5-S4-C1-PO7*** Classify triangles as scalene, isosceles, or equilateral. ***DG5-S4-C1-PO11*** Draw two congruent geometric figures. ***DG5-S4-C1-DPO2*** Distinguish shapes that are congruent. Connections: 5.RI.5; 5.W.2c; 5.W.2d; 5.SL.1; 5.SL.2; 5.SL.3; 5.SL.6	• Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 5

Standards for Mathematical Practice	
Standards	
Students are expected to:	Mathematical Practices are listed throughout the grade level document in the 2nd column to reflect the need to connect the mathematical practices to mathematical content in instruction.
5.MP.1. Make sense of problems and persevere in solving them.	
5.MP.2. Reason abstractly and quantitatively.	
5.MP.3. Construct viable arguments and critique the reasoning of others.	
5.MP.4. Model with mathematics.	
5.MP.5. Use appropriate tools strategically.	
5.MP.6. Attend to precision.	
5.MP.7. Look for and make use of structure.	
5.MP.8. Look for and express regularity in repeated reasoning.	

MATHEMATICS

Diocese of Phoenix Catholic Schools Academic Content Standards

Grade 6

Aligned and Adapted by Diocese of Phoenix Catholic Schools
Updated November 2013

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 6

Grade 6 Overview

Ratios and Proportional Relationships (RP)
- Understand ratio concepts and use ratio reasoning to solve problems.

The Number System (NS)
- Apply and extend previous understandings of multiplication and division to divide fractions by fractions.
- Compute fluently with multi-digit numbers and find common factors and multiples.
- Apply and extend previous understandings of numbers to the system of rational numbers.

Expressions and Equations (EE)
- Apply and extend previous understandings of arithmetic to algebraic expressions.
- Reason about and solve one-variable equations and inequalities.
- Represent and analyze quantitative relationships between dependent and independent variables.

Geometry (G)
- Solve real-world and mathematical problems involving area, surface area, and volume.

Statistics and Probability (SP)
- Develop understanding of statistical variability.
- Summarize and describe distributions.

Performance Objectives
1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 6

In Grade 6, instructional time should focus on four critical areas: (1) connecting ratio and rate to whole number multiplication and division and using concepts of ratio and rate to solve problems; (2) completing understanding of division of fractions and extending the notion of number to the system of rational numbers, which includes negative numbers; (3) writing, interpreting, and using expressions and equations; and (4) developing understanding of statistical thinking.

(1) Students use reasoning about multiplication and division to solve ratio and rate problems about quantities. By viewing equivalent ratios and rates as deriving from, and extending, pairs of rows (or columns) in the multiplication table, and by analyzing simple drawings that indicate the relative size of quantities, students connect their understanding of multiplication and division with ratios and rates. Thus students expand the scope of problems for which they can use multiplication and division to solve problems, and they connect ratios and fractions. Students solve a wide variety of problems involving ratios and rates.

(2) Students use the meaning of fractions, the meanings of multiplication and division, and the relationship between multiplication and division to understand and explain why the procedures for dividing fractions make sense. Students use these operations to solve problems. Students extend their previous understandings of number and the ordering of numbers to the full system of rational numbers, which includes negative rational numbers, and in particular negative integers. They reason about the order and absolute value of rational numbers and about the location of points in all four quadrants of the coordinate plane.

(3) Students understand the use of variables in mathematical expressions. They write expressions and equations that correspond to given situations, evaluate expressions, and use expressions and formulas to solve problems. Students understand that expressions in different forms can be equivalent, and they use the properties of operations to rewrite expressions in equivalent forms. Students know that the solutions of an equation are the values of the variables that make the equation true. Students use properties of operations and the idea of maintaining the equality of both sides of an equation to solve simple one-step equations. Students construct and analyze tables, such as tables of quantities that are in equivalent ratios, and they use equations (such as $3x = y$) to describe relationships between quantities.

(4) Building on and reinforcing their understanding of number, students begin to develop their ability to think statistically. Students recognize that a data distribution may not have a definite center and that different ways to measure center yield different values. The median measures center in the sense that it is roughly the middle value. The mean measures center in the sense that it is the value that each data point would take on if the total of the data values were redistributed equally, and also in the sense that it is a balance point. Students recognize that a measure of variability (interquartile range or mean absolute deviation) can also be useful for summarizing data because two very different sets of data can have the same mean and median yet be distinguished by their variability. Students learn to describe and summarize numerical data sets, identifying clusters, peaks, gaps, and symmetry, considering the context in which the data were collected.

Students in Grade 6 also build on their work with area in elementary school by reasoning about relationships among shapes to determine area, surface area, and volume. They find areas of right triangles, other triangles, and special quadrilaterals by decomposing these shapes, rearranging or removing pieces, and relating the shapes to rectangles. Using these methods, students discuss, develop, and justify formulas for areas of triangles and parallelograms. Students find areas of polygons and surface areas of prisms and pyramids by decomposing them into pieces whose area they can determine. They reason about right rectangular prisms with fractional side lengths to extend formulas for the volume of a right rectangular prism to fractional side lengths. They prepare for work on scale drawings and constructions in Grade 7 by drawing polygons in the coordinate plane.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 6

Ratios of Proportional Relationships (RP) Understand ratio concepts and use ratio reasoning to solve problems.	
Standards	*Performance Objectives*
Students are expected to:	
6.RP.1. Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. *For example, "The ratio of wings to beaks in the bird house at the zoo was 2:1, because for every 2 wings there was 1 beak." "For every vote candidate A received, candidate C received nearly three votes."* ***DG6-S1-C1-PO1*** Express fractions as ratios, comparing two whole numbers (e.g., ¾ is equivalent to 3:4 and 3 to 4). ***DG6-S1-C1-DPO1*** Develop, analyze and explain methods for solving proportions by identifying equal ratios. Connections: 6-8.RST.4; 6-8.WHST.2d	• Reason abstractly and quantitatively. • Attend to precision.
6.RP.2. Understand the concept of a unit rate a/b associated with a ratio $a:b$ with $b \neq 0$, and use rate language in the context of a ratio relationship. *For example, "This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is $3/4$ cup of flour for each cup of sugar." "We paid $75 for 15 hamburgers, which is a rate of $5 per hamburger."* (Expectations for unit rates in this grade are limited to non-complex fractions.) ***DG6-S1-C1-PO1*** Express fractions as ratios, comparing two whole numbers (e.g., ¾ is equivalent to 3:4 and 3 to 4). ***DG6-S1-C1-DPO1*** Develop, analyze and explain methods for solving proportions by identifying equal ratios. ***DG6-S1-C1-DPO2*** Describe how to solve a problem in context using a proportion. Connection: 6-8.RST.4	• Reason abstractly and quantitatively. • Attend to precision.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Ratios of Proportional Relationships (RP) Understand ratio concepts and use ratio reasoning to solve problems.	
Standards	*Performance Objectives*
Students are expected to:	
6.RP.3. Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations. a. Make tables of equivalent ratios relating quantities with whole-number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios. b. Solve unit rate problems including those involving unit pricing and constant speed. *For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?* c. Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent. d. Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities. ***DG6-S1-C1-PO1*** Express fractions as ratios, comparing two whole numbers (e.g., ¾ is equivalent to 3:4 and 3 to 4). ***DG6-S1-C1-DPO1*** Develop, analyze and explain methods for solving proportions by identifying equal ratios. ***DG6-S1-C1-DPO2*** Describe how to solve a problem in context using a proportion. ***DG6-S1-C1-DPO10*** Calculate the percent of a number (e.g. find 50% of 100) utilizing concrete and illustrative models. Connections: 6.EE.9; 6-8.RST.7; ET06-S6C2-03; SC06-S2C2-03	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Model with mathematics • Use appropriate tools strategically. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 6

The Number System (NS) Apply and extend previous understandings of multiplication and division to divide fractions by fractions.	
Standards	*Performance Objectives*
Students are expected to:	
6.NS.1. Interpret and compute quotients of fractions, and solve word problems involving division of fractions by fractions, e.g., by using visual fraction models and equations to represent the problem. *For example, create a story context for (2/3) ÷ (3/4) and use a visual fraction model to show the quotient; use the relationship between multiplication and division to explain that (2/3) ÷ (3/4) = 8/9 because 3/4 of 8/9 is 2/3. (In general, (a/b) ÷ (c/d) = ad/bc.) How much chocolate will each person get if 3 people share 1/2 lb of chocolate equally? How many 3/4-cup servings are in 2/3 of a cup of yogurt? How wide is a rectangular strip of land with length 3/4 mi and area 1/2 square mi?* ***DG6-S1-C1-PO4*** Determine the equivalency between and among fractions, decimals, and percents in contextual situations. ***DG6-S1-C1-DPO8*** Convert fractions, decimals and percents from one to another. ***DG6-S1-C1-DPO10*** Calculate the percent of a number (e.g. find 50% of 100) utilizing concrete and illustrative models. ***DG6-S1-C2-PO14*** Solve problems involving fractions or decimals (including money) in contextual situations. ***DG6-S1-C2-PO1*** Select the grade-level appropriate operation to solve word problems. ***DG6-S1-C2-PO2*** Solve word problems using grade-level appropriate operations and numbers. Connection: 6-8.RST.7	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 6

The Number System (NS) Compute fluently with multi-digit numbers and find common factors and multiples.	
Standards	*Performance Objectives*
Students are expected to:	
6.NS.2. Fluently divide multi-digit numbers using the standard algorithm. ***DG5-S1-C2-PO4*** Divide with whole numbers. Connection: 6-8.RST.3	• Reason abstractly and quantitatively. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.
6.NS.3. Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation. ***DG5-S1-C2-PO12*** Add or subtract decimals. ***DG5-S1-C2-PO13*** Multiply decimals. ***DG5-S1-C2-PO14*** Divide decimals "to hundredths place". ***DG6-S1-C2-PO14*** Solve problems involving fractions or decimals (including money) in contextual situations. Connection: 6-8.RST.3	• Reason abstractly and quantitatively. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 6

The Number System (NS) Compute fluently with multi-digit numbers and find common factors and multiples**.**	
Standards	*Performance Objectives*
Students are expected to:	
6.NS.4. Find the greatest common factor of two whole numbers less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12. Use the distributive property to express a sum of two whole numbers 1–100 with a common factor as a multiple of a sum of two whole numbers with no common factor. *For example, express 36 + 8 as 4*(*9+2*)*.* ***DG5-S1-C1-DPO4*** Determine lowest common multiples and greatest common factors for a set of two whole numbers. ***DG6-S1-C1-DPO11*** Factor numbers into prime form and express in exponential form. ***DG6-S1-C1-PO5*** Identify the greatest common factor for two whole numbers. ***DG6-S1-C1-PO6*** Determine the least common multiple for two whole numbers. ***DG6-S1-C1-PO7*** Express a whole number as a product of its prime factors, using exponents when appropriate. ***DG7-S1-C1-PO2*** Identify the greatest common factor for a set of whole numbers ***DG8-S1-C1-DPO2*** Identify greatest common factor and least common multiple for a set of whole numbers • find multiples, common multiples and least common multiple of two or more numbers • find factors, common factors and greatest common factor of two or more numbers Connection: 6-8.RST.4	• Look for and make use of structure.
6.NS.5. Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent quantities in real-world contexts, explaining the meaning of 0 in each situation. Connections: 6-8.RST.4; 6-8.WHST.2d	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Model with mathematics.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

The Number System (NS) Apply and extend previous understandings of numbers to the system of rational numbers.	
Standards	*Performance Objectives*
Students are expected to:	
6.NS.6. Understand a rational number as a point on the number line. Extend number line diagrams and coordinate axes familiar from previous grades to represent points on the line and in the plane with negative number coordinates. a. Recognize opposite signs of numbers as indicating locations on opposite sides of 0 on the number line; recognize that the opposite of the opposite of a number is the number itself, e.g., -(-3) = 3, and that 0 is its own opposite. b. Understand signs of numbers in ordered pairs as indicating locations in quadrants of the coordinate plane; recognize that when two ordered pairs differ only by signs, the locations of the points are related by reflections across one or both axes. c. Find and position integers and other rational numbers on a horizontal or vertical number line diagram; find and position pairs of integers and other rational numbers on a coordinate plane. ***DG8-S1-C1-PO1*** Locate rational numbers on a number line. ***DG7-S3-C3-PO5*** Solve one-step equations using inverse operations with positive rational numbers (e.g., $\frac{2}{3}n = 6$). ***DG5-S1-C1-DPO7*** Recognize negative numbers as integers less than zero by extending the number line. ***DG7-S1-C1-PO6*** Locate integers on a number line. ***DG8-S3-C3-PO10*** Graph an inequality on a number line. Connections: 6-8.RST.7; SS06-S1C1-03	• Reason abstractly and quantitatively. • Model with mathematics.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

The Number System (NS) Apply and extend previous understandings of numbers to the system of rational numbers.	
Standards	*Performance Objectives*
Students are expected to:	
6.NS.7. Understand ordering and absolute value of rational numbers. a. Interpret statements of inequality as statements about the relative position of two numbers on a number line diagram. *For example, interpret –3 > –7 as a statement that –3 is located to the right of –7 on a number line oriented from left to right.* b. Write, interpret, and explain statements of order for rational numbers in real-world contexts. *For example, write –3 °C > –7 °C to express the fact that –3 °C is warmer than –7 °C.* c. Understand the absolute value of a rational number as its distance from 0 on the number line; interpret absolute value as magnitude for a positive or negative quantity in a real-world situation. *For example, for an account balance of –30 dollars, write |–30| = 30 to describe the size of the debt in dollars.* d. Distinguish comparisons of absolute value from statements about order. *For example, recognize that an account balance less than –30 dollars represents a debt greater than 30 dollars.* Connections: 6-8.WHST.1c; 6-8.WHST.2a	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Model with mathematics.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 6

The Number System (NS) Apply and extend previous understandings of numbers to the system of rational numbers.	
Standards	*Performance Objectives*
Students are expected to:	
6.NS.8. Solve real-world and mathematical problems by graphing points in all four quadrants of the coordinate plane. Include use of coordinates and absolute value to find distances between points with the same first coordinate or the same second coordinate. ***DG7-S4-C3-PO1*** Graph data points in (x, y) form in any quadrant of a coordinate grid. Connections: 6.G.3; 6-8.RST.7	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Look for and make use of structure.
6.NS.9 Convert between expressions for positive rational numbers, including fractions, decimals, and percents. ***DG6-S1-C1-DPO2*** Describe how to solve a problem in context using a proportion. ***DG6-S1-C1-PO2*** Compare two proper fractions, improper fractions, or mixed numbers. ***DG6-S1-C1-PO4*** Determine the equivalency between and among fractions, decimals, and percents in contextual situations. ***DG6-S1-C1-DPO8*** Convert fractions, decimals and percents from one to another. ***DG6-S1-C2-PO14*** Solve problems involving fractions or decimals (including money) in contextual situations.	• Reason abstractly and quantitatively. • Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 6

Expressions and Equations (EE) Apply and extend previous understandings of numbers to the system of rational numbers.	
Standards	*Performance Objectives*
Students are expected to:	
6.EE.1. Write and evaluate numerical expressions involving whole-number exponents. ***DG6-S1-C1-DPO12*** Read, write and evaluate numbers involving exponents. ***DG7-S1-C2-DPO8*** Read, write and evaluate numbers involving negative and positive exponents. ***DG8-S1-C1-DPO1*** Represent and use numbers in equivalent forms (integers, fractions, percents, decimals, exponents, scientific notation and square roots) Connection: 6-8.RST.4	• Reason abstractly and quantitatively.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 6

Expressions and Equations (EE) Apply and extend previous understandings of arithmetic to algebraic expressions	
Standards	*Performance Objectives*
Students are expected to:	
6.EE.2. Write, read, and evaluate expressions in which letters stand for numbers. a. Write expressions that record operations with numbers and with letters standing for numbers. *For example, express the calculation "Subtract y from 5" as 5 – y.* b. Identify parts of an expression using mathematical terms (sum, term, product, factor, quotient, coefficient); view one or more parts of an expression as a single entity. *For example, describe the expression 2(8+7) as a product of two factors; view (8+7) as both a single entity and a sum of two terms* c. Evaluate expressions at specific values of their variables. Include expressions that arise from formulas used in real-world problems. Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations). *For example, use the formulas $V=s^3$ and $A=6\ s^2$ to find the volume and surface area of a cube with sides of length $s=1/2$.* ***DG4-S3-C3-PO3*** Solve one-step equations with one variable represented by a letter or symbol using multiplication of whole numbers (e.g., 12 = *n* x 4). ***DG5-S3-C3-PO3*** Solve one-step equations with one variable represented by a letter or symbol (e.g., 15 = 45 ÷ *n*). ***DG5-S3-C3-DPO1*** Create numerical and algebraic expressions and equations using contextual situations. ***DG6-S3-C3-PO1-5*** Evaluate expressions involving the four basic operations by substituting given fractions for the variable (e.g., n+3, when n= ½); Use variables in contextual situations; Translate a written phrase to an algebraic expression (e.g., The quotient of *m* and 5 is $\frac{m}{5} or\ m \div 5$.); Translate a phrase written in context into an algebraic expression (e.g., Write an expression to describe the situation: John has x pieces of candy and buys three more. x + 3); Solve one-step equations with one variable represented by a letter or symbol, using inverse operations with whole numbers. Connections: 6-8.RST.4; 6-8.WHST.2d	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Attend to precision.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 6

Expressions and Equations (EE) Apply and extend previous understandings of arithmetic to algebraic expressions.	
Standards	*Performance Objectives*
Students are expected to:	
6.EE.3. Apply the properties of operations to generate equivalent expressions. *For example, apply the distributive property to the expression 3 (2 + x) to produce the equivalent expression 6 + 3x; apply the distributive property to the expression 24x + 18y to produce the equivalent expression 6 (4x + 3y); apply properties of operations to y + y + y to produce the equivalent expression 3y.* ***DG5-S1-C2-PO5*** Demonstrate the distributive property of multiplication over addition. ***DG7-S1-C2-PO7*** Apply grade-level appropriate properties to assist in computation. ***DG7-S1-C2-DPO6*** Identify the properties of addition and multiplication: Commutative, Associative, Distributive, and Identity. Connection: 6-8.RST.4	• Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 6

Expressions and Equations (EE) Apply and extend previous understandings of arithmetic to algebraic expressions.	
Standards	*Performance Objectives*
Students are expected to:	
6.EE.4. Identify when two expressions are equivalent (i.e., when the two expressions name the same number regardless of which value is substituted into them). *For example, the expressions y + y + y and 3y are equivalent because they name the same number regardless of which number y stands for.* ***DG4-S3-C3-PO1*** Solve grade-level appropriate problems using estimation. ***DG5-S3-C3-PO1*** Evaluate expressions involving the four basic operations by substituting given decimals for the variable ***DG6-S1-C2-PO15*** Simplify numerical expressions using the order of operations with grade-appropriate operations on number sets. ***DG6-S3-C3-PO1*** Evaluate expressions involving the four basic operations by substituting given fractions for the variable (e.g., n+3, when n= ½). ***DG7-S1-C2-PO12*** Simplify numerical expressions using the order of operations with grade appropriate operations on number sets. ***DG8-S1-C2-PO11*** Simplify numerical expressions using the order of operations with grade-appropriate operations on number sets. ***DG8-S3-C3-PO1*** Evaluate algebraic expressions by substituting rational values for variables [e.g., 2(*ab+ac+bc*), when *a* = 2, *b* = 3/5, and *c* = 4]. Connection: 6-8.RST.5	• Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Expressions and Equations (EE) Reason about and solve one-variable equations and inequalities.	
Standards	*Performance Objectives*
Students are expected to:	
6.EE.5. Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true. ***DG5-S3-C2-DPO1*** Use substitution of variables to complete input/output models ***DG6-S1-C2-PO1-3*** Select the grade-level appropriate operation to solve word problems; Solve word problems using grade-level appropriate operations and numbers; Apply grade-level appropriate properties to assist in computation. Connection: 6-8.RST.7	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Model with mathematics. • Look for and make use of structure.
6.EE.6. Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. ***DG5-S3-C3-DPO1*** Create numerical and algebraic expressions and equations using contextual situations. ***DG5-S3-C3-PO2*** Use variables in contextual situations. ***DG6-S3-C3-PO4*** Translate a phrase written in context into an algebraic expression (e.g., Write an expression to describe the situation: John has x pieces of candy and buys three more. x + 3). ***DG7-S3-C3-PO3*** Translate a written sentence into a one-step, one-variable algebraic equation. ***DG7-S3-C3-PO4*** Translate a sentence written in context into an algebraic equation involving one operation. Connection : 6-8.RST.4	• Reason abstractly and quantitatively. • Model with mathematics. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 6

Expressions and Equations (EE) Reason about and solve one-variable equations and inequalities.	
Standards	*Performance Objectives*
Students are expected to:	
6.EE.7. Solve real-world and mathematical problems by writing and solving equations of the form $x + p = q$ and $px = q$ for cases in which p, q and x are all nonnegative rational numbers. ***DG7-S3-C3-PO3*** Translate a written sentence into a one-step, one-variable algebraic equation. ***DG7-S3-C3-DPO1*** Translate a written sentence into a two-step, one-variable algebraic equation. ***DG7-S3-C3-PO4*** Translate a sentence written in context into an algebraic equation involving one operation. Connection: 6-8.RST.7	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Look for and make use of structure.
6.EE.8. Write an inequality of the form $x > c$ or $x < c$ to represent a constraint or condition in a real-world or mathematical problem. Recognize that inequalities of the form $x > c$ or $x < c$ have infinitely many solutions; represent solutions of such inequalities on number line diagrams. ***DG7-S3-C3-DPO3*** Express a simple inequality from a contextual situation (e.g. Joe earns more than $5.00 an hour; therefore, x > 5) ***DG8-S3-C3-PO5*** Translate a contextual situation into an algebraic inequality (e.g., Joe earns more than $5.00 an hour; therefore, $x > 5$). ***DG8-S3-C3-PO6*** Identify an equation or inequality that represents a contextual situation. ***DG8-S3-C3-PO10*** Graph an inequality on a number line. Connection: 6-8.RST.7	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 6

Expressions and Equations (EE) Represent and analyze quantitative relationships between dependent and independent variables.	
Standards	*Performance Objectives*
Students are expected to:	
6.EE.9. Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. *For example, in a problem involving motion at constant speed, list and graph ordered pairs of distances and times, and write the equation d = 65t to represent the relationship between distance and time.* ET06-S1C2-01; ET06-S1C2-02; ET06-S1C2-03; ET06-S6C2-03; SC06-S2C2-03 ***DG7-S4-C3-PO1*** Graph data points in (x, y) form in any quadrant of a coordinate grid. ***DG8-S3-C2-PO4*** Identify independent and dependent variables for a contextual situation. Connections: 6.RP.3; 6-8. RST.7;	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 6

Geometry (G) Solve real-world and mathematical problems involving area, surface area, and volume.	
Standards	*Performance Objectives*
Students are expected to:	
6.G.1. Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems. ***DG4-S4-C4-DPO2*** Solve problems using given formulas for simple area and perimeter. ***DG4-S4-C4-PO9*** Determine the area of squares and rectangles. ***DG5-S4-C4-DPO3*** Develop, understand, and use formulas to find the area of rectangles, related triangles, and parallelograms. ***DG5-S4-C4-PO7*** Solve problems involving the area of simple polygons. ***DG6-S4-C4-PO7*** Determine the area of triangles. ***DG6-S4-C4-PO9*** Solve problems for the areas of parallelograms (includes rectangles). Connections: 6-8.RST.7; 6-8.WHST.2b,d; ET06-S1C2-02	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 6

Geometry (G) Solve real-world and mathematical problems involving area, surface area, and volume.	
Standards	*Performance Objectives*
Students are expected to:	
6.G.2. Find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas $V = l\ w\ h$ and $V = b\ h$ to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems. ***DG6-S4-C4-DPO2*** Solve problems using given formulas for volume of prisms. ***DG5-S4-C4-DPO5*** Measure length, volume, weight, and temperature in both U.S. customary and metric units. ***DG8-S4-C4-PO2*** Solve problems involving the volume of rectangular prisms and cylinders. Connections: 6-8.RST.4; ET06-S1C2-02	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.
6.G.3. Draw polygons in the coordinate plane given coordinates for the vertices; use coordinates to find the length of a side joining points with the same first coordinate or the same second coordinate. Apply these techniques in the context of solving real-world and mathematical problems. ***DG6-S4-C3-PO2*** State the missing coordinate of a given figure in the first quadrant of a coordinate grid using geometric properties (e.g., Find the coordinates of the missing vertex of a rectangle when two adjacent sides are drawn.). ***DG7-S4-C3-PO2*** State the missing coordinate of a given figure in any quadrant of a coordinate grid using geometric properties (e.g., Find the coordinates of the missing vertex of a rectangle when two adjacent sides are drawn). Connections: 6.NS.8; 6-8.RST.7	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 6

Geometry (G) Solve real-world and mathematical problems involving area, surface area, and volume.	
Standards	*Performance Objectives*
Students are expected to:	
6.G.4. Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems. ***DG5-S4-C4-DPO5*** Develop strategies to determine the surface area and volume of rectangular solids. ***DG6-S4-C1-DPO3*** Draw or build three-dimensional shapes by applying significant properties of each. ***DG7-S4-C1-PO3*** Identify the net (2-dimensional representation) that corresponds to a rectangular prism, cone, or cylinder. ***DG8-S4-C1-PO4*** Represent the surface area of rectangular prisms and cylinders as the area of their net. Connections: 6-8.RST.7; 6-8.WHST.2b; ET06-S1C2-02; ET06-S1C2-03	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 6

Statistics and Probability (SP) Develop understanding of statistical variability.	
Standards	*Performance Objectives*
Students are expected to:	
6.SP.1. Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers. For example, "How old am I?" is not a statistical question, but "How old are the students in my school?" is a statistical question because one anticipates variability in students' ages. ***DG6-S2-C1-PO1*** Formulate questions to collect data in contextual situations.	• Make sense of problems and persevere in solving them. • Construct viable arguments and critique the reasoning of others. • Attend to precision.
6.SP.2. Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape. ***DG5-S2-C1-DPO5*** Justify predictions made from a given set of data. ***DG6-S2-C1-PO1*** Formulate questions to collect data in contextual situations. ***DG6-S2-C1-PO2*** Construct a histogram, line graph, scatter plot, or stem-and-leaf plot with appropriate labels and title from organized data. ***DG6-S2-C1-PO3*** Interpret simple displays of data including double bar graphs, tally charts, frequency tables, circle graphs, and line graphs. ***DG6-S2-C1-PO4*** Answer questions based on simple displays of data including double bar graphs, tally charts, frequency tables, circle graphs, and line graphs. ***DG6-S2-C1-PO5*** Find the mean, median (odd number of data points), mode, range, and extreme values of a given numerical data set. ***DG6-S2-C1-PO6*** Identify a trend (variable increasing, decreasing, remaining constant) from displayed data. Connection: 6-8.RST.4	• Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Statistics and Probability (SP) Develop understanding of statistical variability.	
Standards	*Performance Objectives*
Students are expected to:	
6.SP.3. Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number. ***DG6-S2-C1-PO5*** Find the mean, median (odd number of data points), mode, range, and extreme values of a given numerical data set. Connection: 6-8.RST.4	• Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Statistics and Probability (SP) Summarize and describe distributions.	
Standards	*Performance Objectives*
Students are expected to:	
6.SP.4. Display numerical data in plots on a number line, including dot plots, histograms, and box plots. ***DG7-S2-C1-PO3*** Determine when it is appropriate to use histograms, line graphs, double bar graphs, and stem-and-leaf plots. ***DG7-S2-C1-PO4*** Interpret data displays including histograms, stem-and-leaf plots, circle graphs, and double line graphs. ***DG7-S2-C1-PO5*** Answer questions based on data displays including histograms, stem-and-leaf plots, circle graphs, and double line graphs. ***DG8-S2-C1-PO2*** Construct box-and-whisker plots. Connections: 6-8.RST.7; ET06-S6C2-03;SC06-S1C4-01; SC06-S1C4-02; SS06-S1C1-02; SS06-S1C2-02; SS06-S1C4-01	• Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.
6.SP.5. Summarize numerical data sets in relation to their context, such as by: a. Reporting the number of observations. b. Describing the nature of the attribute under investigation, including how it was measured and its units of measurement c. Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered. d. Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered. ***DG6-S2-C1-PO6*** Identify a trend (variable increasing, decreasing, remaining constant) from displayed data. ***DG6-S2-C1-PO7*** Compare trends in data related to the same investigation. Connections: 6-8.WHST.2a-f; ET06-S6C2-03	• Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 6

Standards for Mathematical Practice	
Standards	
Students are expected to:	Mathematical Practices are listed throughout the grade level document in the 2nd column to reflect the need to connect the mathematical practices to mathematical content in instruction.
6.MP.1. Make sense of problems and persevere in solving them.	
6.MP.2. Reason abstractly and quantitatively.	
6.MP.3. Construct viable arguments and critique the reasoning of others.	
6.MP.4. Model with mathematics.	
6.MP.5. Use appropriate tools strategically.	
6.MP.6. Attend to precision.	
6.MP.7. Look for and make use of structure.	
6.MP.8. Look for and express regularity in repeated reasoning.	

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

MATHEMATICS

Diocese of Phoenix Catholic Schools Academic Content Standards

Grade 7

Aligned and Adapted by Diocese of Phoenix Catholic Schools
Updated November 2013

(***DGK-S1-C1-PO4*** Diocesan Guidelines Grade K, Strand 1, Concept 1, Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 7

Grade 7 Overview

Ratios and Proportional Relationships (RP)
- Analyze proportional relationships and use them to solve real-world and mathematical problems.

The Number System (NS)
- Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.

Expressions and Equations (EE)
- Use properties of operations to generate equivalent expressions.
- Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

Geometry (G)
- Draw, construct and describe geometrical figures and describe the relationships between them.
- Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.

Statistics and Probability (SP)
- Use random sampling to draw inferences about a population.
- Draw informal comparative inferences about two populations.
- Investigate chance processes and develop, use, and evaluate probability models.

Performance Objectives
1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 7

In Grade 7, instructional time should focus on four critical areas: (1) developing understanding of and applying proportional relationships; (2) developing understanding of operations with rational numbers and working with expressions and linear equations; (3) solving problems involving scale drawings and informal geometric constructions, and working with two- and three-dimensional shapes to solve problems involving area, surface area, and volume; and (4) drawing inferences about populations based on samples.

(1) Students extend their understanding of ratios and develop understanding of proportionality to solve single- and multi-step problems. Students use their understanding of ratios and proportionality to solve a wide variety of percent problems, including those involving discounts, interest, taxes, tips, and percent increase or decrease. Students solve problems about scale drawings by relating corresponding lengths between the objects or by using the fact that relationships of lengths within an object are preserved in similar objects. Students graph proportional relationships and understand the unit rate informally as a measure of the steepness of the related line, called the slope. They distinguish proportional relationships from other relationships.

(2) Students develop a unified understanding of number, recognizing fractions, decimals (that have a finite or a repeating decimal representation), and percents as different representations of rational numbers. Students extend addition, subtraction, multiplication, and division to all rational numbers, maintaining the properties of operations and the relationships between addition and subtraction, and multiplication and division. By applying these properties, and by viewing negative numbers in terms of everyday contexts (e.g., amounts owed or temperatures below zero), students explain and interpret the rules for adding, subtracting, multiplying, and dividing with negative numbers. They use the arithmetic of rational numbers as they formulate expressions and equations in one variable and use these equations to solve problems.

(3) Students continue their work with area from Grade 6, solving problems involving the area and circumference of a circle and surface area of three-dimensional objects. In preparation for work on congruence and similarity in Grade 8 they reason about relationships among two-dimensional figures using scale drawings and informal geometric constructions, and they gain familiarity with the relationships between angles formed by intersecting lines. Students work with three-dimensional figures, relating them to two-dimensional figures by examining cross-sections. They solve real-world and mathematical problems involving area, surface area, and volume of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes and right prisms.

(4) Students build on their previous work with single data distributions to compare two data distributions and address questions about differences between populations. They begin informal work with random sampling to generate data sets and learn about the importance of representative samples for drawing inferences.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 7

Ratios of Proportional Relationships (RP) Analyze proportional relationships and use them to solve real-world and mathematical problems.	
Standards	*Mathematical Practices*
Students are expected to:	
7.RP.1. Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. *For example, if a person walks ½ mile in each ¼ hour, compute the unit rate as the complex fraction ½/¼ miles per hour, equivalently 2 miles per hour.* Connections: 6-8.RST.7; SC07-S1C2-04; ET07-S1C1-01	• Reason abstractly and quantitatively. • Attend to precision.
7.RP.2. Recognize and represent proportional relationships between quantities. a. Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin. b. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships. c. Represent proportional relationships by equations. *For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as t = pn.* d. Explain what a point (*x*, *y*) on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, *r*) where *r* is the unit rate. ***DG7-S3-C3-DPO4*** Compare, identify and write quantities using ratios. ***DG7-S3-C3-DPO5*** Determine and identify equal ratios as proportions. ***DG7-S3-C4-PO1*** Analyze change in various linear contextual situations Connections: 6-8.WHST.2c-f; 6-8.WHST.1c; 6-8.RST.7; 6-8.RST.4; ET07-S6C2-03; ET07-S1C1-01; SC07-S1C4-01; SC07-S2C2-03	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(DGK-S1-C1-PO4 - Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 7

Ratios of Proportional Relationships (RP) Analyze proportional relationships and use them to solve real-world and mathematical problems.	
Standards	*Performance Objectives*
Students are expected to:	
7.RP.3. Use proportional relationships to solve multistep ratio and percent problems. *Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.* ***DG7-S3-C3-DPO6 (OURS IS MORE GENERAL)*** Solve problems using ratios, proportions and percents. Connections: 6-8.RST.3; SS07-S5C3-01; SC07-S4C3-04; SC07-S4C3-05	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(DGK-S1-C1-PO4 - Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 7

The Number System (NS) Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers	
Standards	*Performance Objectives*
Students are expected to:	
7.NS.1. Apply and extend previous understandings of addition and subtraction to add and subtract rational numbers; represent addition and subtraction on a horizontal or vertical number line diagram. a. Describe situations in which opposite quantities combine to make 0. *For example, a hydrogen atom has 0 charge because its two constituents are oppositely charged.* b. Understand $p + q$ as the number located a distance $\|q\|$ from p, in the positive or negative direction depending on whether q is positive or negative. Show that a number and its opposite have a sum of 0 (are additive inverses). Interpret sums of rational numbers by describing real-world contexts. c. Understand subtraction of rational numbers as adding the additive inverse, $p - q = p + (-q)$. Show that the distance between two rational numbers on the number line is the absolute value of their difference, and apply this principle in real-world contexts. d. Apply properties of operations as strategies to add and subtract rational numbers. **DG7-S1-C1-PO4** Choose the appropriate signed real number to represent a contextual situation. **DG7-S1-C1-PO5** Recognize the absolute value of a number used in contextual situations. **DG7-S1-C2-PO1** Add integers. . **DG7-S1-C2-PO2** Subtract integers. **DG7-S1-C2-PO7** Apply grade-level appropriate properties to assist in computation. **DG7-S1-C2-PO8** Apply the symbols + and – to represent positive and negative, and "| |" to represent absolute value. Connections: 6-8.WHST.2f; 6-8.WHST.2b; 6-8.RST.3; 6-8.RST.7; ET07-S1C1-01; SS07-S4C5-04	• Reason abstractly and quantitatively. • Model with mathematics. • Look for and make use of structure.

(DGK-S1-C1-PO4 - Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 7

The Number System (NS) Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers	
Standards	*Performance Objectives*
7.NS.2. Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers. a. Understand that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as $(-1)(-1) = 1$ and the rules for multiplying signed numbers. Interpret products of rational numbers by describing real-world contexts. b. Understand that integers can be divided, provided that the divisor is not zero, and every quotient of integers (with non-zero divisor) is a rational number. If p and q are integers, then $-(p/q) = (-p)/q = p/(-q)$. Interpret quotients of rational numbers by describing real-world contexts. c. Apply properties of operations as strategies to multiply and divide rational numbers. d. Convert a rational number to a decimal using long division; know that the decimal form of a rational number terminates in 0s or eventually repeats. ***DG7-S1-C2-PO5*** Multiply integers. ***DG7-S1-C2-PO6*** Divide integers. ***DG7-S1-C2-PO7*** Apply grade-level appropriate properties to assist in computation. ***DG7-S1-C2-DPO3*** Convert ratios, fractions, decimals and percents from one to another. ***DG7-S1-C2-DPO6*** Identify the properties of addition and multiplication: Commutative, Associative, Distributive, and Identity. Connections: 6-8.RST.4; 6-8.RST.5; SC07-S1C3-01; SS07-S5C3-04	• Reason abstractly and quantitatively. • Model with mathematics. • Look for and make use of structure.

(DGK-S1-C1-PO4 - Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 7

The Number System (NS) Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers	
Standards	*Performance Objectives*
Students are expected to:	
7.NS.3. Solve real-world and mathematical problems involving the four operations with rational numbers. (Computations with rational numbers extend the rules for manipulating fractions to complex fractions.) ***DG7-S1-C2-PO3*** Select the grade-level appropriate operation to solve word problems. ***DG7-S1-C2-PO4*** Solve word problems using grade-level appropriate operations and numbers. ***DG7-S5-C1-PO2*** Analyze algorithms for computing with fractions. Connection: 6-8.RST.3	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(DGK-S1-C1-PO4 - Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Expressions and Equations (EE) Use properties of operations to generate equivalent expressions.	
Standards	*Performance Objectives*
Students are expected to:	
7.EE.1. Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients. Connection: 6-8.RST.5	• Reason abstractly and quantitatively. • Attend to precision. • Look for and make use of structure.
7.EE.2. Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. *For example, a + 0.05a = 1.05a means that "increase by 5%" is the same as "multiply by 1.05."* Connections: 6-8.WHST.1b,c; 6-8.WHST.2b-c; 6-8.RST.3; 6-8.RST.7; SS07-S5C2-09; SC07-S2C2-03	• Reason abstractly and quantitatively. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 7

Expressions and Equations (EE) Solve real-life and mathematical problems using numerical and algebraic expressions and equations.	
Standards	*Performance Objectives*
Students are expected to:	
7.EE.3. Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. ***DG7-S3-C3-PO2*** Use variables in contextual situations. ***DG7-S3-C3-PO3*** Translate a written sentence into a one-step, one-variable algebraic equation. ***DG7-S3-C3-DPO1*** Translate a written sentence into a two-step, one-variable algebraic equation. ***DG7-S3-C3-PO4*** Translate a sentence written in context into an algebraic equation involving one operation. ***DG7-S1-C3-PO2*** Use estimation to verify the reasonableness of a calculation (e.g., Is –2.5 x 18 about –50?). Connections: 6-8.WHST.1b,c; 6-8.WHST2b; 6-8.RST.7; ET07-S6C2-03 ***(Does not cover enough problem solving and application)***	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(DGK-S1-C1-PO4 - Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 7

Expressions and Equations (EE) Solve real-life and mathematical problems using numerical and algebraic expressions and equations.	
Standards	*Performance Objectives*
Students are expected to:	
7.EE.4. Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. a. Solve word problems leading to equations of the form $px+q=r$ and $p(x+q)=r$, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. *For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?* b. Solve word problems leading to inequalities of the form $px+q>r$ or $px+q < r$, where p, q, and r are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem. *For example: As a salesperson, you are paid $50 per week plus $3 per sale. This week you want your pay to be at least $100. Write an inequality for the number of sales you need to make, and describe the solutions.* ***DG7-S3-C3-PO2*** Use variables in contextual situations. ***DG7-S3-C3-PO3*** Translate a written sentence into a one-step, one-variable algebraic equation. ***DG7-S3-C3-DPO1*** Translate a written sentence into a two-step, one-variable algebraic equation. ***DG7-S3-C3-PO4*** Translate a sentence written in context into an algebraic equation involving one operation. ***DG7-S3-C3-DPO3*** Express a simple inequality from a contextual situation (e.g. Joe earns more than $5.00 an hour; therefore, $x > 5$) Connections: 6-8.SRT.3; 6-8.RST.4	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(DGK-S1-C1-PO4 - Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 7

Geometry (G) Draw, construct, and describe geometrical figures and describe the relationships between them.	
Standards	*Performance Objectives*
Students are expected to:	
7.G.1. Solve problems involving scale drawings of geometric figures, such as computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale. ***DG7-S4-C4-PO8 (OURS IS WEAK)*** Compare estimated to actual lengths based on scale drawings or maps. Connections: 6-8.RST.7; SC07-S1C2-04; SS07-S4C6-03; SS07-S4C1-01; SS07-S4C1-02; ET07-S1C1-01	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(DGK-S1-C1-PO4 - Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Geometry (G) Draw, construct, and describe geometrical figures and describe the relationships between them.	
Standards	*Performance Objectives*
Students are expected to:	
7.G.2. Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle. ***DG7-S4-C1-PO1*** Draw a geometric figure showing specified properties (e.g., Draw an obtuse triangle.). ***DG7-S4-C1-PO5 (NO CONSTRUCTION)*** Draw polygons with appropriate labels. Connections: 6-8.RST.4; 6-8.RST.7; 6-8.WHST.2b,2f; SC07-S1C2-04; ET07-S1C2-01; ET07-S6C1-03	• Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.
7.G.3. Describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids. Connections: 6-8.WHST.1b; 6-8.WHST.2b	• Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Look for and make use of structure.

(DGK-S1-C1-PO4 - Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 7

Geometry (G) Solve real-life and mathematical problems involving angle measure, area, surface area, and volume..	
Standards	*Performance Objectives*
Students are expected to:	
7.G.4. Know the formulas for the area and circumference of a circle and solve problems; give an informal derivation of the relationship between the circumference and area of a circle. ***DG7-S4-C4-PO4*** Solve problems involving the circumference of a circle. ***DG7-S4-C4-PO5*** Solve problems involving the area of a circle. Connections: 6-8.WHST.1d; SC07-S2C2-03; ET07-S6C2-03; ET07-S1C4-01	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.
7.G.5. Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure. ***DG7-S4-C1-PO6 (WEAK)*** Identify the angles created by two lines and a transversal. Connection: ET07-S1C4-01	• Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.

(DGK-S1-C1-PO4 - Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Geometry (G) Solve real-life and mathematical problems involving angle measure, area, surface area, and volume..	
Standards	*Performance Objectives*
Students are expected to:	
7.G.6. Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms. ***DG7-S4-C4-PO6 (AREA)*** Solve problems for the areas of parallelograms, triangles, and circles. ***(No volume, surface area or 3D)*** Connections: 6-8.WHST.2a; ET07-S1C4-01	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 7

Statistics and Probability (SP) Use random sampling to draw inferences about a population.	
Standards	*Performance Objectives*
Students are expected to:	
7.SP.1. Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences. Connections: SS07-S4C4-04; SS07-S4C4-05; SC07-S3C1-02; SC07-S4C3-04; ET07-S4C2-01; ET07-S4C2-02; ET07-S6C2-03;	• Construct viable arguments and critique the reasoning of others. • Attend to precision.
7.SP.2. Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. *For example, estimate the mean word length in a book by randomly sampling words from the book; predict the winner of a school election based on randomly sampled survey data. Gauge how far off the estimate or prediction might be.* ***DG8-S2-C1-PO7*** Formulate reasonable predictions based on a given set of data. ***DG8-S2-C1-PO8 (PARTLY COVERED)*** Compare trends in data related to the same investigation. Connections: 6-8.WHST.1b; SC07-S1C3-04; SC07-S1C3-05; SC07-S1C3-06; SC07-S1C4-05; SC07-S2C2-03; ET07-S1C3-01; ET07-S1C3-02; ET07-S4C2-02; ET07-S6C2-03	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.

(DGK-S1-C1-PO4 - Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Statistics and Probability (SP) Draw informal comparative inferences about two populations.	
Standards	*Performance Objectives*
Students are expected to:	
7.SP.3. Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities, measuring the difference between the centers by expressing it as a multiple of a measure of variability. *For example, the mean height of players on the basketball team is 10 cm greater than the mean height of players on the soccer team, about twice the variability (mean absolute deviation) on either team; on a dot plot, the separation between the two distributions of heights is noticeable.* Connections: 6-8.WHST.1b; SC07-S1C4-01; SC07-S1C4-02; SC07-S1C4-03; SS07-S4C1-01; SS07-S4C1-02; SS07-S4C1-05; SS07-S4C4-06; SS07-S4C6-03; ET07-S1C3-01; ET07-S1C3-02; ET07-S4C2-01; ET07-S4C2-02; ET07-S6C2-03	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.
7.SP.4. Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations. *For example, decide whether the words in a chapter of a seventh-grade science book are generally longer than the words in a chapter of a fourth-grade science book.* Connections: 6-8.WHST.1b; ET07-S1C3-01; ET07-S1C3-02; ET07-S4C2-01; ET07-S4C2-02; ET07-S6C2-03; SC07-S1C3-01; SC07-S1C3-05; SC07-S1C4-03; SC07-S2C2-03; SC07-S4C3-04; SS07-S4C2-01; SS07-S4C4-06; SS07-S4C4-09	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.

(DGK-S1-C1-PO4 - Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 7

Statistics and Probability (SP) Investigate chance processes and develop, use, and evaluate probability models.	
Standards	*Performance Objectives*
Students are expected to:	
7.SP.5. Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around ½ indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event. Connections: 6-8.WHST.1b; SS07-S5C1-04; ET07-S1C3-01; ET07-S1C3-02 ***DG7-S2-C1-PO1 (DETERMINE NOT UNDERSTAND)*** Formulate questions to collect data in contextual situations. ***DG8-S2-C2-DPO1 (EXPRESS)*** Express probability as a fraction, zero or one.	• Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.

(DGK-S1-C1-PO4 - Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 7

Statistics and Probability (SP) Investigate chance processes and develop, use, and evaluate probability models.	
Standards	*Performance Objectives*
Students are expected to:	
7.SP.6. Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability. *For example, when rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times.* ***DG7-S2-C2-PO3*** Predict the outcome of a grade-level appropriate probability experiment. ***DG7-S2-C2-PO5*** Compare the outcome of an experiment to predictions made prior to performing the experiment. ***DG7-S2-C2-PO6*** Make predictions from the results of student-generated experiments using objects (e.g., coins, spinners, number cubes, cards). ***DG7-S2-C2-PO7*** Compare the results of two repetitions of the same grade-level appropriate probability experiment. Connections: 6-8.WHST.1a; ET07-S1C2-01; ET07-S1C2-02; ET07-S1C2-03; ET07-S1C3-01; ET07-S1C3-02 ET07-S4C2-01; ET07-S6C1-03; ET07-S6C2-03; SC07-S1C2-03; SC07-S1C2-05; SC07-S1C3-05; SC07-S1C4-03; SC07-S1C4-05; SC07-S2C2-03	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically.

(DGK-S1-C1-PO4 - Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 7

Statistics and Probability (SP) Investigate chance processes and develop, use, and evaluate probability models.	
Standards	*Performance Objectives*
Students are expected to:	
7.SP.7. Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. a. Develop a uniform probability model by assigning equal probability to all outcomes, and use the model to determine probabilities of events. *For example, if a student is selected at random from a class, find the probability that Jane will be selected and the probability that a girl will be selected.* b. Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process. *For example, find the approximate probability that a spinning penny will land heads up or that a tossed paper cup will land open-end down. Do the outcomes for the spinning penny appear to be equally likely based on the observed frequencies?* ***DG7-S2-C2-PO2 (PARTIAL)*** Compare probabilities to determine the fairness of a contextual situation (e.g. If John wins when two or greater shows after a six-sided number cube is rolled and Joaquin wins otherwise, is this a fair game?). Connections: 6-8.WHST.2d; SC07-S1C2-02; ET07-S1C2-01; ET07-S1C2-02; ET07-S1C2-03; ET07-S1C3-01; ET07-S1C3-02; ET07-S4C2-01; ET07-S4C2-02; ET07-S6C1-03; ET07-S6C2-03	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(DGK-S1-C1-PO4 - Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 7

Statistics and Probability (SP) Investigate chance processes and develop, use, and evaluate probability models.	
Standards	*Performance Objectives*
Students are expected to:	
7.SP.8. Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation. a. Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs. b. Represent sample spaces for compound events using methods such as organized lists, tables and tree diagrams. For an event described in everyday language (e.g., "rolling double sixes"), identify the outcomes in the sample space which compose the event. c. Design and use a simulation to generate frequencies for compound events. *For example, use random digits as a simulation tool to approximate the answer to the question: If 40% of donors have type A blood, what is the probability that it will take at least 4 donors to find one with type A blood?* ***DG7-S2-C3-PO1*** Determine all possible outcomes involving the combination of up to three sets of objects (e.g., How many outfits can be made with 3 pants, 2 tee shirts and 2 pairs of shoes?). ***DG7-S2-C3-PO2 (PARTIAL)*** Determine all possible arrangements of a given set, using a systematic list, table, tree diagram, or other representation. Connections: 6-8.WHST.2d; ET07-S1C2-01; ET07-S1C2-02; ET07-S1C2-03; SC07-S1C4-03; SC07-S1C4-05; SC07-S1C2-02; SC07-S1C2-03	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(DGK-S1-C1-PO4 - Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 7

Standards for Mathematical Practice	
Standards	
Students are expected to:	Mathematical Practices are listed throughout the grade level document in the 2nd column to reflect the need to connect the mathematical practices to mathematical content in instruction.
7.MP.1. Make sense of problems and persevere in solving them.	
7.MP.2. Reason abstractly and quantitatively.	
7.MP.3. Construct viable arguments and critique the reasoning of others.	
7.MP.4. Model with mathematics.	
7.MP.5. Use appropriate tools strategically.	
7.MP.6. Attend to precision.	
7.MP.7. Look for and make use of structure.	
7MP.8. Look for and express regularity in repeated reasoning.	

MATHEMATICS

Diocese of Phoenix Catholic Schools Academic Content Standards

Grade 8

Aligned and Adapted by Diocese of Phoenix Catholic Schools
Updated November 2013

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 8

Grade 8 Overview

The Number System (NS)
- Know that there are numbers that are not rational, and approximate them by rational numbers.

Expressions and Equations (EE)
- Work with radicals and integer exponents.
- Understand the connections between proportional relationships, lines, and linear equations.
- Analyze and solve linear equations and pairs of simultaneous linear equations.

Functions (F)
- Define, evaluate, and compare functions.
- Use functions to model relationships between quantities.
-

Geometry (G)
- Understand congruence and similarity using physical models, transparencies, or geometry software.
- Understand and apply the Pythagorean Theorem.
- Solve real-world and mathematical problems involving volume of cylinders, cones and spheres.

Statistics and Probability (SP)
- Investigate patterns of association in bivariate data.

Performance Objectives
1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 8

In Grade 8, instructional time should focus on three critical areas: (1) formulating and reasoning about expressions and equations, including modeling an association in bivariate data with a linear equation, and solving linear equations and systems of linear equations; (2) grasping the concept of a function and using functions to describe quantitative relationships; (3) analyzing two- and three-dimensional space and figures using distance, angle, similarity, and congruence, and understanding and applying the Pythagorean Theorem.

(1) Students use linear equations and systems of linear equations to represent, analyze, and solve a variety of problems. Students recognize equations for proportions ($y/x = m$ or $y = mx$) as special linear equations ($y = mx + b$), understanding that the constant of proportionality (m) is the slope, and the graphs are lines through the origin. They understand that the slope (m) of a line is a constant rate of change, so that if the input or x-coordinate changes by an amount A, the output or y-coordinate changes by the amount $m \cdot A$. Students also use a linear equation to describe the association between two quantities in bivariate data (such as arm span vs. height for students in a classroom). At this grade, fitting the model, and assessing its fit to the data are done informally. Interpreting the model in the context of the data requires students to express a relationship between the two quantities in question and to interpret components of the relationship (such as slope and y-intercept) in terms of the situation.

Students strategically choose and efficiently implement procedures to solve linear equations in one variable, understanding that when they use the properties of equality and the concept of logical equivalence, they maintain the solutions of the original equation. Students solve systems of two linear equations in two variables and relate the systems to pairs of lines in the plane; these intersect, are parallel, or are the same line. Students use linear equations, systems of linear equations, linear functions, and their understanding of slope of a line to analyze situations and solve problems.

(2) Students grasp the concept of a function as a rule that assigns to each input exactly one output. They understand that functions describe situations where one quantity determines another. They can translate among representations and partial representations of functions (noting that tabular and graphical representations may be partial representations), and they describe how aspects of the function are reflected in the different representations.

(3) Students use ideas about distance and angles, how they behave under translations, rotations, reflections, and dilations, and ideas about congruence and similarity to describe and analyze two-dimensional figures and to solve problems. Students show that the sum of the angles in a triangle is the angle formed by a straight line, and that various configurations of lines give rise to similar triangles because of the angles created when a transversal cuts parallel lines. Students understand the statement of the Pythagorean Theorem and its converse, and can explain why the Pythagorean Theorem holds, for example, by decomposing a square in two different ways. They apply the Pythagorean Theorem to find distances between points on the coordinate plane, to find lengths, and to analyze polygons. Students complete their work on volume by solving problems involving cones, cylinders, and spheres.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 8

The Number System (NS) Know that there are numbers that are not rational, and approximate them by rational numbers.	
Standards	*Performance Objectives*
Students are expected to:	
8.NS.1. Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number. ***DG8.S1-C1:PO2*** Identify irrational numbers. ***DG8.S1-C1:PO3*** Classify real numbers as rational or irrational. ***DG8.S1.C1:DPO1*** Represent and use numbers in equivalent forms (integers, fractions, percents, decimals, exponents, scientific notation and square roots) ***DG8.S1-C1:DPO2*** Identify greatest common factor and least common multiple for a set of whole numbers • find multiples, common multiples and least common multiple of two or more numbers • find factors, common factors and greatest common factor of two or more numbers Connections: 8.EE.4; 8.EE.7b; 6-8.RST.4; 6-8.RST.7	• Reason abstractly and quantitatively. • Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** **-**Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 8

The Number System (NS) Know that there are numbers that are not rational, and approximate them by rational numbers.	
Standards	*Performance Objectives*
Students are expected to:	
8.NS.2. Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., π^2). *For example, by truncating the decimal expansion of $\sqrt{2}$, show that $\sqrt{2}$ is between 1and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.* ***DG8.S1-C1:PO1*** Locate rational numbers on a number line. ***DG8.S1-C1:PO2*** Identify irrational numbers. ***DG8.S1-C1:PO3*** Classify real numbers as rational or irrational. ***DG8.S1.C1:DPO1*** Represent and use numbers in equivalent forms (integers, fractions, percents, decimals, exponents, scientific notation and square roots) ***DG8.S1-C1:DPO2*** Identify greatest common factor and least common multiple for a set of whole numbers • find multiples, common multiples and least common multiple of two or more numbers • find factors, common factors and greatest common factor of two or more numbers Connections: 8.G.7; 8.G.8; 6-8.RST.5; ET08-S1C2-01	• Reason abstractly and quantitatively. • Model with mathematics. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-PO4*** **-**Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 8

Expressions and Equations (EE) Work with radicals and integer exponents.	
Standards	*Performance Objectives*
Students are expected to:	
8.EE.1. Know and apply the properties of integer exponents to generate equivalent numerical expressions. *For example,* $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$.	• Reason abstractly and quantitatively. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.
8.EE.2. Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that √2 is irrational. ***DG8.S1.C1:PO2*** Identify irrational numbers. ***DG8.S1.C1:PO3*** Classify real numbers as rational or irrational. ***DG8.S1.C2:PO3*** Determine the square of an integer. ***DG8.S1.C2:PO4*** Determine the square root of an integer. ***DG8.S1-C2:PO5*** Identify squaring and finding square roots as inverse operations. ***DG8.S1.C2:PO6*** Apply grade-level appropriate properties to assist in computation. ***DG8.S1.C2:PO7*** Apply the symbols "√" to represent square root, "±" to represent roots, and "{}" as grouping symbols. Connections: 8.G.7; 8.G.8; 6-8.RST.4	• Reason abstractly and quantitatively. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** **-**Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 8

Expressions and Equations (EE) Work with radicals and integer exponents.	
Standards	*Performance Objectives*
Students are expected to:	
8.EE.3. Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. *For example, estimate the population of the United States as 3×10^8 and the population of the world as 7×10^9, and determine that the world population is more than 20 times larger.* ***DG8.S1.C2:PO10*** Convert standard notation to scientific notation, and vice versa.	• Reason abstractly and quantitatively. • Use appropriate tools strategically. • Attend to precision.
8.EE.4. Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology. ***DG8.S1.C2:PO10*** Convert standard notation to scientific notation, and vice versa. Connections: 8.NS.1; 8.EE.1; ET08-S6C1-03	• Reason abstractly and quantitatively. • Use appropriate tools strategically. • Attend to precision.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 8

Expressions and Equations (EE) Understand the connections between proportional relationships, and linear equations.	
Standards	*Performance Objectives*
Students are expected to:	
8.EE.5. Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. *For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.* ***DG8.S2.C1;PO1*** Formulate questions to collect data in contextual situations. ***DG8.S2.C1:PO4*** Interpret box-and-whisker plots, circle graphs, and scatter plots. ***DG8.S2.C1:PO7*** Formulate reasonable predictions based on a given set of data. ***DG8.S2.C1:PO8*** Compare trends in data related to the same investigation. ***DG8.S2.C1:PO9*** Solve contextual problems using scatter plots, box-and-whiskers plots, and double line graphs of continuous data. ***DG8.S2.C1:PO12*** Distinguish between causation and correlation. ***DG8.S3.C2:PO3*** Determine whether a graph or table is related to a given equation of the form $y=ax^2$ where '*a*' is a natural number. ***DG8.S3.C2:PO4*** Identify independent and dependent variables for a contextual situation. ***DG8S3.C3:PO2*** Use variables in contextual situations ***DG8.S3.C4:PO1*** Identify the slope of a line as the rate of change (the ratio of rise over run). Connections: 8.F.2; 8.F.3; 6-8.RST.7; 6-8.WHST.2b; SC08-S5C2-01; SC08-S5C2-05	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-PO4*** **-**Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 8

Expressions and Equations (EE) Understand the connections between proportional relationships, and linear equations.	
Standards	*Performance Objectives*
Students are expected to:	
8.EE.6. Use similar triangles to explain why the slope *m* is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation $y = mx$ for a line through the origin and the equation $y = mx + b$ for a line intercepting the vertical axis at *b*. ***DG8.S3.C2;PO1*** Describe the rule used in a simple grade-level appropriate function (e.g., T-chart, input/output model). ***DG8.S3.C2:DPO1*** Represent and analyze patterns and relationships using shapes, tables, graphs, data points, verbal rules and standard algebraic notation. ***DG8.S3.C2:PO3*** Determine whether a graph or table is related to a given equation of the form $y=ax^2$ where '*a*' is a natural number. ***DG8.S4.C1:PO1*** Draw a model that demonstrates basic geometric relationships such as parallelism, perpendicularity, similarity/proportionality, and congruence. ***DG8.S4.C4:PO6*** Identify the properties of angles created by a transversal intersecting two parallel lines (e.g., corresponding angles are congruent). ***DG8.S5.C1:PO1*** Describe how to use a proportion to solve a problem in context. Connections: 8.F.3; 8.G.4; 6-8.RST.3; 6-8.WHST.1b; ET08-S1C2-01; ET08-S6C1-03	• Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-PO4*** **-**Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 8

Expressions and Equations (EE) Analyze and solve linear equations and pairs of simultaneous linear equations.	
Standards	*Performance Objectives*
Students are expected to:	
8.EE.7. Solve linear equations in one variable. a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form $x = a$, $a = a$, or $a = b$ results (where a and b are different numbers). b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms. ***DG8.S1.C2:DPO1*** Identify the properties of addition and multiplication: Commutative, Associative, Distributive, and Identity. ***DG8.S1.C2:PO6*** Apply grade-level appropriate properties to assist in computation. ***DG8.S1.C2:PO8*** Use grade-level appropriate mathematical terminology. ***DG8.S1.C2:PO11*** Simplify numerical expressions using the order of operations with grade- appropriate operations on number sets. ***DG8.S3.C2:PO2*** Distinguish between linear and nonlinear functions, given graphic examples. ***DG8.S3.C2:PO3*** Determine whether a graph or table is related to a given equation of the form $y=ax^2$ where 'a' is a natural number. ***DG8.S3.C3:PO7*** Solve one-step equations with rational numbers as coefficients or as solutions. Connections: 8.F.3; 8.NS.1; 6-8.RST.3; ET08-S1C3-01	• Reason abstractly and quantitatively. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** **-**Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 8

Expressions and Equations (EE) Analyze and solve linear equations and pairs of simultaneous linear equations.	
Standards	*Performance Objectives*
Students are expected to:	
8.EE.8. Analyze and solve pairs of simultaneous linear equations. a. Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously. b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. *For example, 3x + 2y = 5 and 3x + 2y = 6 have no solution because 3x + 2y cannot simultaneously be 5 and 6.* c. Solve real-world and mathematical problems leading to two linear equations in two variables. *For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.* ***DG8.S2.C4:PO1*** Solve contextual problems represented by vertex-edge graphs. Connections: 6-8.RST.7; ET08-S1C2-01; ET08-S1C2-02	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-PO4*** **-**Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 8

Functions (F) Define, evaluate, and compare functions.	
Standards	*Performance Objectives*
Students are expected to:	
8.F.1. Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output. (Function notation is not required in Grade 8.) Connection: SC08-S5C2-05	• Reason abstractly and quantitatively. • Attend to precision.
8.F.2. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.* ***DG8.S3.C2:PO1*** Describe the rule used in a simple grade-level appropriate function (e.g., T-chart, input/output model). ***DG8.S3.C2:DPO1*** Represent and analyze patterns and relationships using shapes, tables, graphs, data points, verbal rules and standard algebraic notation. ***DG8.S3.C2:PO4*** Identify independent and dependent variables for a contextual situation. Connections: 8.EE.5; 8.F.2; 6-8.RST.7; 6-8.WHST.1b; ET08-S1C3-01	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.
8.F.3. Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. *For example, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.* ***DG8.S3.C2:PO2*** Distinguish between linear and nonlinear functions, given graphic examples. Connections: 8.EE.5; 8.EE.7a ; 6-8.WHST.1b; ET08-S6C1-03	• Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** **-**Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 8

Functions (F) Use functions to model relationships between quantities.	
Standards	*Performance Objectives*
Students are expected to:	
8.F.4. Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (*x*, *y*) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values. ***DG8.S3.C1:PO1*** Communicate a grade-level appropriate iterative or recursive pattern, using symbols or numbers. ***DG8.S3.C1:PO2*** Extend a grade-level appropriate iterative or recursive pattern. ***DG8.S3.C1:PO3*** Solve grade-level appropriate iterative or recursive pattern problems. ***DG8.S3.C2:PO1*** Describe the rule used in a simple grade-level appropriate function (e.g., T-chart, input/output model). ***DG8.S3.C2:DPO1*** Represent and analyze patterns and relationships using shapes, tables, graphs, data points, verbal rules and standard algebraic notation ***DG8.S3.C2:PO3*** Determine whether a graph or table is related to a given equation of the form $y=ax^2$ where '*a*' is a natural number. ***DG8.S3.C2:PO4*** Identify independent and dependent variables for a contextual situation. ***DG8.S3.C4:PO1*** Identify the slope of a line as the rate of change (the ratio of rise over run). Connections: 8.EE.5; 8.SP2; 8.SP.3; ET08-S1C2-01; SC08-S5C2-01; SC08-S1C3-02	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-PO4*** **-**Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 8

Functions (F) Use functions to model relationships between quantities.	
Standards	*Performance Objectives*
Students are expected to:	
8.F.4. Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (*x*, *y*) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values. ***DG8.S3.C1:PO1*** Communicate a grade-level appropriate iterative or recursive pattern, using symbols or numbers. ***DG8.S3.C1:PO2*** Extend a grade-level appropriate iterative or recursive pattern. ***DG8.S3.C1:PO3*** Solve grade-level appropriate iterative or recursive pattern problems. ***DG8.S3.C2:PO1*** Describe the rule used in a simple grade-level appropriate function (e.g., T-chart, input/output model). ***DG8.S3.C2:DPO1*** Represent and analyze patterns and relationships using shapes, tables, graphs, data points, verbal rules and standard algebraic notation. ***DG8.S3.C2:PO3*** Determine whether a graph or table is related to a given equation of the form $y=ax^2$ where '*a*' is a natural number. ***DG8.S3.C2:PO4*** Identify independent and dependent variables for a contextual situation. ***DG8.S3.C4:PO1*** Identify the slope of a line as the rate of change (the ratio of rise over run). Connections: 8.EE.5; 8.SP2; 8.SP.3; ET08-S1C2-01; SC08-S5C2-01; SC08-S1C3-02	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-PO4*** **-**Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 8

Functions (F) Use functions to model relationships between quantities.	
Standards	*Performance Objectives*
Students are expected to:	
8.F.5. Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally. ***DG8.S3.C2:PO4*** Identify independent and dependent variables for a contextual situation. ***DG8.S3.C3:PO6*** Identify an equation or inequality that represents a contextual situation. ***DG8.S3.C4:PO1*** Identify the slope of a line as the rate of change (the ratio of rise over run). Connections: 6-8.WHST.2a-f; ET08-S1C2-01; SC08-S5C2-05	• Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** **-**Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 8

Geometry (G) Understand congruence and similarity using physical models, transparencies, or geometry software.	
Standards	*Performance Objectives*
Students are expected to:	
8.G.1. Verify experimentally the properties of rotations, reflections, and translations: a. Lines are taken to lines, and line segments to line segments of the same length. b. Angles are taken to angles of the same measure. c. Parallel lines are taken to parallel lines. ***DG8.S4.C1:PO6*** Identify the properties of angles created by a transversal intersecting two parallel lines (e.g., corresponding angles are congruent). ***DG8.S4.C2:PO1*** Identify the planar geometric figure that is the result of a given rigid transformation.	• Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.
8.G.2. Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them. ***DG8.S4.C1:PO1*** Draw a model that demonstrates basic geometric relationships such as parallelism, perpendicularity, similarity/proportionality, and congruence. ***DG8.S4.C1:PO2*** Draw 3-dimensional figures by applying properties of each (e.g., parallelism, perpendicularity, congruency). ***DG8.S4.C2:PO1*** Identify the planar geometric figure that is the result of a given rigid transformation. Connections: 6-8.WHST.2b,f; ET08-S6C1-03	• Reason abstractly and quantitatively. • Model with mathematics. • Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** **-**Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 8

Geometry (G) Understand congruence and similarity using physical models, transparencies, or geometry software.	
Standards	*Performance Objectives*
Students are expected to:	
8.G.3. Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates. Connections: 6-8.WHST.2b,f; ET08-S6C1-03 ***DG8.S4.C2:PO1*** Identify the planar geometric figure that is the result of a given rigid transformation. ***DG8.S4.C3:PO2*** Determine the midpoint given two points on a number line. ***DG8.S4.C3:PO3*** Determine the distance between two points on a number line.	• Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.
8.G.4. Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them. ***DG8.S4.C1:PO1*** Draw a model that demonstrates basic geometric relationships such as parallelism, perpendicularity, similarity/proportionality, and congruence. ***DG8.S4.C1:PO10*** Identify corresponding angles of similar polygons as congruent and sides as proportional. ***DG8.S4.C2:PO1*** Identify the planar geometric figure that is the result of a given rigid transformation. Connections: 8.EE.6; 6-8.WHST.2b,f; ET08-S6C1-03; ET08-S1C1-01	• Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** **-**Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Geometry (G) Understand congruence and similarity using physical models, transparencies, or geometry software.	
Standards	*Performance Objectives*
Students are expected to:	
8.G.5. Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. *For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.* ***DG8.S4.C1:PO6*** Identify the properties of angles created by a transversal intersecting two parallel lines (e.g., corresponding angles are congruent). ***DG8.S4.C1:PO9*** Determine whether three given lengths can form a triangle. Connections: 6-8.WHST.2b,f; 6-8.WHST.1b; ET08-S6C1-03; ET08-S1C1-01; ET08-S1C3-03	• Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 8

Geometry (G) Understand and apply the Pythagorean Theorem.	
Standards	*Performance Objectives*
Students are expected to:	
8.G.6. Explain a proof of the Pythagorean Theorem and its converse. ***DG8.S3.C2:PO4*** Identify independent and dependent variables for a contextual situation. ***DG8.S3.C3:PO12*** Solve applied problems using the Pythagorean theorem. Connections: 6-8.WHST.2a-f; ET08-S1C2-01	• Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Attend to precision. • Look for and make use of structure.
8.G.7. Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. ***DG8.S1.C2:PO4*** Determine the square root of an integer. ***DG8.S1.C2:PO5*** Identify squaring and finding square roots as inverse operations. ***DG8.S3.C3:PO12*** Solve applied problems using the Pythagorean theorem. ***DG8.S4.C4:PO5*** Find the measure of a missing interior angle in a triangle or quadrilateral. ***DG8.S4.C4:PO7*** Calculate the length of a side, given two similar triangles. Connections: 8.NS.2; ET08-S2C2-01	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** **-**Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 8

Geometry (G) Understand and apply the Pythagorean Theorem.	
Standards	*Performance Objectives*
Students are expected to:	
8.G.8. Apply the Pythagorean Theorem to find the distance between two points in a coordinate system. Connections: 8.NS.2; ET08-S6C1-03 ***DG8.S2.C4:PO1*** Solve contextual problems represented by vertex-edge graphs. ***DG8.S3.C3:PO12*** Solve applied problems using the Pythagorean theorem. ***DG8.S4.C3:PO3*** Determine the distance between two points on a number line.	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.
8.G.9. Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems. ***DG8.S4.C1:PO1*** Draw a model that demonstrates basic geometric relationships such as parallelism, perpendicularity, similarity/proportionality, and congruence. ***DG8.S4.C1:PO2*** Draw 3-dimensional figures by applying properties of each (e.g., parallelism, perpendicularity, congruency). ***DG8.S4.C1:PO3*** Recognize the 3-dimensional figure represented by a net. ***DG8.S4.C4:PO2*** Solve problems involving the volume of rectangular prisms and cylinders ***DG8.S4.C4:PO4*** Identify rectangular prisms and cylinders having the same volume. Connections: 6-8.RST.3; 6-8.RST.7; ET08-S2C2-01; ET08-S1C4-01	• Make sense of problems and persevere in solving them. • Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure. • Look for and express regularity in repeated reasoning.

(***DGK-S1-C1-PO4*** **-**Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 8

Statistics and Probability (SP) Investigate patterns of association in bivariate data.	
Standards	*Performance Objectives*
Students are expected to:	
8.SP.1. Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association. ***DG8.S2.C1:PO3*** Determine the appropriate type of graphical display for a given data set. ***DG8.S2.C1:PO4*** Interpret box-and-whisker plots, circle graphs, and scatter plots. ***DG8.S2.C1:PO5*** Answer questions based on box-and-whisker plots, circle graphs, and scatter plots. ***DG8.S2.C1:PO6*** Solve problems in contextual situations using the mean, median, mode, and range of a given data set. ***DG8.S2.C1.PO8*** Compare trends in data related to the same investigation. ***DG8.S2.C1:PO9*** Solve contextual problems using scatter plots, box-and-whiskers plots, and double line graphs of continuous data. ***DG8.S2.C1:PO10*** Evaluate the effects of missing or incorrect data on the results of an investigation (e.g., Susie's teacher recorded a 39 instead of a 93 for her last quiz, what will happen to Susie's average?). ***DG8.S2.C1:PO11*** Identify a line of best fit for a scatter plot. ***DG8.S2.C1:PO12*** Distinguish between causation and correlation. ***DG8.S2.C2.PO3*** Predict the outcome of a grade-level appropriate probability experiment. ***DG8.S2.C2.PO4*** Record the data from performing a grade-level appropriate probability experiment.	• Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** **-**Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Statistics and Probability (SP) Investigate patterns of association in bivariate data.	
Standards	*Performance Objectives*
Students are expected to:	
8.SP.1 (Continued) ***DG8.S2.C2.PO6*** Distinguish between independent and dependent events. ***DG8.S2.C2.PO7*** Compare the results of two repetitions of the same grade-level appropriate probability experiment. ***DG8.S2.C3:PO1*** Determine all possible outcomes involving the combination of two or more sets of objects (e.g., If you roll a six-sided number cube 4 times, how many possible outcomes are possible?). ***DG8.S2.C2:PO2*** Solve contextual situations using probability (e.g., If the probability of Michelle making a free throw is 0.25, what is the probability that she will make three free throws in a row?). Connections: 6-8.WHST.2b,f; ET08-S1C3-01; ET08-S1C3-02; ET08-S6C1-03; SS08-S4C1-01;SS08-S4C2-03; SS08-S4C1-05; SC08-S1C3-02; SC08-S1C3-03	
8.SP.2. Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line. ***DG8.S2.C1.PO8*** Compare trends in data related to the same investigation. ***DG8.S2.C1:PO11*** Identify a line of best fit for a scatter plot. Connections: 8.EE.5; 8.F.3; ET08-S1C3-01; ET08-S6C1-03; SS08-S4C1-05;	• Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** **-**Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 8

Statistics and Probability (SP) Investigate patterns of association in bivariate data.	
Standards	*Performance Objectives*
Students are expected to:	
8.SP.3. Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. *For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height*. ***DG8.S2.C1.PO7*** Formulate reasonable predictions based on a given set of data. ***DG8.S2.C1:PO11*** Identify a line of best fit for a scatter plot. ***DG8.S2.C2:PO2*** Construct box-and-whisker plots. Connections: 8.EE.5; 8.F.3; 8.F.4; ET08-S1C3-03; ET08-S2C2-01;	• Reason abstractly and quantitatively. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.
8.SP.4. Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. *For example, collect data from students in your class on whether or not they have a curfew on school nights and whether or not they have assigned chores at home. Is there evidence that those who have a curfew also tend to have chores?* ***DG8.S2.C1:PO1*** Formulate questions to collect data in contextual situations. ***DG8.S2.C1.PO3*** Determine the appropriate type of graphical display for a given data set. (Continued on next page)	• Reason abstractly and quantitatively. • Construct viable arguments and critique the reasoning of others. • Model with mathematics. • Use appropriate tools strategically. • Attend to precision. • Look for and make use of structure.

(***DGK-S1-C1-PO4*** **-**Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Statistics and Probability (SP) Investigate patterns of association in bivariate data.	
Standards	*Performance Objectives*
Students are expected to:	
8.SP.4 (Continued) ***DG8.S2.C1:PO5*** Answer questions based on box-and-whisker plots, circle graphs, and scatter plots. ***DG8.S2.C1.PO7*** Formulate reasonable predictions based on a given set of data. ***DG8.S2.C1:PO8*** Compare trends in data related to the same investigation. ***DG8.S2.C1.PO9*** Solve contextual problems using scatter plots, box-and-whiskers plots, and double line graphs of continuous data. ***DG8.S2.C1:PO11*** Identify a line of best fit for a scatter plot. ***DG8.S2.C1.PO12*** Distinguish between causation and correlation. ***DG8.S2.C2:PO1*** Determine the probability that a specific event will occur in a 2-stage probability experiment. ***DG8.S2.C2:PO6*** Distinguish between independent and dependent events. Connections: 6-8.WHST.2b,f; ET08-S1C1-01; ET08-S1C3-02; ET08-S1C3-03; SS08-S4C2-03; SS08-S4C1-05; SC08-S1C3-02	

(***DGK-S1-C1-PO4*** **-**Diocesan Guidelines Grade K, Strand 1, Concept 1, Diocesan Performance Objective 4)

Diocese of Phoenix Mathematics Standards Articulated by Grade Level
Grade 8

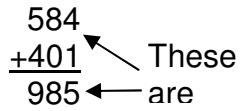
Standards for Mathematical Practice	
Standards	
Students are expected to:	Performance Objectives are listed throughout the grade level document in the 2nd column to reflect the need to connect the mathematical practices to mathematical content in instruction.
8.MP.1. Make sense of problems and persevere in solving them.	
8.MP.2. Reason abstractly and quantitatively.	
8.MP.3. Construct viable arguments and critique the reasoning of others.	
8.MP.4. Model with mathematics.	
8.MP.5. Use appropriate tools strategically.	
8.MP.6. Attend to precision.	
8.MP.7. Look for and make use of structure.	
8.MP.8. Look for and express regularity in repeated reasoning.	

DIOCESE OF PHOENIX
MATHEMATICS GLOSSARY

The purpose of this glossary is to help the user better implement the Elementary Mathematics Curriculum Standards of the Diocese of Phoenix. It is not an exhaustive list of mathematical terms.

Absolute Value A number's distance from zero on a number line. The absolute value of –4 is 4; the absolute value of 4 is 4.

Addends Numbers to be added.



Addition and subtraction within 5, 10, 20, 100, 04 1000.

Addition or subtraction of two whole number with whole number answers, and with sum or minuend in the range of 0-5, 0-10, 0-20, or 0-100, respectively. Example: 8 + 2 = 10 is an addition within 10, 14-5 = 9 is a subtraction within 20, and 55 – 18 = 37 is a subtraction within 100.

Additive inverses. Two numbers whose sum is 0 are additive inverses of one another. Example: ¾ and -3/4 are additive inverses of one another because ¾ + (-3/4) = (-3/4) + ¾ = 0.

Algebra A mathematical language that uses letters along with numbers. The letters stand for numbers that are unknown. x – 3 = 17 is an example of an algebra problem.

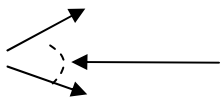
Algebraic Methods The use of symbols to represent quantities and signs to represent their relationships.

Algebraic Sentence A general term for equations and inequalities.

Algorithms A mechanical procedure for performing a given calculation or solving a problem through step-by step procedures such as those used in long division.

Analog Time Time displayed on a timepiece having hour and minutes hands.

Angle Two rays with a common endpoint form an angle



Angle Measure The measure of the space between two lines that meet in a point. Angles are measured in degrees or radians.

Area The number of square units needed to cover a surface like a wall, floor or other two-dimensional shape.

Array Arrangement of a series of items according to the values of the items, e.g., largest to smallest.

Associative Property a+(b+c)=(a+b)+c or ax(bxc)=(axb)xc. Changing the order in which you group numbers when adding or multiplying does not change the answer.

Axiomatic Systems Systems that include self-evident truths; truths without proof and from which further statements, or theorems, can be derived.

Binomial In algebra, an expression consisting of two terms connected by a plus or minus sign, such as 4a + 6.

Box-and-Whisker Plot A graphic method for showing a summary of data using median, quartiles and extremes of data. A box plot shows where the data are spread out and where they are concentrated.

Capacity The volume of a container given in units of liquid measure.

Cardinality (of a set) The number of elements in a set. Example: A = {4, 6, -9, 12} n (A)=4 (because there are 4 elements in set A)

Census The count of a population.

Closed Interval An interval which includes both endpoints.

$a \leq x \leq b$

Combinations Subsets of a larger number of items (e.g., the number of different teams of three that can be chosen from a group of 21).

Common Factor A number that is a factor of two or more numbers. Common factors of 2 and 8 are 1 and 2.

Common Multiple Multiple that two or more numbers share. Some multiples of 2 are 2, 4, 6, 8, 10, 12. Some multiples of 3 are 3, 6, 9, 12. The first two common multiples of 2 and 3 are 6 and 12.

Commutative Property axb=bxa or a+b=b+a. Changing the order of the numbers when multiplying or adding numbers does not change the answer.

Complex fraction A fraction A/B where A and/or B are fractions (B nonzero).

Computation algorithm
A set of predefined steps applicable to a class of problems that gives the correct result in every case when the steps are carried out correctly. See also: computation strategy.

Computation strategy.
Purposeful manipulations that may be chosen for specific problems, may not have a fixed order, and may be aimed at converting one problem into another. See also: computation algorithm.

Composite Numbers Any positive integer exactly divisible by one or more positive integers other than itself and 1. Numbers that have 3 or more factors.

Computational Techniques Operations or tools-number lines, calculators.

Complex Numbers Numbers that have the form a + bi where a and b are real numbers and i is an imaginary number.

Congruent Two plain or solid figures are congruent if one can be obtained from the other by rigid motion (a sequence of rotations, reflections, and translations).

Congruency The state of having the same size and shape.

Conjecture An inference drawn from observed patterns in several examples.

Constant Monomials that contain no variables.

Contextual Situation Relating mathematical problems to real, modeled or illustrated circumstance.

Coordinate System Any set of two or more magnitudes used to locate points, lines or curves. Commonly placed by using a horizontal axis (x-axis) and vertical axis (y-axis).

Correlation Coefficient	A statistical measure that relates how well a set of data points can be modeled by a line.
Cosine	The trigonometric function that is defined as the ratio of the leg adjacent to an angle to the hypotenuse of its right triangle.
Counterexample	An example of a conditional statement in which the hypothesis is true and the conclusion is false.
Curve Fitting	Plotting data and observing the pattern to predict trends.
Customary System	A system of weights and measures frequently used in the United States. The basic unit of weight is the pound; the basic unit of capacity is the quart.
Deductive Reasoning	A series of logical steps in which a conclusion is drawn directly from a set of statements that are known or assumed to be true.
Diameter	The distance across a circle through its center.
Dilation	A transformation that either enlarges or reduces a geometric figure proportionately.
Direct Proof	A conclusion proved through deductive reasoning.
Direct Variation	When two variables are so related that their ratio remains constant, one of them is said to vary directly as the other.
Discrete Math	The study of mathematical properties of sets and systems that have only a specific number of elements. For example, the results of tossing dice form a discrete set of events, since a die has to land on one of its six faces.
Disjoint Sets	Sets with no elements in common. If sets A and B are disjoint, then $A \cap B = \emptyset$.
Distributive Property	$a(b + c) = ab + ac$ The multiplication "is distributed" over the addition.
Domain	The set of all possible replacements for the placeholder in an open sentence.
Empirical	Relating to the collection of actual data.

Equation A statement of equality between two mathematical expressions. (e.g., x + 5 = y –2). A number sentence with an equal sign, 5 x 4 = 20.

Equivalent Forms Different forms of numbers that name the same number; e.g., fraction, decimal, percent as ½, .5, 50%.

Euclidean Transformations In geometry, the process of changing one configuration into another, including slides, rotations and reflections.

Expanded form A multi-digit number is expressed in expanded form when it is written as a sum of single-digit multiples of powers of ten. For example, 643 – 600 + 40 + 3.

Exponent A numeral used to tell how many times a number or variable is used as a factor (e.g., a2, 2n, yx).

Exponential Function A function whose general equation is $y = a \times b^x$ or $y = a \times bk^x$, where a, b and k stand for constants.

Expression A mathematical phrase with no equal sign, such as 3x, 6, 2n + 3m.

Faces Sides of a box.

Factorial The expression n! (n factorial) is the product of all the numbers from 1 to n for any positive integer n.

Factors Any of two or more quantities that are multiplied together.

Finite Graph A structure consisting of vertices and edges, where the edges indicate a mapping among the vertices (e.g., the vertices may represent players in a tournament, and the edges indicate who plays whom).

Flip A transformation, also called a reflection, that produces a mirror image of a geometric figure.

Fractal An algebraically generated complex geometric shape having the property of being endlessly self-similar under magnification. Some computer screen savers utilize fractals.

Fraction A number expressible in the form a/b where *a* is a whole number and *b* is a positive whole number. (The word *fraction* in these standards always refers to a non-negative number.) See also: rational number.

Function A dependent relationship between two sets of numbers in which a value in the first set has only one defined element in the second set.

Geoboard A board with pegs aligned in grid fashion which permits rubber bands to be wrapped around pegs to form geometric figures.

Graphing Calculator A calculator that will store and draw the graph of several functions at once.

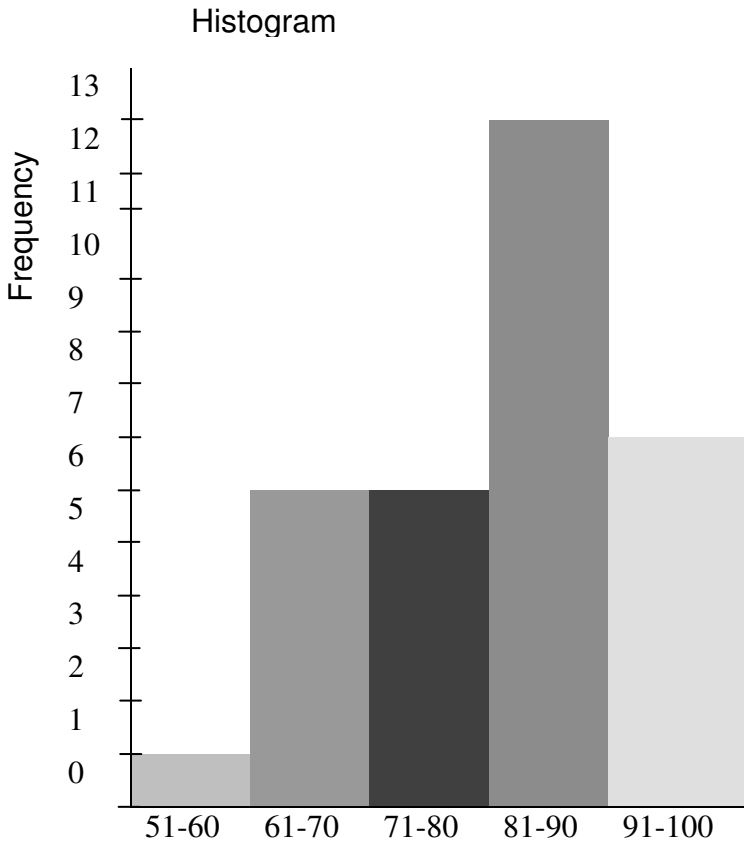
Greatest Common Factor The largest number that is a factor of two or more indicated numbers.

Hexagon A polygon with six sides.

Regular Hexagon

Non-Regular Hexagon

Histogram A special kind of bar graph that displays the frequency of data that has been organized into equal number groupings. The number groupings cover all possible values of data, therefore there are no spaces between the bars.



Independently combined probability models.

Two probability models are said to be combined independently if the probability of each ordered pair in the combined model equals the product of the original probabilities of the two individual outcomes in the ordered pair.

Identify To state, match, select, write.

Identity Property of One (multiplication) Property which states that the product of 1 and any factor is that factor.

Identity Property of Zero (addition) Property which states that the sum of any number and zero is that number.

Imaginary Numbers The square root of a negative number usually expressed using i, e.g., $(\sqrt{-9}) = 3i$.

Independent Events Events such that the outcome of the first event has no effect on the probabilities of the outcome of the second event. (e.g., two tosses of the same coin are independent events).

Indirect Proof A deductive proof using contradiction or elimination to rule out all except the desired conclusion.

Inductive Reasoning A form of reasoning from individual cases to general ones or from observed instances to unobserved ones.

Inequalities Statements indicating that two quantities are not equal, utilizing symbols > (greater than) or < (less than) and ≠.

Integers A set of numbers consisting of the whole numbers and their opposites {…-2, -1, 0, 1, 2…}.

Interquartile Range A measure of variation in a set of numerical data, the interquartile range is the distance between the first and third quartiles of the data set. Example: For the data set {1, 3, 6, 7, 10, 12, 14, 15, 22, 120}, the interquartile range is 15 – 6 = 9. See also: first quartile, third quartile.

Inverse A related but opposite process or number such as multiplication being the inverse of division and 2/1 being the inverse of ½.

Inverse Operations Operations that undo each other. (e.g., addition and subtraction are inverse operations, multiplication and division are inverse operations).

Inverse Variation When the ratio of one variable to the reciprocal of the other is constant, one of them is said to vary inversely as the other.

Irrational Numbers A set of numbers that cannot be represented as an exact ratio of two integers. For example, the square root of 2.

Iterative Processes In discrete math, a method of calculating an amount by using an initial value and applying a function repeatedly.

Least Common Of two or more fractions, a denominator that is the least common multiple of Denominator the denominators of the fractions.

Least Common Multiple The smallest number that is a common multiple of two or more given numbers.

Limit A number to which the terms of a sequence get closer so that beyond a certain term all terms are as close as desired to that number.

Line of Best Fit The line that fits a set of data points with the smallest value for the sum of the squares of the errors (vertical distances) from the data points to the line. Also called the regression line.

Line Plot A method of visually displaying a distribution of data values where each data value is shown as a dot or mark above a number line. Also know as a dot plot. (*adapted from Wisconsin Department of Public Instruction, op. cit.)*

Linear Function A function that has a constant rate of change and can be modeled by a straight line.

Linear Measurement Measurement in a straight line.

Logarithm The exponent indicating the power to which a fixed number, the base, must be raised to produce a given number. For example, if $n^x = a$, the logarithm of a, with n as the base, is x; symbolically, $\log_n a = x$. If the base is 10, the log of 100 is 2 or 10^2.

Logic A system of reasoning used to validate arguments.

Magnitude Size or quantity.

Manipulatives A wide variety of physical materials and supplies that students use to foster the learning of abstract ideas in mathematics.

Mathematical Induction A formal method of proving that a statement about a positive integer n is true for all positive integers n, by: 1) proving that the statement is true for the first integer, then, 2) proving that if the statement is true for n, it must be true for (n-1).

Mathematical Mode A representation in the mathematical world of some phenomenon in the real world. It frequently consists of a function or relation specifying how two variables are related.

Matrix A rectangular array of numbers or letters arranged in rows and columns.

Mean In statistics, the average obtained by dividing the sum of two or more quantities by the number of these quantities.

Measures of Central Tendency Numbers that communicate the "center" or " middle" of a set of data. The mean, median and mode are statistical measures of central tendency.

Median In statistics, the quantity designating the middle value in a set of numbers.

Metric System A system of measurement used throughout the world based on factors of 10. It includes measures of length, weight, and capacity.

Missing Addend A member of an addition number sentence in which that term is missing. (e.g., 5 + _ = 8).

Mode In statistics, the value that occurs most frequently in a given series of numbers.

Model (noun) A display of concrete materials, objects or drawings.

Model (verb) Use of concrete materials, symbolic.

Monomial In algebra, an expression consisting of a single term such as 5y.

Multiple A number into which another number may be divided with no remainder.

Multiplication and division within 100.
Multiplication or division of two whole numbers with whole number answers, and with product or dividend in the range of 0-100. Example: 72 ÷ 8 = 9.

Multiplicative Inverses
Two numbers whose product is 1 are multi;locative inverses of one another. Example: ¾ and 4/3 are multiplicative inverses of one another because ¾ x 4/3 = 4/3 x ¾ =1.

Negative Integers Whole numbers less than zero; found to the left of zero on the number line (without decimals or fractions), example –2, -7, but not –2.5, or –2½.

Nonstandard Measurement Measurement expressed in terms of objects such as paper clips, sticks of gum, shoes, etc.

Normal Curve In statistics, the distribution of data along a bell-shaped curve that reaches its maximum height at the mean.

One-to-One Correspondence When one and only one element of a second set is assigned to an element of a first set, all elements of the second set are assigned, and every element of the first set has an assignment, the mapping is called one-to-one. (e.g., in the set Bill Clinton, George Bush, Ronald Reagan, Jimmy Carter, Hillary Clinton, Barbara Bush, Nancy Reagan, and Rosalyn Carter, there is a one-to-one correspondence between the pairs.)

Open Sentence A statement that contains at least one unknown. For example, $6 + x = 14$.

Order of Operations Rules for evaluating an expression: work first within parentheses: then calculate all powers from left to right; then do multiplications or divisions, from left to right; then do additions and subtractions, from left to right.

Parallelism The state of being parallel, not intersecting.

Parameter A quantity whose value varies with the circumstances of its application, such as the radius of a group of circles.

Patterns Regularities in situations such as those in nature, events, shapes, designs and sets of numbers (for example, spirals on pineapples, geometric designs in quilts, the number sequence 3, 6, 9, 12,…).

Percent rate of change

A rate of change repressed as a percent. Example: if a population grows from 50 to 55 in a year, it grows by 5/50 = 10% of year.

Permutations Ordered arrangements of a given number of items in a set.

Perpendicular Lines Two lines which intersect to form right angles. (e.g., ⊥ ⌐)

Pictographs A kind of graph that uses pictures or symbols where each symbol or picture represents a certain number of something.

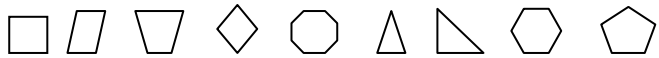
Average Number of Years Animals Live

Mouse	□ □
Kangaroo	□ □
Giraffe	□ □ □ □ □ □
Fox	□ □ □ □
Wolf	□ □ □ □ □
Deer	□ □ □ □ □

Each symbol □ stands for 3 years.

Plotting Points Locating points by means of coordinates, or a curve by plotted points, and to represent an equation by means of a curve so constructed.

Polygon A union of segments connected end to end, such that each segment intersects exactly two others at its endpoints.



Polynomial In algebra, an expression consisting of two or more terms such as $x^2 - 2xy + y^2$.

Powers A number expressed using an exponent. The number 5^3 is read five to the third power or five cubed.

Primes Counting numbers that can only be evenly divided by two numbers which are the number itself and 1. For example, the numbers 2, 3, 5, 7.

Probability A number from 0 to 1 that indicates how likely something is to happen.

Problem Solving Finding ways to reach a goal when no routine path is apparent.

Proof by Contradiction A proof in which, if s is to be proven, one reasons from not s until a contradiction is deduced; from this it is concluded that not s is false, which means that s is true.

Properties of operations **See Table 3 in this Glossary**

Properties of equality **See Table 4 in this Glossary**

Properties of inequality **See Table 5 in the Glossary**

Properties of operations **See Table 3 in this Glossary**

Proportion An equality between ratios. For example, 2/6 = 3/9.

Quadratic Function A function that has an equation of the form $y = Ax^2 + Bx + C$ where A does not equal 0.

Quadrilateral A polygon (2-dimensional figure) with four sides.

Quartiles The three values that divide an ordered set into four subsets of approximately equal size. The second quartile is the median. The Third quartile is the median of the data values greater than M

Radian The size of the central angle of a circle when the arc length equals the radius.

Random Variable A quantity that can take any one of a number of unpredicted values.

Range In statistics, the difference between the greatest and smallest values in a set of data.

Rate of Change The limit of the ratio of an increment of the function value at the point to that of the independent variable as the increment of the variable approaches zero.

Ratio A comparison expressed as indicated division. For example, there is a ratio of three boys to two girls in our class 3/2, 3:2).

Rational Numbers Numbers that can be expressed as an exact ratio of two integers.

Real Numbers All rational and irrational numbers.

Reasonableness Quality of a solution such that it is not extreme or excessive.

Reciprocal The fractional number that results from dividing one by the number.

Rectangular Array An organized arrangement of square units (tiles).

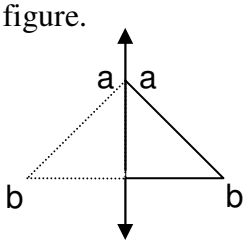
Rectangular Prism A three-dimensional figure whose sides are all rectangles, (eg., a box).

Rectilinear figure A polygon all angles of whch are right angles

Recurrence Relations In discrete mathematics, a value in a series is derived by applying a formula to the previous value.

Recursive Sequence In discrete mathematics, a series of numbers in which values are derived by applying a formula to the previous value.

Reflection In geometry, a transformation, also called a flip, that produces a mirror image of a geometric figure.



Regression The line that represents the least deviation from the points in a scatter plot of data.

Regular Polygon A polygon in which all sides have the same measure and all angles have the same measure.

Relation A set of ordered pairs.

Reliability The extent to which a measuring procedure yields the same results on repeated trials.

Repeated Addition A model for multiplication. (e.g., 2 + 2 + 2 = 3 x 2).

Rigid Motion A transformation of points in space consisting of a sequence of one or more translations, reflectins, and/or rotations. Rigid motions are here assumed to preserve distances and angle measures.

Rotation In geometry, a transformation that turns a figure about a point.

Sample A part of the total population. Used in statistics to make predictions about the characteristics of the entire group.

Scatter Plots A graph of the points representing a collection of data.

Scientific A calculator which represents very large or very small numbers in scientific

Calculator Notation and with the powering, factorial, square root, negative, and reciprocal keys.

Scientific Notation A shorthand way of writing very large or very small numbers. A number expressed in scientific notation is expressed as a decimal number between 1 and 10 multiplied by a power of 10.

Sequence A set of ordered quantities. (e.g., positive integers).

Series The indicated sum of the terms of a sequence.

Similarity In geometry, objects or figures that are the same shape but not necessarily the same size.

Simple Event An event whose probability can be obtained from consideration of a single occurrence. (e.g., the tossing of a coin in a simple event).

Simulation Modeling a real event without actually observing the event.

Sine A trigonometric function that is defined as the ratio of the leg opposite the angle to the hypotenuse of its right triangle.

Skip Counting Counting by equal intervals.

Slides In geometry, a transformation where a figure moves in a given direction.

Slope The slope of a line is the ratio of the change in y to the corresponding change in x. (The constant m in the linear function equation.)(Rise/run.) $y = mx+b$

Square Root Two equal factors of a number. For example, 4 is the square root of 16.

Standard Deviation A statistic that measures the dispersion of a sample.

Stem-and-Leaf Plot A table utilizing digit(s) of a number as stems and the other digit(s) as leaves. For example, 5 | 7, 8 shows 57 and 58.

Survey Interview, questionnaire and/or polling.

Syllogism An argument in which two statements are made and a logical conclusion is drawn from them.

Symmetry A correspondence in size, form and arrangement of parts on opposite sides of a plane, line or point. For example, a figure that has line symmetry has two halves that coincide if folded along its line of symmetry.

Synthetic Representation The geometric form as opposed to the algebraic representation of a figure.

Systems of Equations Two or more equations that are conditions imposed simultaneously on all the variables, but may or may not have common solutions. (e.g., $x + y = 2$, and $3x + 2y = 5$).

T-test A statistical test done to test the difference of means of two samples.

Tangent A trigonometric function of an angle which is defined as the ratio of the lengths of the leg opposite to the leg adjacent to an angle in its right triangle. Also a line having one point in common with a curve.

Tessellations A mosaic formed by repetitions of a single shape.

Theoretical (mathematical) Relating to the probability of a given event, using mathematical relationships (e.g., the chance of a red side coming up on the flip of a two-colored counter is one in two or ½).

Transformation A geometric process for changing one figure into another.

Transitivity principle for indirect measurement.

If the length of object A is greater than the length of object B, and the length of object B is greater than the length of object C, then the length of object A is greater than the length of object C. The principle applies to measurement of other quantities as well.

Translations A transformation that moves a geometric figure by sliding each of the points the same distance in the same direction.

Tree Diagram A diagram used to show the total number of possible outcomes in a probability experiment.

Trigonometric Functions A function (sine, cosine, tangent, cotangent, secant, cosecant) whose independent variable is an angle measure, usually in degrees or radians.

Trigonometric Ratios The ratios of the lengths of pairs of sides in a right triangle, i.e., sine, cosine and tangent.

Trigonometry The branch of mathematics involving triangles that combines arithmetic, algebra and geometry. Trigonometry is used in surveying, navigation and physics.

Valid Argument An argument with the property no matter what statements are substituted in the premises, the truth value of the form is true. If the premises are true, then the conclusion is true.

Validity An argument that is correctly inferred or deduced from a premise.

Variability Numbers that describe how spread out a set of data is (e.g., range and quartile).

Variable A place holder in algebraic expressions. In $3x + y = 23$, x and y are variables.

Variance In a data set, the sum of the squared deviations divided by one less than the number of elements in the set (sample variance s^2) or by the number of elements in the set (population variance).

Vector Quantity that has magnitude (length) and direction. It may be represented as a directed line segment ($\rightarrow$).

Venn Diagram A display that pictures unions and intersections of sets.

Volume The amount of space enclosed in a space (3-dimensional) figure, measured in cubic units, (how many small cubes would fit inside the figure.)

Whole Numbers The counting numbers and zero {1, 1, 2, 3…}.

Y-Intercept The y-intercept of a line is the y-coordinate of the point at which the graph of an equation crosses the y-axis.

π pi, the ratio of the circumference of a circle to its diameter: about 3.1415926535.

Table 1. Common addition and subtraction situations.[6]

	Result Unknown	Change Unknown	Start Unknown
Add to	Two bunnies sat on the grass. Three more bunnies hopped there. How many bunnies are on the grass now? 2 + 3 = ?	Two bunnies were sitting on the grass. Some more bunnies hopped there. Then there were five bunnies. How many bunnies hopped over to the first two? 2 + ? = 5	Some bunnies were sitting on the grass. Three more bunnies hopped there. Then there were five bunnies. How many bunnies were on the grass before? ? + 3 = 5
Take from	Five apples were on the table. I ate two apples. How many apples are on the table now? 5 – 2 = ?	Five apples were on the table. I ate some apples. Then there were three apples. How many apples did I eat? 5 – ? = 3	Some apples were on the table. I ate two apples. Then there were three apples. How many apples were on the table before? ? – 2 = 3
	Total Unknown	**Total Unknown**	**Total Unknown**
Put Together/ Take Apart[2]	Three red apples and two green apples are on the table. How many apples are on the table? 3 + 2 = ?	Five apples are on the table. Three are red and the rest are green. How many apples are green? 3 + ? = 5, 5 – 3 = ?	Grandma has five flowers. How many can she put in her red vase and how many in her blue vase? 5 = 0 + 5, 5 = 5 + 0 5 = 1 + 4, 5 = 4 + 1 5 = 2 + 3, 5 = 3 + 2
Compare[3]	("How many more?" version): Lucy has two apples. Julie has five apples. How many more apples does Julie have than Lucy? ("How many fewer?" version): Lucy has two apples. Julie has five apples. How many fewer apples does Lucy have than Julie? 2 + ? = 5, 5 – 2 = ?	(Version with "more"): Julie has three more apples than Lucy. Lucy has two apples. How many apples does Julie have? (Version with "fewer"): Lucy has 3 fewer apples than Julie. Lucy has two apples. How many apples does Julie have? 2 + 3 = ?, 3 + 2 = ?	(Version with "more"): Julie has three more apples than Lucy. Julie has five apples. How many apples does Lucy have? (Version with "fewer"): Lucy has 3 fewer apples than Julie. Julie has five apples. How many apples does Lucy have? 5 – 3 = ?, ? + 3 = 5

[1]These take apart situations can be used to show all the decompositions of a given number. The associated equations, which have the total on the left of the equal sign, help children understand that the = sign does not always mean makes or results in but always does mean is the same number as.

[2]Either addend can be unknown, so there are three variations of these problem situations. Both Addends Unknown is a productive extension of this basic situation, especially for small numbers less than or equal to 10.

[3]For the Bigger Unknown or Smaller Unknown situations, one version directs the correct operation (the version using more for the bigger unknown and using less for the smaller unknown). The other versions are more difficult.

[6]Adapted from Box 2-4 of Mathematics Learning in Early Childhood, National Research Council (2009, pp. 32, 33).

Table 2. Common multiplication and division situations[7]

	Unknown Product	**Group Size Unknown** ("How many in each group?" Division)	**Number of Groups Unknown** ("How many groups?" Division)
	3 x 6 = ?	3 □ ? = 18, and 18 ÷ 3 = ?	? □ 6 = 18, and 18 ÷ 6 = ?
Equal Groups	There are 3 bags with 6 plums in each bag. How many plums are there in all? *Measurement example*. You need 3 lengths of string, each 6 inches long. How much string will you need together?	If 18 plums are shared equally into 3 bags, then how many plums will be in each bag? *Measurement example*. You have 18 inches of string, which you will cut into 3 equal pieces. How long will each piece of string be?	If 18 plums are to be packed 6 to a bag, then how many bags are needed? *Measurement example*. You have 18 inches of string, which you will cut into pieces that are 6 inches long. How many pieces of string will you have?
Arrays[4] Area[5]	There are 3 rows of apples with 6 apples in each row. How many apples are there? *Area example*. What is the area of a 3 cm by 6 cm rectangle?	If 18 apples are arranged into 3 equal rows, how many apples will be in each row? *Area example*. A rectangle has area 18 square centimeters. If one side is 3 cm long, how long is a side next to it?	If 18 apples are arranged into equal rows of 6 apples, how many rows will there be? *Area example*. A rectangle has area 18 square centimeters. If one side is 6 cm long, how long is a side next to it?
Compare	A blue hat costs $6. A red hat costs 3 times as much as the blue hat. How much does the red hat cost? *Measurement example*. A rubber band is 6 cm long. How long will the rubber band be when it is stretched to be 3 times as long?	A red hat costs $18 and that is 3 times as much as a blue hat costs. How much does a blue hat cost? *Measurement example*. A rubber band is stretched to be 18 cm long and that is 3 times as long as it was at first. How long was the rubber band at first?	A red hat costs $18 and a bluehat costs $6. How many times as much does the red hat cost as the blue hat? *Measurement example*. A rubber band was 6 cm long at first. Now it is stretched to be 18 cm long. How many times as long is the rubber band now as it was at first?
General	a x b = ?	a x ? = p, and p ÷ a + ?	? x b = p, and p ÷ b = ?

4The language in the array examples shows the easiest form of array problems. A harder form is to use the terms rows and columns: The apples in the grocery window are in 3 rows and 6 columns. How many apples are in there? Both forms are valuable.

5Area involves arrays of squares that have been pushed together so that there are no gaps or overlaps, so array problems include these especially important measurement situations.

7The first examples in each cell are examples of discrete things. These are easier for students and should be given before the measurement examples.

Table 3. The properties of operations. Here *a*, *b* and *c* stand for arbitrary numbers in a given number system. The properties of operations apply to the rational number system, the real number system, and the complex number system.

Associate property of addition	$(a + b) + c = a + (b + c)$
Commutative property of addition	$a + b = b + a$
Additive identity property of 0	$a + 0 = 0 + a = a$
Existence of additive inverses	For every a there exists $-a$ so that $a + (-a) = (-a) + a = 0$.
Associative property of multiplication	$(a \cdot b) \cdot c = a \cdot (b \cdot c)$
Commutative property of multiplication	$a \cdot b = b \cdot a$
Multiplicative identity property of 1	$a \cdot 1 = 1 \cdot a = a$
Existence of multiplicative inverses	*For every $a \neq 0$ there exist $1/a$ so that $a \times 1/a = 1/a \times a = 1$.*
Distributive property of multiplication over addition	$a \cdot (b + c) = a \cdot b + a \cdot c$

Table 4. The properties of equality. Here *a, b,* and *c* stand for arbitrary numbers in the rational, real, or complex number systems.

Reflexive property of equality	$a = a$
Symmetric property of equality	If $a = b$, then $b = a$.
Transitive property of equality	If $a = b$ and $b = c$, then $a = c$.
Addition property of equality	If $a = b$, then $a + c = b + c$.
Subtraction property of equality	If $a = b$, then $a - c = b - c$.
Multiplicative property of equality	If $a = b$, then $a \cdot c = b \cdot c$.
Division property of equality	If $a = b$ and $c \neq 0$, then $a \div c = b \div c$.
Substitution property of equality	If $a = b$, then b may be substituted for a in any expression containing a.

Table 5. The properties of inequality. Here *a, b,* and *c* stand for arbitrary numbers in the rational or real number systems.

Exactly one of the following is true: $a < b$, $a = b$, $a > b$.
If $a > b$ and $b > c$ then $a > c$.
If $a > b$, then $b < a$.
If $a > b$, then $-a < -b$.
If $a > b$, then $a \pm c > b \pm c$.
If $a > b$ and $c > 0$, then $a \times c > b \times c$.
If $a > b$ and $c < 0$, then $a \times c < b \times c$.
If $a > b$ and $c > 0$, then $a \div c > b \div c$.
If $a > b$ and $c < 0$, then $a \div c < b \div c$.

RESOURCES

Books:

***Teaching Student-Centered Mathematics by John A. Van De Walle
Grades K-3
Grades 3-5
Grades 5-8

Elementary and Middle School Mathematics by John A. Van De Walle

Beyond Pizza and Pies by Julie McNamara, Meghan M. Shaughnessy

Children's Mathematics: Cognitively Guided Instruction
By: Thomas P. Carpenter, Elizabeth Fennema, Megan Loef Franke, Linda Levi, Susan B. Empson

Extending Children's Mathematics by Susan B. Empson

Web-Based Resources:

Common Core Standards K-12:

http://www.azed.gov/standards-practices/mathematics-standards/

http://www.teachingchannel.org/videos

http://www.k-5mathteachingresources.com/

http://www.ixl.com/math/standards/common-core/grade-4

http://mathchimp.com/

http://mangomath.com

http://www.techlearning.com/Default.aspx?tabid=67&EntryId=3473

http://itunes.apple.com/us/app/common-core-standards/id439424555?mt=8

http://nsdl.org/commcore/math/

http://www.achieve.org/achievingcommoncore
http://www.achievethecore.org

Ohio Department of Education

http://www.ode.state.oh.us/GD/Templates/Pages/ODE/ODEDetail.aspx?page=3&TopicRelationID=1704&ContentID=83475

http://www.ode.state.oh.us/GD/Templates/Pages/ODE/ODEDetail.aspx?page=3&TopicRelationID=1704&ContentID=83475&Content=122440

http://www.mathscore.com/math/standards/common%20Core/4th%20Grade/

http://www.tenmarks.com/

National Science Digital Library
http://nsdl.org/commcore/math?id=K.CC

National Council Teachers of Mathematics
http://www.nctm.org/

http://www.khanacademy.org/

http://www.fuelthebrain.com/

Utah – Granite School District (curriculum maps)'
http://www.graniteschools.org/depart/teachinglearning/curriculuminstruction/math/elementarymathematics/Pages/math6.aspx

www.mathlearningcenter.org (Bridges)

The Cornerstone for Teachers (centers ideas):
http://thecornerstoneforteachers.com/free-resources/math/math-games-center-ideas

http://www.firstinmath.com

www.achievethescore.org