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The Language of Mathematics: Mathematical Terminology Simplified for Classroom Use.

Beverly Karen Owens
East Tennessee State University

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by

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Anant Godbole, Chair

Jeff Knisley

Michel Helfgott

ABSTRACT

The Language of Mathematics: Mathematical Terminology

Simplified for Classroom Use

by

Beverly Owens

After recognizing the need for a simpler approach to the teaching of mathematical terminology, I concluded it would be valuable to make a unit of simplified terms and describe methods of teaching these terms. In this thesis I have compared the terminology found in the Virginia Standards of Learning objectives to the materials found at each grade level. The units developed are as follows: The Primary Persistence Unit- for grades K-2; The Elementary Expansion Unit- for grades 3-5; and The Middle School Mastery Unit- for grades 6-8.

DEDICATION

This thesis is dedicated to every student who entered my classroom door and to my family that has always supported me throughout my educational journey. To my husband, Timothy O'Quinn, my first love, I could not have finished without your unconditional love and never ending encouragement; my children, Heather and Codie, for being so understanding and inspirational when I needed that extra boost to keep me going. Most importantly I would like to thank my Heavenly Father. "The Lord is my strength and my shield; my heart trusts in him, and I am helped." Psalms 28:7. Special thanks to the Wise Consortium and the Russell County school system for grant and financial support.

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CHAPTER 1

INTRODUCTION

Motivation

When I began looking at the current mathematical terminology used in my classroom, I felt a need to go back to the basics and start at the very beginning, kindergarten. I decided to research the Standards of Learning Objectives for Virginia schools to find what is expected of children in terms of the mathematical vocabulary, kindergarten through grade eight. A list of current Virginia Standards of Learning Objectives (SOLs) is listed in the appendix for each unit of study.

As stated in the current Virginia Department of Education Standards at each grade level, mathematics has its own language, and the acquisition of specialized vocabulary and language patterns is crucial to a student's understanding and appreciation of the subject of mathematics. At each level students are to be encouraged to correctly use the concepts, skills, symbols, and the mathematical vocabulary correctly. The Standards also state that the development of problem-solving skills should be the major goal of a mathematics program at every grade level. Problem solving and vocabulary instruction need to be integrated early and continuously into every student's mathematical education. What the Department of Education is failing to tell teachers is how to get children excited by mathematics and how to teach the terminology that will help these students to be successful at every grade level and develop a love for the subject of mathematics.

A beginning teacher, when looking at these Standards for the first time, may feel overwhelmed. This thesis will be of value to teachers at all grade levels, not just the beginning teacher, but also the veteran teacher who is struggling to have students

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become successful and mathematically literate. Mathematics does have its own language, and I will give suggestions that will make teaching this language easier for the teacher and learning this language easier for the student.

<center>Overview/Selecting the Units</center>

When beginning this thesis, I decided to research the mathematics program of study in my own school district, Russell County, Virginia. I discovered that the mathematics program was divided over which textbooks to use. In kindergarten through grade five, the students are using a math series from the publisher McGraw-Hill. At the middle school level, grades six through eight, the series used is from the publisher Glencoe. A survey of teachers reveals they are unaware of why their school district uses different math series (Teacher Survey Appendix I). There is concern that the mathematics series should be the same for all grade levels and that each level should build upon the previous so that the students will benefit more and learn more of the required subject matter.

Teachers also express a concern about their ability to teach the subject matter (Teacher Survey Appendix I). Most teachers have taken just enough mathematics in college to "get by" and consider themselves under qualified when it came to teaching mathematics. A copy of the survey for teachers is listed in Appendix I of this thesis.

I also chose to survey parents to see if they were satisfied with the mathematics program in which their children were participating. Parents stated that the students need to have more instruction in mathematics vocabulary at every grade level (Parent Survey Appendix I).

At this point I decided to investigate the research on the importance of teaching

mathematical vocabulary to students. There are numerous researchers who have devoted great time and effort to the study of mathematical vocabulary instruction. These include mathematicians such as Liping Ma, Miki Murray, Deborah Ball and many others who are cited in this paper and in the Works Cited page.

When deciding what units to use, I chose to develop a primary unit that would be used in kindergarten through grade two. As stated in the Virginia SOLs for the primary level, teachers need to plan the introduction of new words in a suitable context with relevant real objects, mathematical apparatus, pictures, stories, and diagrams. At this level teachers need to explain the meaning of the vocabulary carefully and have repetition daily. Students are not tested at the current time at this level on the Virginia SOLs. The goal of this unit is to help students to be successful when testing time begins in third grade.

I chose to develop a unit for the elementary grades of three through five. Students get their first "taste" of the Virginia SOL tests at grade three and are tested on all subject matter. This unit will expand and continue with what begins in the primary unit. Teachers should use every opportunity to introduce new mathematics vocabulary or symbols with the whole class, in a small group, or when working individually with a student. Through graphic organizers, mathematics journals, and games students will become more literate with the terms and Standards.

The middle school unit consists of grades six through eight. This unit will continue with the study of mathematical vocabulary that began in the previous years. It is a goal of this thesis that students will be well educated in mathematics vocabulary by the time they enter high school.

CHAPTER 2

BACKGROUND

<u>Statement of the Problem</u>

Many years of teaching have convinced me that students are not mastering

mathematics vocabulary by the time they reach eighth grade. A survey of teachers reveals

that 86% report that by the time students enter eighth grade they are not sufficiently

prepared in the correct use of mathematical terminology (Teacher Survey Appendix I).

Most students begin school with a good understanding of some mathematical words.

Students may not understand the meanings of these words fully, but they are ready to

learn and at this age are very eager to learn. I am not sure what happens to "turn them

off" when it comes to learning mathematics in higher grades.

The teaching and learning of mathematics needs improvement. Liping Ma states

that every prospective teacher must have a solid understanding of mathematics

vocabulary (147). In turn, teachers can teach vocabulary as a coherent activity and

communicate the skills and terminology that students will need. Many teachers lack the

needed skills or have deficiencies in their mathematics background, and some teachers

are even "math phobic," which in turn causes the students to develop "math anxiety" (Ma

144). According to Ball, past reform movements have consisted more of effort than

effect. She states that how well teachers know mathematics is central to their capacity to

use instructional materials wisely and to assess students' progress (373-375).

Teachers often use informal everyday language in math lessons before or along

with technical math vocabulary. This instruction can be used to help children grasp the

meaning of different words or phrases. One may find that a more structured approach to

the teaching and learning of vocabulary is essential if children are to move on from grade level to grade level and begin using the correct mathematical terminology. This instruction needs to begin as early as possible, preferably in kindergarten. A teacher must know how to apply mathematical knowledge quickly and in a way that makes sense to students. According to the National Council of Teachers of Mathematics, students need to become familiar with mathematical vocabulary at a much earlier age (NCTM). By doing so, they will be better able to comprehend and understand the mathematical terminology.

A student's understanding of mathematics is illustrated through oral and written work, and this allows the teacher to assess student understanding and progression (Hiebert 165). Students need to write regularly about the mathematics they are learning, especially the vocabulary. They need to become organized with their work and learn to keep a math journal or binder of problem solving and vocabulary. This will be a guide they will reflect on as the school year progresses.

In addition, every classroom needs a mathematical dictionary especially suited to the age of the children. This could either be a published version or one that the students create themselves. A math dictionary should be simple enough for the children to learn and understand. I suspect that there are few students who can find a word in the textbook glossary and then explain what it means. As stated by the Mid Continent Research for Education and Learning (McREL) in their publication Ed Thoughts, definitions are critical to the study of mathematics, and students must understand and integrate them into their mathematical writings.

Mathematical communication requires much more than mastery of numbers and symbols. "It requires the development of a common language using vocabulary that is

understood by all" (Murray 11). If students are not able to learn the correct mathematical terminology at an early age, they may become handicapped in their efforts to learn mathematics. One obstacle that makes mathematical vocabulary difficult to learn is that some mathematical terms differ from their meanings in everyday usage. One good example is the term "yard." To a child the term yard can mean a place in front of a house to go and play, but in a math class the term "yard" is a unit of measurement that equals 36 inches. If teachers do not take the time to explain, and explain again, then it is obvious that children can become confused.

Another obstacle to learning mathematical vocabulary is that the terms are somewhat abstract. A teacher needs to design math lessons around the student's real life experiences. There is no point in solving a problem that deals with the Egyptian Sphinx when the children in the class will probably never see Egypt or even know anything about the Sphinx in the early grades. Mathematics needs to be about things they can understand, real life situations, such as playing ball or going to the grocery store with mom. Mathematics Spoken Here concludes that mathematics vocabulary studied in context has a profound effect on performance (Capps 5).

Camille Blanchowicz and Peter Fisher in summarizing their research on vocabulary learning, list seven characteristics essential for vocabulary development in any discipline. They are

1. Immerse students in words.

2. Encourage students to be active in making connections between words and experiences.

3. Encourage students to personalize word learning.

4. Build on multiple sources of information.

5. Help students control their learning.

6. Aid students in developing independent strategies.

7. Assist students in using words in meaningful way; meaningful use leads to long-lasting learning (7).

In order to help every child to learn mathematical vocabulary, teachers need to become more familiar with the vocabulary themselves. According to the Conference Board of Mathematical Sciences, better teacher training will ensure a deeper understanding of mathematics terminology by prospective teachers and increase student understanding of mathematics vocabulary (CBMS Issues in Mathematics Education).

The goal of this thesis is to give teachers a variety of ways to teach the mathematical vocabulary that the students can use. The materials in this thesis address the problem and importance of having students become proficient in using the correct mathematical vocabulary. Specifically, the purpose of this thesis is to construct a simplified mathematical dictionary which can be used in the primary, elementary, and middle grade levels.

CHAPTER 3

RESEARCH INTO VOCABULARY

There have been changing expectations concerning what mathematics teachers must know. Arithmetic skills and a little algebra were once all that were required for professions outside of the engineering and physical sciences fields. Now, with the explosion of the computer sciences and mathematics fields, there is increased mathematics skills needed for many jobs. This means that teachers must be able to instruct their students in the correct mathematical terminology and problem solving skills that they will need to be successful later in life.

According to the National Council of Teachers of Mathematics, the school mathematics reform efforts of the 1960s and 1970s had several long-lasting effects, such as expanding the elementary math program to include some geometry and a little algebra (NCTM). This period is often remembered for the New Math movements and a theoretical approach to teaching. The New Math movement, however, was not successful at bringing about overall improvement in mathematics teaching and learning (NCTM Curriculum Standards for School Mathematics).

There have always been complaints about how poorly students in the United States perform in their mathematics skills. As indicated in McKnight's The Underachieving Curriculum, many developed countries, particularly some in East Asia, provide a richer school mathematics course of instruction than that of the United States (9). In Knowing and Teaching Elementary Mathematics, Liping Ma states that Chinese teachers are not as well trained to teach mathematics as American teachers, but that Chinese children perform better than American children on international comparison

studies of mathematical competency (xvii). It has also been shown that American students lag behind their world peers in mathematics achievement and that there even exists a substantial achievement gap between groups of our own students. International studies have shown the importance of a continuing study plan as part of all teachers' weekly duties (Ma 145). Although the National Assessment of Educational Progress shows that U.S. students have made steady progress in mathematics achievement since 1973, the national assessment exposes areas of weakness that must be remedied (Ma 144). Evidence from the Third International Mathematics and Science Study indicates that U.S. students are performing well below their international peers from the nations with which the United States economically competes (Ma xix).

School districts should not place a teacher in a class to teach mathematics unless that teacher is highly qualified to teach the subject matter, no matter what the subject. According to the No Child Left Behind Act, teachers are to be highly qualified to teach the subject matter for which they are hired (NCLB). Further, according to Every Child Mathematically Proficient, all students of mathematics should be taught by teachers who have been well prepared in the content of mathematics and the techniques of teaching the subject matter (3). One fallacy is that prospective elementary and middle school teachers learn all the mathematics they need during their years of schooling (Ball 16). Every teacher of mathematics, argues Ma, needs to develop a deep understanding of the subject (xx).

"Mathematics is a language and reading a mathematics text is somewhat like reading Tolstoy's Anna Karenina in the original Russian language" (Lindgren 16). Mathematics is a language that needs to be revered from the primary grade elementary

teachers through the graduate level professors of mathematics (Renne 258). "Mathematical vocabulary must be looked upon as a unique language that must be meaningful and consistent if the students are expected to communicate and apply mathematics with proficiency" (Monroe 139-142). According to the National Council of Teachers of Mathematics, the goal of mathematical vocabulary proficiency is to become fluid and natural with the language so that students may either speak or write to enhance their mathematical work (NCTM). In 1989 the NCTM asserted that mathematics and literacy are intertwined and interdependent.

Martinez, another researcher, divides the importance of mathematics language in the classroom into the three following component parts:

1. We teach through the medium of language. It is our major means of communication.

2. Students build understanding as they process ideas through language.

3. We diagnose and assess students' understanding by listening to their oral communication and by reading their mathematical writings (248).

In order for students to aspire to their maximum level of mathematical potential, they must become confident with their mathematical vocabulary. Vocabulary familiarity is directly correlated to the student's conceptual understanding and is crucial for success. Teachers should strongly endorse the use of appropriate mathematical vocabulary in the classroom and frequently make efforts to assess student communication. Monroe shows that in order for students to learn mathematical vocabulary, meaningful context is vital, and mathematics instruction that encourages appropriate teacher and student communication provides contexts for learning the language of mathematics (139-142).

What does it mean to know mathematics for teaching? Ball explains that "This involves knowledge of mathematical ideas, skills of mathematical reasoning and communication, fluency with examples and terms, and thoughtfulness about the nature of mathematical proficiency" (17). According to Adding It Up: Helping Children Learn Mathematics, by Kilpatrick, teachers need skill with mathematical terms that enable careful mathematical work by students and that do not make way for misconceptions or errors. Students need definitions that are usable, relying on terms and ideas they already understand. Another problem area of mathematical vocabulary development lies in the lack of the teacher's vocabulary instruction. This requires teachers to know more than the definitions they might encounter in a university course (Ball 18). Content Area Reading states that students are not likely to learn mathematics vocabulary in a classroom where the teacher is uncomfortable presenting the terms (Vacca 65). Teachers need to be adequately prepared to teach the subject matter before entering a classroom to teach. According to the No Child Left Behind Act, a good teacher needs to have a rich background in education and, likewise, a firm foundation in the mathematics discipline. One can not be effective without the other (NCLB).

In their 2001 report, The Mathematical Education of Teachers, The Conference Board of the Mathematical Sciences, The American Mathematical Society, and The Mathematical Association of America call for,

> prospective elementary teachers to take at least nine semester-hours on fundamental ideas of elementary school mathematics; prospective middle-grades math teachers to take at least 21 semester hours of mathematics, including at least 12 semester hours on fundamental ideas of school

mathematics appropriate for the middle grades; and prospective high school mathematics teachers to complete the equivalent of an undergraduate major in mathematics, including a 6 hour capstone course connecting their college mathematics courses with high school mathematics. The report recommends that prospective teachers take mathematics courses that develop a deep understanding of the mathematics they will teach, and a thorough mastery of the mathematics in several grades beyond that which they expect to teach, as well as of the mathematics in earlier grades. NCLB requires that all new middle and high school teachers demonstrate subject-matter competency by 1) passing a state academic subject test in each of the subjects in which they teach; or 2) completing an academic major, a graduate degree, coursework equivalent to an undergraduate academic major, or advanced certification or credentialing in each of the subjects in which they teach.

(NCLB Public Law 107-110, Section 9101)

CHAPTER 4

THE PRIMARY PERSISTENCE UNIT

When looking at the Primary Standards developed by the Virginia Department of

Education, one finds that

> emphasis on developing the concept of number by counting, combining,
>
> sorting, and comparing sets of objects; recognizing and describing simple
>
> repeating patterns; and recognizing shapes and sizes of figures and
>
> objects. Students are required to investigate nonstandard measurement,
>
> collect data, and create graphs and are to be actively engaged in the
>
> learning of mathematics. They will use concrete materials and appropriate
>
> technologies, such as calculators and computers. The Standards are
>
> divided into six different categories: 1.) Number and Number Sense; 2.)
>
> Computation and Estimation; 3.) Measurement; 4.) Geometry; 5.)
>
> Probability and Statistics; and 6.) Patterns, Functions, and Algebra.
>
> (Virginia Department of Education)

Vocabulary instruction in a mathematics classroom should be basically the same

as for a language arts classroom. Teachers need to know where in the curriculum to

introduce the vocabulary words and how to make the connections that will build upon

what the students already know. Teachers will need to pre-teach the mathematics

vocabulary, to model the vocabulary, to use labels and diagrams for the words such as

graphic organizers, and to assess the students' knowledge of the mathematical

vocabulary. Vocabulary words are often misunderstood or lost by elementary students

because teachers are mainly focusing on the learning of the new procedures, not on the

vocabulary words. Pre-teaching the vocabulary words is very important and will help students learn these words before they show up on a formative or summative assessment.

Modeling of new vocabulary words is essential for learning the new words. Murray argues that every primary classroom teacher needs to have mathematical words posted on the wall and have their students to refer to these words as the school year progresses (27).This can be referred to as The Mathematical Word Wall and it is imperative that young students be exposed to mathematical vocabulary from the first day of kindergarten. With the development of the classroom word wall, students can see the words, hear the words spoken, and learn the meanings of these words long before they may be able to write them or read them in printed text. This "word wall" will become the foundation of the students' vocabulary collections. The word wall can be displayed on large sheets of alphabet paper, under which the words can be listed for that letter of the alphabet. The words on the word wall will become the index of mathematical terms, and students will be able to locate any word that is being used in a lesson (Murray 27-31).

Instructors should model vocabulary words with multiple examples and use graphic organizers when appropriate. Studies have shown that children grasp the idea of mathematical vocabulary, as well as other relational concepts, from a very early age (Dehaene 12). Children learn mathematics by using it, and understanding the language of math gives students the skills they need to think about, talk about, and assimilate new math concepts as they are introduced in class.

For primary students hands-on learning is very important. Ball believes that teachers should make sure that their students are processing the right information and that

the correct vocabulary words are being used by the students (25). The vocabulary

knowledge provides the young learners with a mathematics foundation they can apply

and build on, in and out of the classroom, and for years to come.

Appendix A there lists words that will be introduced in kindergarten and

continued with in first and second grade. As stated by Ball, students do not learn how to

speak mathematics by memorizing definitions, but by hearing these words frequently and

having many opportunities to use them (45). In the primary grades vocabulary is

introduced naturally during activities involving objects, pictures, and physical

movements. By the end of second grade students will be able to identify, draw, and

describe numerous mathematical terms.

CHAPTER 5

THE ELEMENTARY EXPANSION UNIT

The expansion unit will cover grades three through five. At this level students

begin to be tested on all subject areas with the Virginia Standards of Learning tests. By

grade three students are becoming more familiar with the vocabulary of mathematics. By

doing so, they will be better able to comprehend problems and carry on from grade level

to grade level with a deeper understanding of mathematical problems. As stated by the

Virginia Department of Education, it is hoped that all students are able to read by grade

three. As stated in the previous unit, reading and mathematics should go hand in hand. If

the mathematical vocabulary is introduced in the primary grades, the elementary teacher

should have a much easier job. One will just pick up where the primary unit ends and

extend through grades three, four, and five.

By grade three students will be writing regularly about the mathematics they are

learning. They will learn how to organize their work, especially the vocabulary and

writing in a binder. A journal of mathematical writing will begin in grade three. Journals

or learning logs are on-going written records, including graphics, which help you assess

how students organize, formulate, internalize, explain, and evaluate concepts and

processes. Writing sends a message to students that the communication of their

mathematical ideas is important. Not all students are eager to embrace the learning of

vocabulary and writing in mathematics because, after all, math is supposed to be about

numbers, not about writing. But as the year progresses students will understand how

writing and mathematics enhance their learning of the mathematical topics covered.

The learning of mathematical vocabulary helps to promote more classroom

discussions among teachers and students. The Conference Board of Mathematics states in Issues in Mathematics Education that mathematical communication requires more than mastery of numbers and symbols. It requires the development of a common language using vocabulary that is understood by all students.

Parents need to be involved in the learning as well. According to Murray, it is a good idea to send a mathematical vocabulary list home with the students, just as one would send a reading vocabulary list home to be learned. Students will be more mathematically literate if mathematical vocabulary is spoken in the home, as well as in the school setting (13). It is the job of the classroom teacher to get the parents involved in the mathematical learning process. One must relate to the parents that attention will be directed to vocabulary and why. Parental support and involvement must be included.

Grades three, four, and five must also start to use graphic organizers. As Murray explains, these are a wonderful way for students to become more mathematically literate. Graphic organizers are maps that represent student thinking. They involve students in skills like sequencing, comparing, and classifying to create representations of concepts and processes. These mental maps show complex relationships and can become "blueprints" that make abstract ideas more visible and concrete (29). These can be used with any unit of mathematical study to organize and extend mathematical vocabulary. By using a graphic organizer students will gain a deeper understanding of the material that is being covered. There is also a need for specific mathematical words that will be learned at these grade levels. These are listed in Appendix D, and teachers should feel free to use them as they find it necessary and appropriate with their classes.

Different things are expected of fourth graders than of first graders. At the

elementary level teachers will enter into student conservations, using mathematical terms, but also asking questions that will challenge students to be more precise. Students will not only identify, draw, and describe but will also categorize their mathematical vocabulary. This will, in turn, prepare the students for the middle school years.

CHAPTER 6

THE MIDDLE SCHOOL MASTERY UNIT

Teachers will play a crucial role in the change from elementary school to the

middle school level. How can we create classrooms that make mathematical power a

reality for all students? If students have participated in the primary unit and the

elementary unit, then they are on their way to becoming mathematically literate and ready

to expand with the mastery unit of grade six, seven, and eight. They have the foundation

of a strong mathematics vocabulary program and are ready to extend that knowledge to

the middle school and then to the high school years and beyond.

It is important that the teacher convey the message that studying mathematics

vocabulary is worthwhile. One must use whatever strategies support and engage students

in learning and using math vocabulary. The mathematics binder can become more

organized at the middle school level. The binder should include things like the following:

the journal—where all work done during class is recorded and thoughts are written; the

homework—where in-process and completed assignments are kept so that students

always know where their homework is; forms and guides—where handouts, guidelines,

etc., are kept throughout the year; returns—where papers are kept until completion of the

unit; and vocabulary—where lists and graphic organizers are kept.

Dictionary definitions are not a primary source for good information. According

to Murray, students need to hear, see, and use the terminology in context before trying to

understand what the dictionary definition means (26). Students hear terms used in context

and use them during discussions and in their writing to describe the mathematics they are

doing and learning about. Growth continues when students keep a record of the

vocabulary they are learning and when they have frequent opportunities to use the vocabulary to communicate mathematically (Murray 27).

Students should list three things in the math journal daily:

1. Mathematics words they are confident using.

2. Mathematics words they understand but need to practice using.

3. Mathematics words they do not understand or use.

It is more efficient for the teacher to update the list once a week and a good idea to have every Friday as "vocabulary day." At the beginning of the class each student shares one new vocabulary word along with their definition for the term. No repeats will be allowed. Murray believes that this is a wonderful way to hear and use the language of mathematics in a meaningful context and a good way to gain knowledge about the students' conceptions, and sometimes misconceptions, about their mathematical vocabulary (27).

Listed in Appendix F are some of the words that should be introduced or continued with from the earlier units. If students have been introduced to mathematical terms from kindergarten through the middle school grades, then they have encountered these words from year to year. The goal is for students to be ready for high school, and to master the mathematical vocabulary that they will need to be successful in their high school mathematics courses. Ideally, this knowledge will carry extend to any higher field of study that a student will want to pursue.

CHAPTER 7

SUMMARY AND OBSERVATIONS

The language of mathematics often confuses children, and it is sometimes

difficult for the teacher to explain the meaning of mathematical terms simply and

accurately. This thesis offers an up-to-date way for teachers to promote the learning of

mathematics vocabulary in the students they teach. The mathematical dictionary of

simplified terms will offer a way for definitions to be simple, clear, and precise and be

able to be understood by children from kindergarten through grade eight. Mathematics is

a language all its own and learning this language will help students be successful now, in

educational years to come, and in every aspect of life. For these reasons I conclude with

the most important results of this project, "A Simplified Mathematical Dictionary" that

can be used by students at any grade level (A to Z Index Mathwords).

Simplified Mathematical Dictionary

A

AAS Congruence
SAA Congruence, SSA Congruence

> Angle-angle-side congruence (AAS) states that two triangles are congruent if a
> pair of corresponding angles and an adjacent side are equal. Side-angle-angle
> congruence (SAA) is the same as angle-angle-side congruence. Angle-side-angle
> (ASA) congruence states that two triangles are congruent if a pair of
> corresponding angles and the included side are equal.
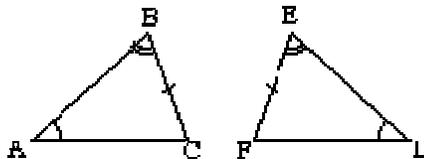
Absolute Value

The absolute value of a number is the distance the number is from zero on the number line. The absolute value of x is written $|x|$. For example, $|-5| = 5$ since -5 is 5 units away from zero.

Acute Angle

An angle whose measure is less than 90 degrees.

Acute Triangle

A triangle in which all interior angles are acute, or less than 90 degrees.

Addend

Any number that is to be added. In $2 + 6 = 8$, the numbers 2 and 6 are the addends and 8 is the sum.

Addition

The operation or process of calculating the sum of two numbers or quantities. Some words that mean to add are sum, altogether, plus, combine, increased by, and join.

Addition Property of Zero

When zero is added to any number, the sum is the same as the number.
$4 + 0 = 4, 0 + 12 = 12$

Additive Inverse of a Number

The negative of a number. For example, the additive inverse of 12 is -12 and the additive inverse of -3 is 3.

Additive Property of Equality

The formal name for the property of equality, that allows one to add the same quantity to both sides of an equation.

Property: **If $a = b$ then $a + c = b + c$.**

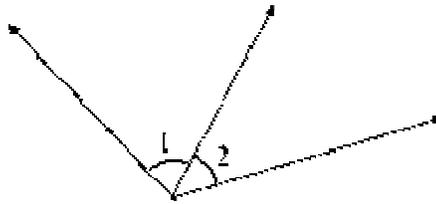**Example:** $$x - 5 = 7$$
$$(x - 5) + 5 = 7 + 5$$
$$x = 12$$

Adjacent

Next to, neighboring, or side by side.

Adjacent Angles

Two angles that share a ray, thereby being directly next to each other. Two angles in a plane which share a common vertex and a common side, but do not overlap. Angles 1 and 2 below are adjacent angles.

Adjacent Angles

Algebra

A branch of mathematics in which arithmetic is performed both with numbers and with variables.

Alternate Exterior Angles

Angles located outside a set of parallel lines and on opposite sides of the transversal. In the drawing below, angles 1 and 8 are alternate exterior angles, as are angles 2 and 7. Alternate exterior angles are congruent. Formally, alternate exterior angles are defined as two exterior angles on opposite sides of a transversal which lie on different parallel lines.

**Parallel lines cut
by a transversal**
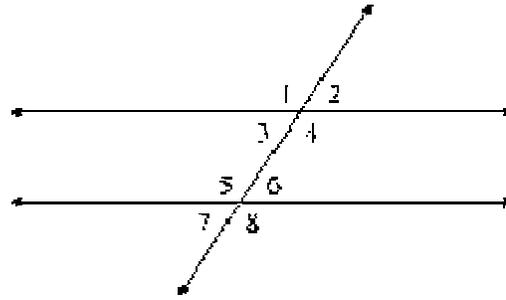
Alternate Interior Angles

        Angles located inside a set of parallel lines and on opposite sides of the
   transversal. Angles 3 & 6 and 5 & 4 are alternate interior angles.
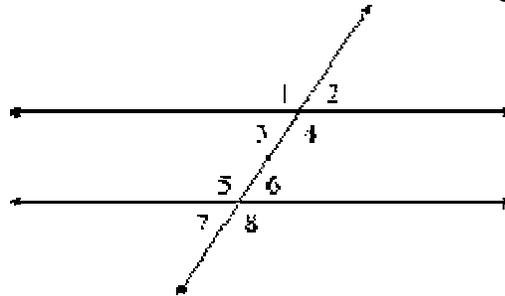
Altitude
Height

        The shortest distance between the base of a geometric figure and its top. How
        high something is above the surface of the earth, sea level, or horizon. Altitude is
        the length of perpendicular height from base to vertex.

Angle

        The figure formed by two line segments or rays that extend from a given point.

                        Angle
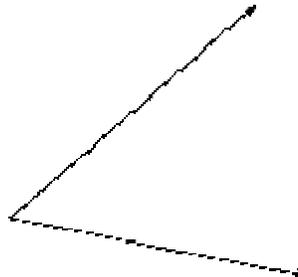
Angle Bisector

        A ray that divides an angle into two congruent angles.

Angle Sum

The total amount of degrees in any polygon. Angle sum of a triangle is 180 degrees. Angel sum of a quadrilateral is 360 degrees.

Area

The number of square units needed to cover a surface.
The amount of surface or the size of a surface.
Area is measured in square units.

Ascending Order

Going upwards or increasing in value.

Associative Property

This property applies both to multiplication and addition and states that you can group several numbers that are being added or multiplied (not both) in any way and yield the same value. In mathematical terms, for all real numbers a, b, and c,
$$(a + b) + c = a + (b+c) \text{ or } (ab)c = a(bc).$$
When three or more numbers are added, changing the way the numbers are grouped does not change the answer.

Average

It usually refers to the (arithmetic) mean. The average of a collection of numbers is found by adding all the numbers and dividing the sum by the number of addends.

Axis

The lines that form the framework for a graph. The horizontal axis is called the x-axis; the vertical axis is called the y-axis. The point where the axes intersect is called the origin.
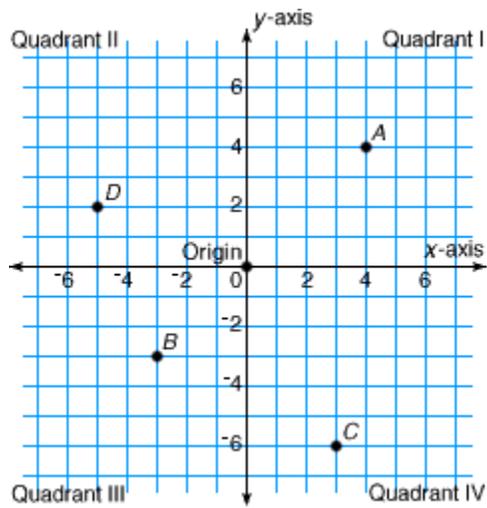
B

Bar Graph

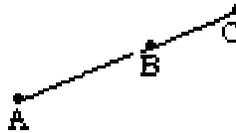A graph that uses horizontal or vertical bars to represent various kinds of information.

Base

In plane geometry, or solid geometry, the bottom of a figure. If the top is parallel to the bottom (as in a trapezoid or prism), both the top and bottom are called bases.
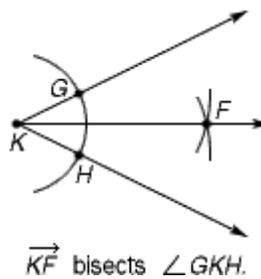
Between

Point B is between points A and C if it is on the line segment connecting A and C.

Bisect
To cut or divide into two equal parts.
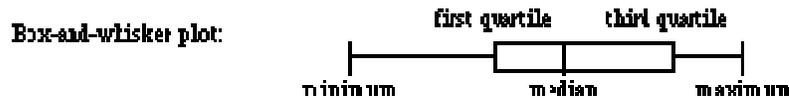
$\overrightarrow{KF}$ bisects $\angle GKH.$

Boundary

The curve that forms the edge of a region.

Box-and-Whisker Plot

A visual display of the five number summary. The box-and-whisker plot is a simplified box plot taught to beginners. It does not show outliers. The whiskers extending all the way to the minimum and maximum values regardless of how far out they may be.

Box plot
Modified Box plot

A graphic representation of data that displays the five-number summary. The whiskers, stretching outward from the first quartile and third quartile as shown below, are no longer than 1.5 times the interquartile range (IQR). Outliers beyond that are marked separately.

Note: Beginners are sometimes taught to draw box-and-whisker plots, which do not show outliers. *Modified box plot* is a name sometimes used for box plots to distinguish them from box-and-whisker plots.

C

Calculate

    To work out the answer; to use mathematical procedures to determine a number, quantity, or expression, to solve.

Century

    One hundred years.

Chord

    A line joining two points on a circle is a chord.

Circle

    The set of all points in a plane that are at a fixed distance from a given point called the center of the center.

center
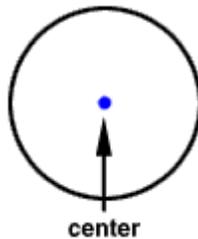
Circumference

    The length of a complete circular arc. Circumference also means the distance around the outside of a circle.

$$Area = \pi r^2$$
$$Circumference = 2\pi r \text{ or } \pi d$$
$$(d = diameter)$$

Clockwise

    The direction in which the hands of a clock normally travel.

Coefficient

The numerical factor in an algebraic term. For example, in 3y, 3 is the
coefficient; in
$$7(a + b),$$
the number 7 is the coefficient; in xy, the coefficient is 1; and in $123x^3y$, the
coefficient is 123.

Column

A vertical arrangement of numbers or items.

Combination

A selection of objects from a collection. Order is irrelevant. A way of arranging
the objects in a group.

Example: **A poker hand is a combination of 5 cards from a 52 card deck.
This is a combination since the order of the 5 cards does not
matter.**

Commutative property

This property of both multiplication and addition states that you can rearrange the
order of the numbers being added or reorder numbers being multiplied without
changing the value of the expression. In mathematical terms, for all real numbers
a and b, a + b = b + a and ab = ba.

Complementary Angles

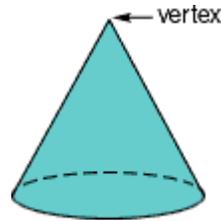Two acute angles that add up to 90°. For example, 58° and 32° are
complementary.
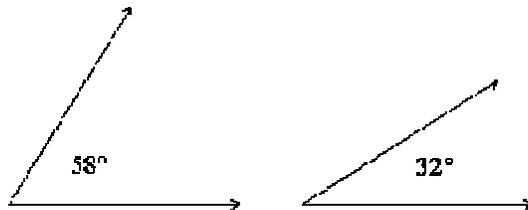
Composite Number

A positive number that has factors other than just 1 and the number itself. For
example, 4, 6, 8, 9, 10, 12, etc. are all composite numbers. The number 1 is not
composite.

Cone

A solid which has a circular base and comes to a point at the top, similar to an ice-cream cone.

Congruent

Two figures are congruent to one another if they have the same size and shape. Exactly equal in size and shape. Congruent sides or segments have the exact same length. Congruent angles have the exact same measure. For any set of congruent geometric figures, corresponding sides, angles, faces, etc. are congruent.

Note: Congruent segments, sides, and angles are often marked.

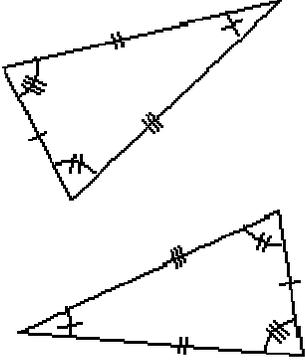| **Congruent Segments**	**Congruent Angles**

All four sides of this rhombus are marked to show they are congruent to each other.	**The marked angles of this isosceles triangle are congruent to each other.**

Congruent Triangles	**These triangles are congruent. Corresponding sides and angles are congruent.**
Congruent Plane Figures	**These figures are congruent because their shapes and sizes are identical, even though there are no sides or angles to measure and compare.**
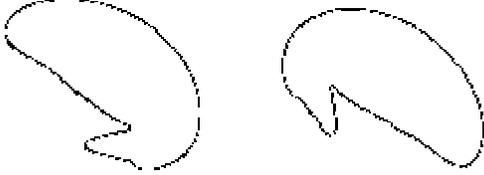
Consecutive numbers

Numbers that follow each other in a sequence.

Coordinate plane (Cartesian)

A plane with a point selected as an origin, some length selected as a unit of distance, and two perpendicular lines that intersect at the origin, with positive and negative direction selected on each line. Traditionally, the lines are called x (drawn from left to right, with positive direction to the right of the origin) and y (drawn from bottom to top, with positive direction upward of the origin). Coordinates of a point are determined by the distance of this point from the lines, and the signs of the coordinates are determined by whether the point is in the positive or in the negative direction from the origin.
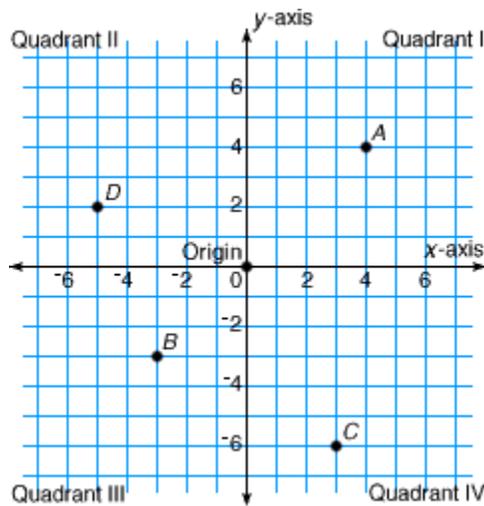
Coordinates

A unique ordered pair of numbers that identifies a point on the coordinate plane. The first number in the ordered pair identifies the position with regard to the x-axis while the second number identifies the position on the y-axis.

Corresponding angles

Angles in two polygons in the same position with respect to each polygon. In congruent shapes, corresponding angles have the same size (they are congruent).

Cost

The price of something.

Counterclockwise

The direction opposite to that in which the hands of a clock travel.

Cube

A prism with six square faces. A solid, shaped like a box, with twelve equal edges, six equal square faces, and eight corners.
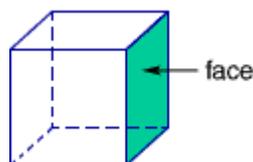
Cylinder

A three-dimensional geometric figure with parallel congruent bases. A right circular cylinder is a shape like a soup can. It is a solid with two circular faces at right angles to a curved surface.

Oblique Cylinder
h = height of cylinder
B = area of the base

Volume = Bh

Right Cylinder
h = height of cylinder
B = area of the base
C = circumference of the base

Volume = Bh

Lateral Surface Area = hC

Total Surface Area = $2B + hC$
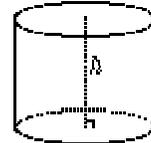
D

Data

A general term used to describe a collection of facts, numbers, measurements, or symbols.

Decagon

A polygon with ten sides.
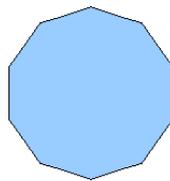
Decimal number

A number containing a decimal point. For example, 3.0, 0.07 and 1.35 are decimal numbers.

Decrease

To make smaller.

Degrees

A circle is measured in units called degrees. The entire circle is 360 degrees, half a circle is 180 degrees, and one quarter of a circle is 90 degrees.

Denominator

The number written below the line in a fraction; it tells how many parts there are in the whole.

Descending order

A collection of numbers written so as to be decreasing in value.

Diagonal of a Polygon

A line segment joining two corners that are not next to each other in any polygon.

Note: An *n*-gon has n(n-3)/2 diagonals.
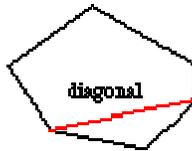
Diameter of a Circle or Sphere

A line segment joining two points of a circle (respectively, sphere) and passing through the center of the circle (respectively, sphere). The word *diameter* is also refers to the length of this line segment.
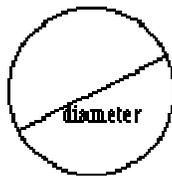
Difference

The result of subtracting two numbers or expressions. For example, the difference between 7 and 12 is 12 – 7, which equals 5.

Dilation of a Graph

A transformation in which all distances on the coordinate plane are lengthened by multiplying either all *x*-coordinates (horizontal dilation) or all *y*-coordinates (vertical dilation) by a common factor greater than 1.

Original graph   Same graph, vertically dilated
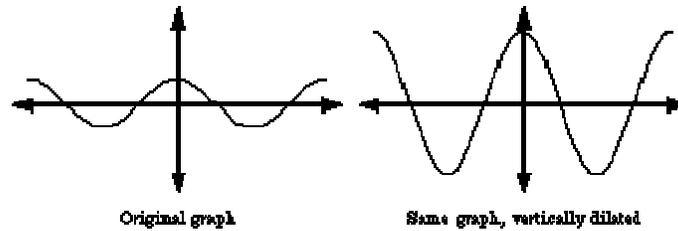
Distributive property

For all real numbers a, b, and c, a(b + c) = ab + ac. Every term inside the grouping symbols is multiplied by the term that is immediately outside.

Dividend

A number that is to be divided by another number.

Division

The inverse operation of multiplication.

Domain of the function f

The set of numbers x for which f(x) is defined.

Dozen

Twelve items.

E

Edge

In geometry, the line that is the intersection of two plane faces.

Element

A member of or an object in a set

Empty set

The empty set, Ø, is the set that has no members.

Equal

Identical in quantity. The symbol for equal is = .

Equally likely

In probability, when there are the same chances for more than one event to happen, the events are *equally likely* to occur. For example, if someone flips a coin, the chances of getting heads or tails are the same. There are equally likely chances of getting heads or tails

Equation

A statement that two quantities are equal. An equation has two sides which are equal or balanced. There must be an = sign.

Equilateral

Having sides of equal length. The angles of any equilateral triangle are always 60 degrees.
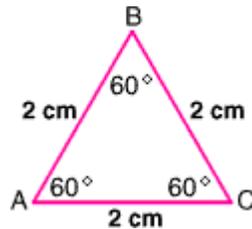
Equivalent

Having the same amount or the same value.

Estimate

A best guess arrived at after considering all the information given in a problem.

Evaluate

To find the value of or to solve the problem.

Even Number

A number that is divisible by two. All even numbers end with one of the digits: 0, 2,4,6,8

Event

In probability, an event is an occurrence or the possibility of an occurrence that is being investigated.

Exponent

An expression of the number of times that a base is used as a factor. A symbol indicating how many times the quantity is to be multiplied by itself to produce the power shown. In $4^3 = 4 \times 4 \times 4$, the number 4 is the base and 3 is the exponent.

Experimental probability

The chances of something happening, based on repeated testing and observing results. It is the ratio of the number of times an event occurred to the number of times tested. For example, to find the experimental probability of winning a game is the ratio of the number of games won to the number of games played as the number of games played becomes arbitrarily large.

Expression

An arithmetic construction involving both variables and numbers.

Exterior

The outside of something, such as the exterior angle of a triangle.

F

Face

In a three-dimensional shape, a face is the flat part of the surface that is bounded by the edges.
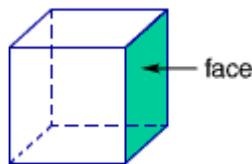
Factor

A number or expression which divides evenly into another number or expression. For example, 3 is a factor of 12, because 3 can be multiplied by 4 to give 12. Similarly, 5 is a factor of 20, because 5 times 4 is 20.

Factor Tree

A diagram that shows the prime factors of a given number.

$$24$$
$$12 \times 2$$
$$4 \times 3 \times 2$$
$$2 \times 2 \times 3 \times 2$$
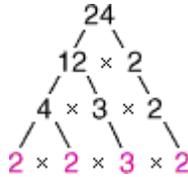
Flip (reflect)

A move of a figure over a line. The resulting figure is a mirror image of the first.

Foot

Plural (feet), symbol (ft.) one foot measures 12 inches.

Fraction

A rational number of the form a/b where a is called the numerator and b is called the denominator. A number that compares part of an object or a set with the whole.

Frequency

The number of occurrences of a particular item in a collection of data.

Function

A function f of a variable x is a rule that assigns to each number x in the function's domain a single number f(x). The word "single" in this definition is very important. Alternatively, a set of ordered pairs in which no two pairs have the same x-coordinate.

G

Geometric sequence

A list of numbers where each entry is a fixed multiple of the previous entry.

Geometry

The part of mathematics that deals with the relationships, properties and measurements of solids, surfaces, lines, angles, and space.

Googol

A very large number. It is the numeral 1 with a hundred zeros after it.

Graph

Drawings or diagrams that show information.

Greater than

A relation between a pair of numbers showing which is greater. (>)

Greatest Common Factor

The greatest number that divides into all given numbers. For given numbers 8, 12, 16, and 20 the greatest common factor (GCF) is 4.

H

Half

 One part of two equal parts.

Height

Measurement from top to bottom or the vertical distance.

Heptagon

A polygon with seven sides and seven angles. Regular Heptagons have all sides and all angles congruent.
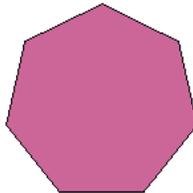
Hexagon

A polygon that has six sides and six angles.
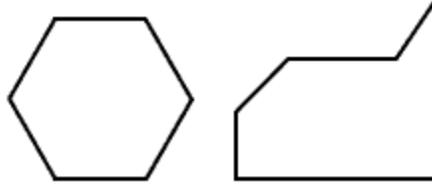
Histogram

A bar graph in which bars correspond to classes of data and the heights of the bars are the frequencies of those classes. (the bars are connected)
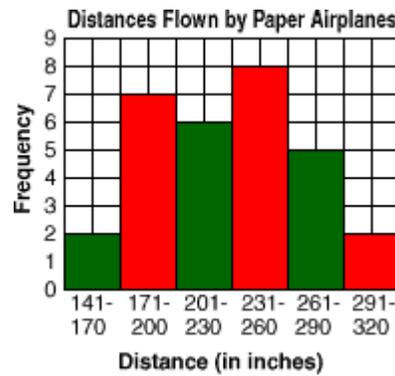
Horizontal line

Line parallel to, or on a level with, the horizon. A vertical line is at right angles to the horizon.

Hour

A unit of time that measures 60 minutes.

Hypotenuse

The side of a right triangle that is opposite the right angle. This is also the longest side of a right triangle.
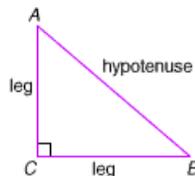
I

Improper Fraction

A fraction whose numerator is greater than its denominator.

Increase

To make larger by adding a certain amount, or multiplying by a number.

Identity

A number is an identity for an operation if application of that operation to that number and any given number yields that given number. For multiplication, the identity is one, and for addition the identity is zero.

Indefinitely

An unspecified amount, having no exact limits.

Independent events

Two events A and B are independent if the probability that they happen at the same time is the product of the probabilities that each occurs individually; i.e., if $P(A \& B) = P(A)P(B)$.

Inequality

A statement that one quantity is less than or greater than another. The symbols $<$, $>$ and the not equal sign are used to express inequalities.
$$6 < 9$$
$$3x \geq 12$$

Infinity

Greater than any fixed counting number, or extending forever. No matter how large a number one thinks of, infinity is larger than it. Infinity has no limits

Input

The number or value that is entered, for example, into a function machine. The number that goes into the machine is the input.

Integer

Any positive or negative number that does not include a fraction or decimal, including zero.
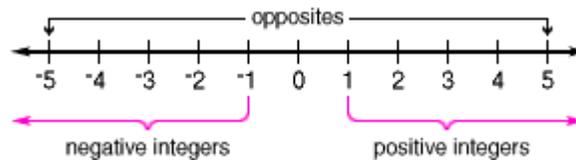
Interior

The inside of a figure, or the inside of something. Interior angles are angles inside a geometric figure.

Intersection of lines

When two or more lines cross.

$\overleftrightarrow{AE}$ and $\overleftrightarrow{CD}$ intersect at point B.
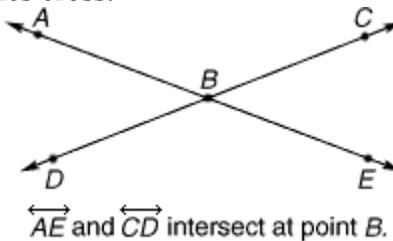
Intersection of sets

The intersection of two or more sets is the set of elements that all the sets have in common; in other words, all the elements contained in every one of the sets. The mathematical symbol for intersection is ∩.

Inverse, additive

A number when added to a given number yields zero.

Inverse, multiplicative

A number when multiplied by a given number yields one.

Irrational number

A number that cannot be written as the ratio of two integers.

Isosceles triangle

A triangle that has at least two congruent sides.
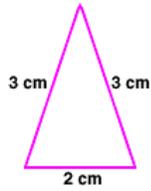
L

Line

> A continuous extent of length containing two or more points that continues indefinitely in both directions.

Line graph

> A diagram showing a system of connections or interrelations between two or more things by using lines.

Line plot

> Data that is plotted on a number line.
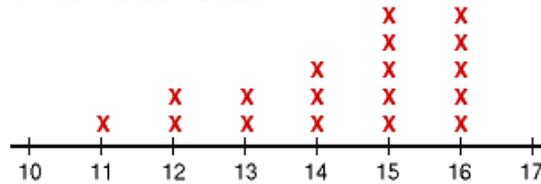
Line segment

> A piece of a line with endpoints at both ends.

line segment AB, or $\overline{AB}$

line segment CD, or $\overline{CD}$
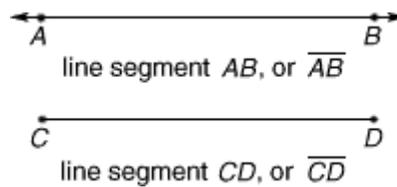
Line symmetry

> If a figure is divided by a line and both divisions are mirrors of each other, the figure has line symmetry. The line that divides the figure is the line of symmetry

line of symmetry
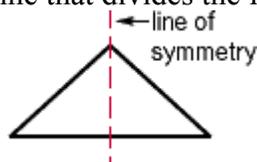
Linear

An equation or function whose graph is a straight line.

Linear function

A function of the form f(x) = mx + b where m and b are some fixed numbers. The names "m" and "b" are traditional. Functions of this kind are called "linear" because their graphs are straight lines.

M

Mean

The sum of a list of numbers divided by the total number of numbers in the list. The mean is used to describe the central tendencies of a set of numbers.

Median

"Middle value" of a list. The smallest number such that at least half the numbers in the list are no greater than it. If the list has an odd number of entries, the median is the middle entry in the list after sorting the list into increasing order. If the list has an even number of entries, the median is equal to the sum of the two middle (after sorting) numbers divided by two. The median can be estimated from a histogram by finding the smallest number such that the area under the histogram to the left of that number is 50%.

Mixed numbers

A number written as the sum of an integer and a fraction, such as 2 ¾ , which is the sum of 2 and ¾ .

Mode

For lists, the mode is the most common (frequent) value. A list can have more than one mode.

Multiples

The product of multiplying a number by a whole number. For example, multiples of 5 are 10, 15, 20, or any number that can be evenly divided by 5.

Multiplication

The operation by which the product of two quantities is calculated.

Multiplication rule

The probability that events A and B both occur (i.e., that event A&B occurs), is equal to the conditional probability that A occurs given that B occurs, times the unconditional probability that B occurs: P(A & B)=P(A/B)*P(B).

N

Natural numbers

The counting numbers, i.e. 1, 2, 3, 4... In graphing, numbers to the right of zero.

Negative numbers

Numbers less than zero. In graphing, numbers to the left of zero. Negative numbers are represented by placing a minus sign (-) in front of the number.

Nonagon

A geometric figure with nine sides.
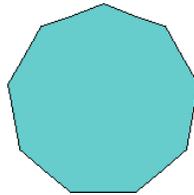
Normal distribution

A distribution symmetric about a mean and falling off on both sides of the mean as described by a bell curve.

Numerator

The number above the fraction bar that indicates the number of parts of the whole there are in a rational number.

O

Obtuse angle

An angle whose measure is greater than 90 degrees and less than 180 degrees.
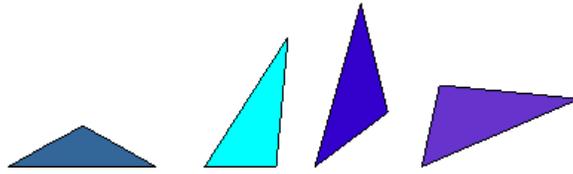
Octagon

A geometric figure with eight sides.
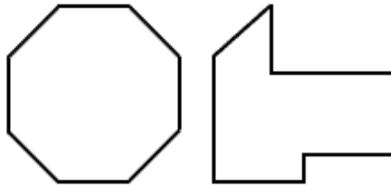
Order of operations

The order that operations are to be carried out in an algebraic equation.
(A mnemonic for remembering the order of operations is "Please Excuse My Dear Aunt Sally," which corresponds to the operations parentheses, exponents, multiply and divide in order, add and subtract in order)

Origin

In the Cartesian coordinate plane, the origin is the point at which the horizontal and vertical axes intersect – that is, the point with coordinates (0,0).

Outcome

Any one of the possible results of an experiment.

Outlier

A data point (or points) that is at a great distance from the greater portion of the points in the data set.

Output

The number or value that comes out from a process. For example, in a function machine, a number goes in, something is done to it, and the resulting number is the output.

P

Parallel

Lines that are in the same plane that do not intersect.

$$\overleftrightarrow{AB} \parallel \overleftrightarrow{CD}$$
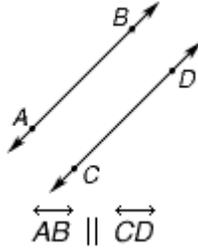
Parallelogram

A quadrilateral that contains two pairs of parallel sides.
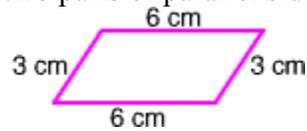
Pattern

Characteristic(s) observed in one item that may be repeated in similar or identical manners in other items.

Pentagon

A geometric figure with five sides.
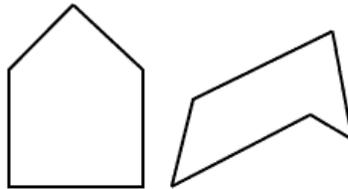
Percent

A ratio that compares a number to one hundred. The symbol for percent is %.

Perimeter

The sum of the lengths of the sides of a polygon.
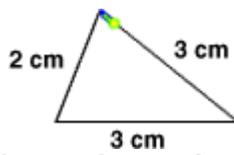
$$3 \text{ cm} + 3 \text{ cm} + 2 \text{ cm} = 8 \text{ cm}$$

The perimeter of this figure is 8 centimeters.

Permutation

A particular ordering of a set of objects. For example, given the set {1, 2, 3}, there are six permutations: {1, 2, 3}, {1, 3, 2}, {2, 1, 3}, {2, 3, 1}, {3, 1, 2}, and {3, 2, 1}.

Pi

The designated name for the ratio of the circumference of a circle to its diameter.

Pie graph

A diagram showing a system of connections or interrelations between two or more things by using a circle divided into segments that look like pieces of pie.
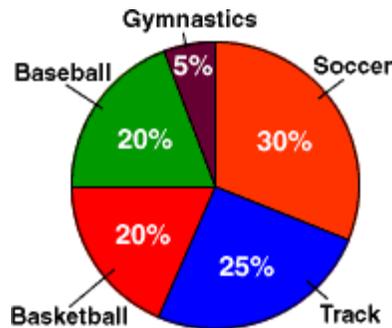
Polygon

A closed plane figure formed by three or more line segments that do not cross over each other.
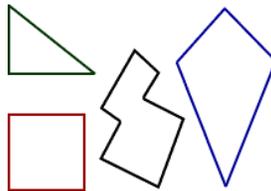
Prime number

A natural number that has exactly two factors, 1 and the number itself.

Probability

The measure of how likely it is for an event to occur. The probability of an event is always a number between zero and 100%. The meaning (interpretation) of probability is the subject of theories of probability. However, any rule for assigning probabilities to events has to satisfy the axioms of probability.

Proportion

If four quantities form equivalent ratios, then those quantities are said to be in proportion.

Protractor

An instrument for laying down and measuring angles on paper, used in drawing and plotting.

Read the angle measure from this point on the protractor.

Pythagorean Theorem

Used to find side lengths of right triangles, the Pythagorean Theorem states that the square of the hypotenuse is equal to the sum of the squares of the two sides, or
$$A^2 + B^2 = C^2,$$
where C is the hypotenuse.
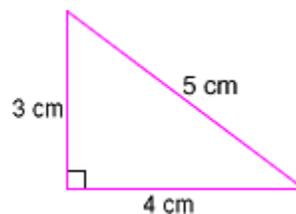
$$c^2 = a^2 + b^2$$
$$5^2 = 3^2 + 4^2$$
$$25 = 9 + 16$$
$$25 = \quad 25$$

Q

Quadrant

The four regions of the plane bounded by the x and y axes.   Each of these
quadrants have a number designation:

- First quadrant - contains all the points with positive x and positive y
  coordinates.
- Second quadrant - contains all the points with negative x and positive y
  coordinates.
- Third quadrant - contains all the points with negative x and negative y
  coordinates.
- Fourth quadrant - contains all the points with positive x and negative y
  coordinates.
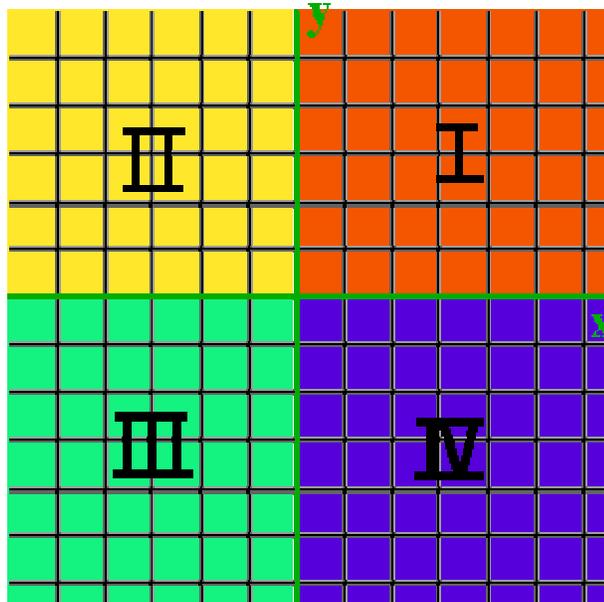
Quadratic function

A function of the form $f(x) = ax^2 + bx + c$ where a is not equal to zero (in which
case the function turns into a linear function).

Quadrilateral

A polygon that has four sides. All quadrilaterals have an inside angle
measurement of 360 degrees.

Quotient

> When performing division, the number of times one value can be multiplied to reach the other value represents the quotient. For example, when dividing 7 by 3, 3 can be multiplied twice, making 6, and the remainder is 1, so the quotient is 2

R

Random number generator

> A device used to produce a selection of numbers in a fair manner, in no particular order and with no favor being given to any numbers. Examples include dice, spinners, coins, and computer programs designed to randomly pick numbers.

Range

> The range of a set of numbers is the largest value in the set minus the smallest value in the set. Note that the range is a single number.

Ratio

> A rational number of the form a/b where a is called the numerator and b is called the denominator.

Range of the function f

> The set of all the numbers f(x) for x in the domain of f.

Ray

> A straight line that begins at a point and continues outward in one direction.

ray JK, or $\overrightarrow{JK}$
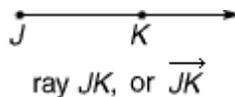
Real numbers

> The numbers corresponding to points on the number line.

Rectangle

> A parallelogram with four right angles. In rectangles all angles measure 90 degrees.

Reflect

In a tessellation, reflect means to repeat an image by flipping it across a line so it appears as it would in a mirror.

Regular polygon

A polygon whose side lengths are all the same and whose interior angle measures are all the same.

Remainders

The amount by which a quantity exceeds the largest integer multiple of a given number not exceeding that quantity. For example, when 8 is divided by 3, three goes in to eight twice (making 6), and the remainder is 2. When dividing 9 by 3, there is no remainder, because 3 goes in to 9 exactly 3 times, with nothing left over.

Rhombus

A parallelogram with four congruent (equal) sides.
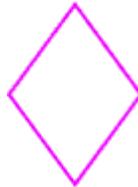
Right angle

An angle of 90 degrees.

┐ is a mark
for a 90° angle.
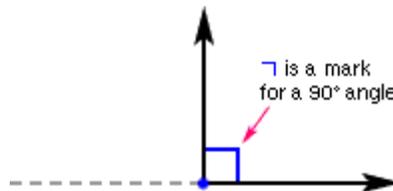
Right triangle

A triangle with an angle of 90 degrees.
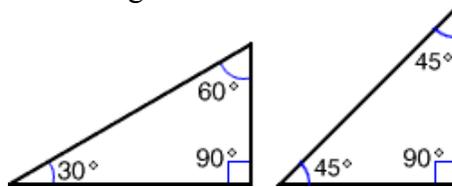
Rotate

To rotate an object in a tessellation means to repeat the object by spinning it on a point a certain angle.

Rule of probabilities for simultaneous independent events

When finding the probability of two independent events (two things happening where the outcomes are not affected by each other), multiply the probabilities of each event happening to get the probability of both events happening. For example, to find the probability of getting "heads" and then "tails" when flipping a coin twice, multiply the probability of getting heads once by the probability of getting tails once.

S

Scalene triangle

A triangle with no two sides equal in length or no two angles equal in measure.
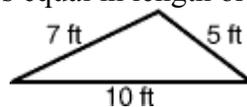
Scatter plot

A graph that shows data points graphed on the coordinate plane.
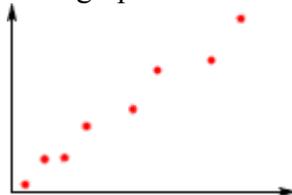
Sequence

An ordered set whose elements are usually determined based on some function of the counting numbers.

Set

        A set is a collection of things, without regard to their order

Significant digits

        The number of digits to consider when using numbers in scientific calculations.
        There are three rules in determining the number of digits considered significant in
        a number.
        1) All non-zero digits are significant.
        2) Any zero digits between two non-zero digits are significant
        3) Any zero digits between the decimal and a non-zero digit are significant.

Slope of the linear function

        The slope of the line $y = mx + b$ is the rate at which y is changing per unit of
        change in x.

Sphere

        A geometric figure resembling a ball that is the set of all points a fixed distance
        from a given point called the center of the sphere.
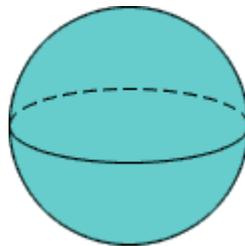
Square

        A parallelogram with four congruent sides and four right angles.
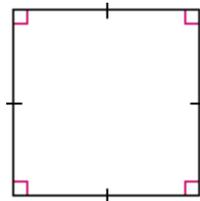
Square pyramid

        A figure with three sides consisting of triangles and the base a square figure.
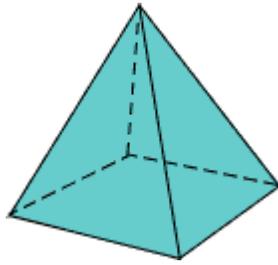
Standard deviation

Standard deviation indicates the amount of spread of a set of numbers with respect to their mean, calculated as the square root of the average of the squares of the deviations from the mean.

Stem-and-leaf plot

A unique way of listing data by dividing the numbers into stems and leaves.

Set of Data
140, 130, 136, 158, 152, 167

Stem	Leaves
13	0 6
14	0
15	2 8
16	7

Subset

A subset of a given set is a collection of things that belong to the original set. For example, A= {a,b,d} is a subset of B ={a,b,c,d}.

Subtraction

The operation in which the difference between two numbers or quantities is calculated. Also, the inverse of addition. Other words that mean subtraction are minus, take away, or less.

Surface area

A measure of the number of square units needed to cover a given surface.

Symmetry

The correspondence in size, form, or arrangement of parts on a plane or line. In line symmetry, each point on one side of the line has a corresponding point on the opposite side of the line (picture a heart, with pieces that are identical on either side). Plane symmetry refers to similar figures being repeated at different but regular locations on the plane.

T

Tangram

A Chinese puzzle consisting of seven geometric shapes.
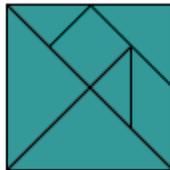
Tessellation

A tessellation is a repeated geometric design that covers a plane without gaps or overlaps.

Theories of Probability

A theory of probability is a way of understanding probability statements. That is, a theory of probability connects the mathematics of probability, which is the set of experiment. There are several common theories of probability. According to the frequency theory of probability, the probability of an event is the limit of the percentage of times that the event occurs in repeated, independent trials under essentially the same circumstances. According to the subjective theory of probability, probability is a number that measures how strongly we believe an event will occur. The number is on a scale of 0% to 100% (or 0 to 1), with 0% indicating that we are completely sure it won't occur, and 100% indicating that we are completely sure that it will occur.

Translate

In a tessellation, to translate an object means repeating it by sliding it over a certain distance in a certain direction.

Transversal

A line or ray that divides other lines or rays.

Trapezoid

A quadrilateral with exactly one pair of parallel sides.

U, V, W

Union of sets

The union of two or more sets is the set of all the objects contained by at least one of the sets. The symbol for union is ∪ .

Venn Diagram

A diagram where sets are represented as simple geometric figures, with overlapping and similarity of sets represented by intersections and unions of the figures.
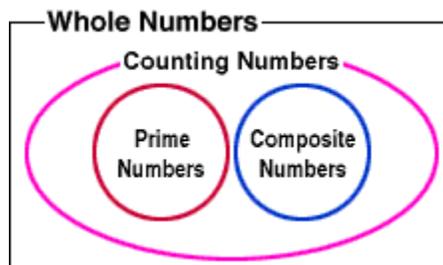
Vertical angles

The two nonadjacent angles formed when two straight lines intersect.
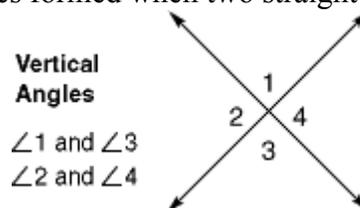
Volume

A measure of the number of cubic units needed to fill the space inside an object.

Whole numbers

The union of zero with the set of natural numbers. (0, 1, 2, …)

X, Y, Z

X-axis

The horizontal axis in the xy-plane. The across axis.

X-intercept

The x-coordinate of the point where a line crosses the x-axis.

Y-axis

The vertical axis in the xy-plane. Up and down axis.

Y-intercept

The y-coordinate of the point where the line crosses the y-axis.

(A to Z Index, Mathwords)

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APPENDICES

APPENDIX A

Primary Mathematical Words

<u>Numbers and the number system</u>

Counting, properties of numbers and number sequences
number
zero, one, two, three... to twenty and beyond
zero, ten, twenty... one hundred
zero, one hundred, two hundred... one thousand
none
how many...?
count, count (up) to
count on (from, to)
count back (from, to)
count in ones, twos, threes, fours, fives, and so on
count in tens
more, less, many, few
tally
odd, even
every other
how many times?
multiple of
sequence
continue
predict
pattern, pair, rule

Place value and ordering
units, ones
tens, hundreds
digit
one-, two- or three-digit number
'teens' number
place, place value
stands for, represents
exchange
the same number as, as many as
equal to

Of two objects/amounts:
greater, more, larger, bigger
less, fewer, smaller

Of three or more objects/amounts:
greatest, most, biggest, largest
least, fewest, smallest
one more, ten more
one less, ten less
compare
order
size
first, second, third... tenth... twentieth
twenty-first, twenty-second...
last, last but one
before, after
next
between, half-way between
above, below

Estimating
guess how many, estimate
nearly, roughly, close to
about the same as
just over, just under
exact, exactly
too many, too few, enough, not enough
round, nearest, round to the nearest ten

Fractions
part, equal parts
fraction
one whole
one half, two halves
one quarter, two... three... four quarters

Calculations

Addition and subtraction
+, add, addition, more, plus
make, sum, total
altogether
score
double, near double
one more, two more... ten more... one hundred more
how many more to make...?
how many more is... than...?
how much more is...?
-, subtract, take away, minus
leave, how many are left/left over?

one less, two less... ten less... one hundred less
how many less is... than...?
how much fewer is...?
difference between
half, halve
=, equals, sign, is the same as
tens boundary

Multiplication and division
lots of, groups of
x, times, multiply, multiplied by
multiple of
once, twice, three times,
four times, five times... ten times...
times as (big, long, wide and so on)
repeated addition
array
row, column
double, halve
share, share equally
one each, two each, three each...
group in pairs, threes... tens
equal groups of
÷, divide, divided by, divided into, left, left over

<u>*Solving problems*</u>

Making decisions and reasoning
pattern, puzzle
calculate, calculation
mental calculation
jotting
answer
right, correct, wrong
what could we try next?
how did you work it out?
number sentence
sign, operation, symbol

Money
money
coin
penny, pence, pound, (£)
price, cost
buy, bought, sell, sold
spend, spent
pay

change
dear, costs more
cheap, costs less, cheaper
how much...? how many...?
total

Organizing and using data
count, tally, sort, vote
graph, block graph, pictogram
represent
group, set
list, table
label, title
most popular, most common
least popular, least common

Measures, shape and space
measure
size
compare
measuring scale
guess, estimate
enough, not enough
too much, too little
too many, too few
nearly, roughly, about, close to, about the same as
just over, just under

Length
length, width, height, depth
long, short, tall, high, low
wide, narrow, deep, shallow, thick, thin
longer, shorter, taller, higher... and so on
longest, shortest, tallest, highest... and so on
far, further, furthest, near, close
metre (*m*), centimetre (*cm*)
ruler, metre stick, tape measure

Mass
weigh, weighs, balances
heavy/light, heavier/lighter, heaviest/lightest
kilogram (*kg*), half-kilogram, gram(*g*)
balance, scales, weight

Capacity
full, half full

empty
holds, contains
litre (*l*), half-litre, millilitre (*ml*)
container

Time
days of the week: Monday, Tuesday...
months of the year: January, February...
seasons: spring, summer, autumn, winter
day, week, fortnight, month, year
weekend
birthday, holiday
morning, afternoon, evening, night, midnight
bedtime, dinnertime, playtime
today, yesterday, tomorrow
before, after
next, last
now, soon, early, late
quick, quicker, quickest, quickly
fast, faster, fastest
slow, slower, slowest, slowly
old, older, oldest
new, newer, newest
takes longer, takes less time
how long ago?/how long will it be to...?
how long will it take to...?
hour, minute, second
o'clock, half past, quarter to, quarter past
clock, watch, hands
digital/analogue clock/watch, timer
how often?
always, never, often, sometimes, usually
once, twice

Shape and space
shape, pattern
flat, curved, straight
round
hollow, solid
corner
point, pointed
face, side, edge, end
sort
make, build, draw
surface

3D shapes
cube
cuboid
pyramid
sphere
cone
cylinder

2D shapes
circle, circular
triangle, triangular
square
rectangle, rectangular
star
pentagon
hexagon
octagon

Patterns and symmetry
size
bigger, larger, smaller
symmetrical
line of symmetry
fold
match
mirror line, reflection
pattern
repeating pattern

Position, direction and movement
over, under, underneath
above, below
top, bottom, side
on, in
outside, inside
around
in front, behind
front, back
before, after
beside, next to
opposite
apart
between
middle, edge
centre
corner

direction
journey, route
left, right
up, down
higher, lower
forwards, backwards, sideways
across
close, far, near
along
through
to, from, towards, away from
clockwise, anti-clockwise
movement
slide
roll
whole turn, half turn, quarter turn
right angle
straight line
stretch, bend

Instructions

listen
join in
say
recite
think
imagine
remember
start from
start with
start at
look at
point to
show me
put, place
fit
arrange, rearrange
change, change over
split
separate
carry on, continue
repeat
what comes next...?
predict

describe the pattern
describe the rule
find, find all, find different
investigate
choose
decide
collect
use
make
build
tell me
describe
name
pick out
discuss
talk about
explain
explain your method
explain how you got your answer
give an example of...
show how you...
read
write
record
write in figures
present
represent
trace
copy
complete
finish, end
fill in
shade, colour
label
tick, cross
draw
draw a line between
join (up)
ring
arrow
cost, count, tally
calculate
work out
solve
answer
check

General
same, different
missing number/s
number facts
number pairs
number bonds

number line, number track
number square, hundred square
number cards
number grid
abacus
counters, cubes, blocks, rods
die, dice
dominoes
pegs, peg board
geo-strips

same way, different way
best way, another way
in order, in a different order
not
all, every, each

(National Numeracy Strategy <u>Mathematical Vocabulary</u>)

APPENDIX B

Virginia Standards of Learning Objectives (K-2)

Here is a list of the Virginia Standards of Learning Objectives for kindergarten, first, and second grade. As one can see, this is a lot of information for teachers to instill in the minds of primary children.

Kindergarten Standards of Learning Objectives (SOLs)

Number and Number Sense

K.1   The student, given two sets containing 10 or fewer concrete items, will identify and describe one set as having more, fewer, or the same number of members as the other set, using the concept of one-to-one correspondence.

K.2   The student, given a set containing 10 or fewer concrete items, will
        a) tell how many are in the set by counting the number of items orally;
        b) select the corresponding numeral from a given set; and
        c) write the numeral to tell how many are in the set.

K.3   The student, given an ordered set of three objects and/or pictures, will indicate the ordinal position of each item, first through third, and the ordered position of each item from left-to-right, right-to-left, top-to-bottom, and/or bottom-to-top.

K.4   The student will investigate and recognize patterns from counting by fives and tens to 30, using concrete objects and a calculator.

K.5   The student will count forward to 30 and backward from 10.

Computation and Estimation

K.6   The student will add and subtract whole numbers, using up to 10 concrete items.

Measurement

K.7   The student will recognize a penny, nickel, dime, and quarter and will determine the value of a collection of pennies and/or nickels whose total value is 10 cents or less.

K.8   The student will identify the instruments used to measure length (ruler), weight (scale), time (clock: digital and analog; calendar: day, month, and season), and temperature (thermometer).

K.9   The student will tell time to the hour, using an analog or digital clock.

K.10   The student will compare two objects or events, using direct comparisons or nonstandard units of measure, according to one or more of the following attributes: length (shorter, longer), height (taller, shorter), weight (heavier, lighter), temperature (hotter, colder). Examples of nonstandard units include foot length, hand span, new pencil, paper clip, and block.

Geometry

K.11   The student will identify, describe, and draw two-dimensional (plane) geometric figures (circle, triangle, square, and rectangle).

K.12   The student will describe the location of one object relative to another (above, below, next to) and identify representations of plane geometric figures (circle, triangle, square, and rectangle) regardless of their position and orientation in space.

K.13   The student will compare the size (larger, smaller) and shape of plane geometric figures (circle, triangle, square, and rectangle).

Probability and Statistics

K.14   The student will gather data relating to familiar experiences by counting and tallying.

K.15   The student will display objects and information, using objects graphs, pictorial graphs, and tables.

K.16   The student will investigate and describe the results of dropping a two-colored counter or using a multicolored spinner

.Patterns, Functions, and Algebra

K.17   The student will sort and classify objects according to similar attributes (size, shape, and color).

K.18   The student will identify, describe, and extend a repeating relationship (pattern) found in common objects, sounds, and movements (Virginia Department of Education).

First Grade Standards of Learning Objectives (Sol's)

Number and Number Sense

1.1   The student will count objects in a given set containing between 1 and 100 objects and write the corresponding numeral.

1.2   The student will group a collection of up to 100 objects into tens and ones and write the corresponding numeral to develop an understanding of place value.

1.3   The student will count forward by ones, fives, and tens to 100, by twos to 20, and backward by ones from 20.

1.4   The student will recognize and write numerals 0 through 100.

1.5   The student will identify the ordinal positions first through tenth, using an ordered set of objects.

1.6   The student will identify and represent the concepts of one-half and one-fourth, using appropriate materials or a drawing.

Computation and Estimation

1.7   The student, given a familiar problem situation involving magnitude, will
        a) select a reasonable magnitude from three given quantities: a one-digit numeral, a two-digit numeral, and a three-digit numeral (e.g., 5, 50, and 500); and
        b) explain the reasonableness of his/her choice.

1.8   The student will recall basic addition facts — i.e., sums to 10 or less — and the corresponding subtraction facts.

1.9   The student will create and solve story and picture problems involving one-step solutions, using basic addition and subtraction facts.

Measurement

1.10   The student will
        a) identify the number of pennies equivalent to a nickel, a dime, and a quarter;
        b) determine the value of a collection of pennies, nickels, and dimes whose total value is 100 cents or less.

1.11   The student will tell time to the half-hour, using an analog or digital clock.

1.12   The student will use nonstandard units to measure length and weight.

1.13   The student will compare the volumes of two given containers by using concrete materials (e.g., jelly beans, sand, water, rice).

1.14   The student will compare the weights of two objects, using a balance scale.

Geometry

1.15   The student will describe the proximity of objects in space (*near, far, close by, below, above, up, down, beside,* and *next to*).

1.16   The student will draw, describe, and sort plane geometric figures (triangle, square, rectangle, and circle) according to number of sides, corners, and square corners.

1.17   The student will identify and describe objects in his/her environment that depict plane geometric figures (triangle, rectangle, square, and circle).

Probability and Statistics

1.18   The student will investigate, identify, and describe various forms of data collection in his/her world (e.g., recording daily temperature, lunch count, attendance, and favorite ice cream), using tables, picture graphs, and object graphs.

1.19   The student will interpret information displayed in a picture or object graph, using the vocabulary *more, less, fewer, greater than, less than,* and *equal to*.

Patterns, Functions, and Algebra

1.20   The student will sort and classify concrete objects according to one or more attributes, including color, size, shape, and thickness.

1.21   The student will recognize, describe, extend, and create a wide variety of patterns, including rhythmic, color, shape, and numerical. Patterns will include both growing and repeating patterns. Concrete materials and calculators will be used by students (Virginia Department of Education).

Second Grade Standards of Learning Objectives (Sol's)

Number and Number Sense

2.1   The student will
        a) read, write, and identify the place value of each digit in a three-digit numeral, using numeration models; and
        b) round two-digit numbers to the nearest ten.

2.2   The student will compare two whole numbers between 0 and 999, using symbols (>, <, or =) and words (*greater than, less than,* or *equal to*).

2.3   The student will identify the ordinal positions first through twentieth, using an ordered set of objects.

2.4   The student will identify the part of a set and/or region that represents fractions for one-half, one-third, one-fourth, one-eighth, and one-tenth and write the corresponding fraction.

2.5   The student will
      a) count forward by twos, fives, and tens to 100, starting at various multiples of 2, 5, or 10, using mental mathematics, paper and pencil, hundred chart, calculators, and/or concrete objects, as appropriate;
      b) count backward by tens from 100;
      c) group objects by threes and fours; and
      d) recognize even and odd numbers, using objects.

Computation and Estimation

2.6   The student will recall basic addition facts, sums to 18 or less and the corresponding subtraction facts.

2.7   The student, given two whole numbers whose sum is 99 or less, will
      a) estimate the sum; and
      b) find the sum, using various methods of calculation (mental computation, concrete materials, and paper and pencil).

2.8   The student, given two whole numbers, each of which is 99 or less, will
      a) estimate the difference; and
      b) find the difference, using various methods of calculation (mental computation, concrete materials, and paper and pencil).

2.9   The student will create and solve one-step addition and subtraction problems using data from simple tables, picture graphs, bar graphs, and practical situations.

2.10   The student, given a simple addition or subtraction fact, will recognize and describe the related facts which represent and describe the inverse relationship between addition and subtraction (e.g., $3 + \_\_ = 7$, $\_\_\_ + 3 = 7$; $7 - 3 = \_\_$, and $7 - \_\_ = 3$).

Measurement

2.11   The student will
      a) count and compare a collection of pennies, nickels, dimes, and quarters whose total value is $2.00 or less; and
      b) identify the correct usage of the cent symbol (¢), dollar symbol ($), and decimal point (.)

2.12   The student will estimate and then use a ruler to make linear measurements to the nearest centimeter and inch, including measuring the distance around a polygon in order to determine perimeter.

2.13   The student, given grid paper, will estimate and then count the number of square units needed to cover a given surface in order to determine area.

2.14   The student will estimate and then count the number of cubes in a rectangular box in order to determine volume.

2.15   The student will estimate and then determine weight/mass of familiar objects in pounds and/or kilograms, using a scale.

2.16   The student will tell and write time to the quarter hour, using analog and digital clocks.

2.17   The student will use actual measuring devices to compare metric and U.S. Customary units (cups, pints, quarts, gallons, and liters) for measuring liquid volume, using the concepts of *more, less,* and *equivalent*.

2.18   The student will
      a) use calendar language appropriately (e.g., months, *today, yesterday, next week, last week*);
      b) determine past and future days of the week; and
      c) identify specific dates on a given calendar.

2.19   The student will read the temperature on a Celsius and/or Fahrenheit thermometer to the nearest 10 degrees.

Geometry

2.20   The student will identify, describe, and sort three-dimensional (solid) concrete figures, including a cube, rectangular solid (prism), square pyramid, sphere, cylinder, and cone, according to the number and shape of the solid's faces, edges, and corners.

2.21   The student will identify and create figures, symmetric along a line, using various concrete materials.

2.22   The student will compare and contrast plane and solid geometric shapes (circle/sphere, square/cube, and rectangle/rectangular solid).

Probability and Statistics

2.23   The student will read, construct, and interpret a simple picture and bar graph.

2.24   The student will record data from experiments, using spinners and colored tiles/cubes, and use the data to predict which of two events is more likely to occur if the experiment is repeated.

Patterns, Functions, and Algebra

2.25   The student will identify, create, and extend a wide variety of patterns, using numbers concrete objects and pictures.

2.25   The student will solve problems by completing a numerical sentence involving the basic facts for addition and subtraction. Examples include: $3 + \_\_ = 7$, or $9 - \_\_ = 2$. Students will create story problems, using the numerical sentences (Virginia Department of Education)

APPENDIX C

Learning Mathematics Vocabulary with Literature

Go into any primary classroom and one will find the teaching of reading. It is a crucial objective in any primary classroom that students learn to read. My question is simple. Why not teach reading and mathematics together? Children love stories, so why not find stories that teach some aspect of mathematics?

So I began to look for primary reading selections that deal with a mathematical topic. Not only will the children develop a love for reading, but they will also be incorporating different mathematical vocabulary into the reading lesson. What I found, in my search for mathematical stories, was an abundance of great literature that will connect reading with mathematics. This is a list of what is available for any primary classroom from Scholastic Book Club.

- ONE MOOSE, TWENTY MICE, students search for cats as they count to 20.

- THE ICKY BUG COUNTING BOOK, children learn numbers 1-26 and fun facts about each insect then backwards to find an insect for each letter.

- DRAW ME A STAR, basic geometry is explored as a boy learns how to draw.

- BENNY'S PENNIES, an introduction to money and counting.

- MOUSE COUNT, children count forwards and backwards.

- CLOCKS AND MORE CLOCKS, Mr. Higgins must find out why four clocks on four levels tell four different times.

- KNOTS ON A COUNTING ROPE, children learn about estimation, measurement, logic, counting and time as a young boy learns about his family.

- ONE LESS FISH, great science and math story about 12 fish that disappear one

by one.

- TEN BLACK DOTS, using rhymes and familiar objects children learn what can be done with up to ten blocks.

- STELLALUNA, graphing and comparisons are used as a lost bat finds its way home.

- FROG AND TOAD ARE FRIENDS, a story about five adventures of two best friends.

- 1 HUNTER, children count the animals our hunter doesn't see.

- INCHWORM AND A HALF, students learn about fractions and measurement as this puzzled inchworm and friends travel through a vegetable garden.

- THE KEEPING QUILT, an adorable story about traditional memories that are passed down from generation to generation.

- JIM AND THE BEANSTALK, children learn about measurement and proportions in this unique story.

- MONSTER MONEY BOOK, children learn about budgeting, borrowing, and checking and savings accounts with Sarah and the Monster Club.

- PEPPER'S JOURNAL: A KITTEN'S FIRST YEAR, as Lisa keeps track of her kittens first year, she learns concepts of calendar time.

- BETCHA!, two friends learn about estimation on a bus trip.

- THE ELEVENTH HOUR, critical thinking and problem solving skills are used as children follow visual clues and hidden messages to solve this mystery.

- HOW TALL, HOW SHORT, HOW FARAWAY, children learn that a palm is more than just a tree in this hands-on measurements story.

- A THREE HAT DAY, a dreamer finds his true love in a hat shop after dreaming of his future wife.

- ANNO'S MAGIC SEEDS, enchanted seeds planted by Jack will have students exploring number patterns.

- SHAPE UP, polygons are introduced through a variety of everyday geometric objects.

- THE VERY BUSY SPIDER, as a spider spins his web children learn about spatial and linear patterns.

- SWEET CLARA AND THE FREEDOM QUILT, as this young slave girl constructs a quilt she shows others the way to freedom.

- INCH BY INCH, by demonstrating how useful a measurement tool he was, this clever inchworm avoided being eaten.

- HOW BIG IS A FOOT, relating measurement to the real world is the basis of the story.

- MISSION: ADDITION, children learn how to develop word problems, add large numbers and check their own work with Miss Prime and her class.

- SUBTRACTION ACTION, Miss Prime and her class explore subtraction facts at the school fair, and student learn that subtraction does make a difference!

- ONE HUNDRED HUNGRY ANTS, children find opportunities for counting, classifying, and adding in the story.

- ONLY ONE, opportunities abound for counting parts of a whole while at the county fair.

- DAVE'S DOWN-TO-EARTH ROCK SHOP, Dave and Amy organize their rock

collection.

- A CLOCK FOR THE DREAMER, relationships among geometric shapes is introduced by this tailor and his three sons.

- AMANDA BEAN'S AMAZING DREAMS, through her amazing dreams Amanda learns that multiplication will help her count.

- THE KING'S COMMISSIONERS, rather than counting 1, 2, 3… this king counts his commissioners by 2's, 5's, and 10's and so on.

- SIX-DINNER SID, living at six different homes this clever cat gets six meals a day.

- WHERE THE FOREST MEETS THE SEA, a beautiful story about a boy and his father looking at the lifespan of a forest.

- SPAGHETTI AND MEATBALLS FOR ALL!, area and perimeter are explored as seating arrangements are decided for a family reunion.

- MATH CURSE, an exciting story of a young girl who encounters a multitude of problems as she discovers that everything can be seen as a math problem.

- $1.00 WORD RIDDLE BOOK, the riddles in this book give clues to finding $41.00 words.

- WHAT'S SMALLER THAN A PYGMY SHREW?, this story takes students on a journey from the mighty but small pygmy shrew to microorganisms and molecules.

- A REMAINDER OF ONE, in a parade for the queen a lonely bug uses division to find his place.

- THE PHANTOM TOOLBOOTH,   an exciting journey through the land of

Conclusions as Milo learns about time.

- A MILLION FISH…MORE OR LESS, introducing number and sequencing activities are a joy through this Louisiana tale.

- SIR CUMFERENCE AND THE SWORD IN THE CONE, the first knight to find King Arthur's sword, Edgecalibur, will be the next kind. Help Sir Cumference, Ladi Di of Ameter, and Raidus as the help find the sword.

- SIR CUMFERENCE AND THE FIRST ROUND TABLE, help Sir Cumference as he searches for the shape of the future.

- SIR CUMFERENCE AND THE DRAGON OF PI, Sir Cumference changes into a fire breathing dragon.

- SIR CUMFERENCE AND THE GREAT KNIGHT OF ANGLELAND, join Raidus in the ultimate challenge in the castle's maze with many angles.

- EACH ORANGE HAD EIGHT SLICES, children are introduced to beginning math concepts that reinforce the visual literacy, classifying, and counting skills.

- P. BEAR'S NEW YEAR'S PARTY, children learn about analog clocks as P. Bear formally greets his guests at the top of each hour.

- BATS AROUND THE CLOCK, rhymes about time with dancing bats from noon to midnight.

- TELLING TIME WITH BIG MAMA CAT, as Big Mama Cat goes through her day, children change the hands on the clock.

- TWO WAYS TO COUNT TO TEN, this counting story has animals that lead children through the story.

- 12 WAYS TO GET TO 11, through appealing objects children learn strategies for

counting.

- ROOSTER'S OFF TO SEE THE WORLD, introduce numbers through these charming characters, a rooster, cats, and fish.

- ANNO'S COUNTING BOOK, the numbers 1-12 are illustrated by the changing seasons.

- ANNO'S MYSTERIOUS MULTIPLYING JAR, having a jar that holds the sea introduces students to factorials.

- SHIP OF DREAMS, helps to develop mathematical literacy through night time dreams and travels.

- THE NAPPING HOUSE, sleepy people and sleepy animals pile on a bed, can you guess how many can pile on before it collapses!

- SAM JOHNSON AND THE BLUE RIBBON QUILT, students learn about patterns and symmetry with these border prints of well known quilting patterns.

- FRACTION ACTION, this book has characters in five stories that depict fractions being used in their everyday life.

- HOW MUCH IS A MILLION, students get to see what a million, a billion and a trillion really mean.

- THE GREEDY TRIANGLE, the unhappy triangle explores life as a multitude of geometric shapes.

- JUMANJI, explore probability through the exciting jungle fantasy.

- PIGS WILL BE PIGS: FUN WITH MATH AND MONEY, join the fun and pig out on math and money concepts with the Pigs.

- PIGS IN THE PANTRY: FUN WITH MATH AND COOKING, join the Pigs and

see what trouble they can cook up in the kitchen.

- PIGS ON THE BALL: FUN WITH MATH AND SPORTS, join the Pigs in an exciting game of golf.

- PIGS AT ODDS: FUN WITH MATH AND GAMES, join the Pigs at the county fair to play games and win prizes.

- THE M&M'S COUNTING BOOK, young readers are motivated to learn simple math, sets of twelve, the six M&M colors, and three primary shapes.

- MORE M&M'S MATH, children build estimation, graphing, multiplication, factoring, division, fraction, and problem solving skills in the book.

- THE M&M'S COLOR PATTERN BOOK, students are introduced to color sorting, pattern addition and multiplication that begin with 2-color to complex 6-color arrangements.

- M&M'S BRAND COUNT TO 100 BOOK, students learn to count to 100 by ones, twos, fives, and tens.

- SKITTLES RIDDLES MATH, children learn about negative numbers, number sentences, quantity comparisons, fractions, infinity, and interpreting pie-graphs through riddles and poetry.

- PIZZA COUNTING, count, add, and multiply the toppings on these pizza masterpieces, then divide them up into filling fractions.

- ALICE IN PASTALAND, when Alice pursues a white rabbit, she finds a Wonderland where the common denominator is pasta.

- BUGS FOR LUNCH, children count, add, and make guesses about a variety of creatures that eat insects.

- SOLD! A MATHEMATICS ADVENTURE, a curious boy finds out what it's like to spend money before you have it. Can he somehow multiply the debt into a profit of millions?

- BIRDS: NATURE'S MAGNIFICENT FLYING MACHINES, students will measure and compare wingspans, map migration paths, convert scaled distances, and discuss average speed of different birds.

- OUR WET WORLD, in this story of thirteen different ecosystems students will explore percentages and conversions of pounds/kilograms and feet/meters.

- COUNTING ON CALICO, counting from 1-20 is fun when you count on a calico cat and her seven kittens.

- THE HERSHEY'S MILK CHOCOLATE FRACTIONS BOOK, a Hershey bar is made up of 12 little rectangles, making it perfect for teaching fractions. A bunch of comical cows, some cocoa pods, and a few stalks of sugar cane come along to join the fraction party.

- HERSHEY'S MILK CHOCOLATE WEIGHTS AND MEASURES, learn how long is a foot, what is the metric system, and which weighs more a pound of feathers or a pound of Hershey candy.

- THE COIN COUNTING BOOK, count coins in rhymes.

- ONCE UPON A DIME, organic farmer Truman Worth knows that money does grow on trees and students will calculate the changing value of his crop.

- SOCCER COUNTS, rhymes that will help students count to fifteen.

- TELLING TIME: HOW TO TELL TIME ON DIGITAL AND ANALOG CLOCKS, helps to teach students how we tell time on both types of clocks.

- A PLACE FOR ZERO: A MATH ADVENTURE, join Zero as he goes on a journey to discover his place. He can't play Addemup with the other numbers because he has nothing to add.

- CUT DOWN TO SIZE AT HIGH NOON, the town of Cowlick turns out for a scale-drawing showdown when a tough-talkin stranger challenges the local hero.

- CLEVER CALCULATOR CAT, encourages effective calculator use and awareness of reasonable and unreasonable numbers.

- THE BUTTON BOX, a little boy explores the fun of sorting buttons in his Grandmothers button box.

- WHALE OF A TALE, the adventures of a magic square that transforms into different origami shapes (Scholastic Book Club).

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APPENDIX D

Elementary Mathematical Words

<u>Numbers and the number system</u>

Place value, ordering and rounding
units, ones
tens, hundreds, thousands
ten thousand, hundred thousand, million
digit, one-, two-, three- or four-digit number
numeral
'teens' number
place, place value
stands for, represents
exchange
the same number as, as many as
equal to
Of two objects/amounts:
>, greater than, bigger than, more than, larger than
<, less than, fewer than, smaller than
Of three or more objects/amounts:
greatest, most, largest, biggest
least, fewest, smallest,
one... ten... one hundred... one thousand more/less
compare, order, size
first... tenth... twentieth
last, last but one
before, after
next
between, half-way between
guess how many, estimate
nearly, roughly, close to, about the same as
approximate, approximately
just over, just under
exact, exactly
too many, too few, enough, not enough
round (up or down), nearest
round to the nearest ten
round to the nearest hundred
integer, positive, negative
above/below zero, minus

Properties of numbers and number sequences
number, count, how many...?
odd, even
every other
how many times?
multiple of
digit
next, consecutive
sequence
continue
predict
pattern, pair, rule
relationship
sort, classify, property

Fractions and decimals
part, equal parts
fraction
one whole
half, quarter, eighth
third, sixth
fifth, tenth, twentieth
proportion, in every, for every
decimal, decimal fraction
decimal point, decimal place

Calculations

Addition and subtraction
add, addition, more, plus, increase
sum, total, altogether
score
double, near double
how many more to make...?
subtract, subtraction, take away, minus, decrease
leave, how many are left/left over?
difference between
half, halve
how many more/fewer is... than...?
how much more/less is...?
is the same as, equals, sign
tens boundary, hundreds boundary
inverse

Multiplication and division
lots of, groups of

times, multiplication, multiply, multiplied by
multiple of, product
once, twice, three times
four times, five times... ten times
times as (big, long, wide, and so on)
repeated addition
array
row, column
double, halve
share, share equally
one each, two each, three each...
group in pairs, threes... tens
equal groups of
divide, division, divided by, divided into, divisible by
remainder
factor, quotient
inverse

Solving problems

Making decisions and reasoning
pattern, puzzle
calculate, calculation
mental calculation
method
jotting
answer
right, correct, wrong
what could we try next?
how did you work it out?
number sentence
sign, operation, symbol, equation

Money
money
coin, note
penny, pence, pound, (£)
price, cost
buy, bought, sell, sold
spend, spent
pay
change
dear, costs more, more/most expensive
cheap, costs less, cheaper, less/least expensive
how much...? how many...?

total, amount
value, worth

Handling data

count, tally, sort, vote
survey, questionnaire, data
graph, block graph, pictogram
represent
group, set
list, chart, bar chart, tally chart
table, frequency table
Carroll diagram, Venn diagram
label, title, axis, axes
diagram
most popular, most common
least popular, least common

Measures, shape and space

Measures (general)
measure, measurement
size
compare
unit, standard unit
metric unit, imperial unit
measuring scale, division
guess, estimate
enough, not enough
too much, too little
too many, too few
nearly, roughly, about, close to
about the same as, approximately
just over, just under

Length
length, width, height, depth, breadth
long, short, tall, high, low
wide, narrow, deep, shallow, thick, thin
longer, shorter, taller, higher... and so on
longest, shortest, tallest, highest... and so on
far, further, furthest, near, close
distance apart... between... to... from
edge, perimeter
kilometre (*km*), metre (*m*), centimetre (*cm*), millimetre (*mm*)

mile
ruler, metre stick, tape measure

Mass
mass: big, bigger, small, smaller, balances
weight: heavy/light, heavier/lighter, heaviest/lightest
weigh, weighs
kilogram (*kg*), half-kilogram, gram (*g*)
balance, scales

Capacity
capacity
full, half full
empty
holds, contains
litre (*l*), half-litre, millilitre (*ml*)
pint
container, measuring cylinder

Area
area, covers, surface
square centimetre (cm^2)

Time
days of the week: Monday, Tuesday...
months of the year: January, February...
seasons: spring, summer, autumn, winter
day, week, fortnight, month
year, leap year, century, millennium
weekend, birthday
holiday
calendar, date, date of birth
morning, afternoon, evening, night
am, pm, noon, midnight
today, yesterday, tomorrow
before, after, next, last
now, soon, early, late, earliest, latest
quick, quicker, quickest, quickly
fast, faster, fastest, slow, slower, slowest, slowly
old, older, oldest, new, newer, newest
takes longer, takes less time
how long ago?/how long will it be to...?
how long will it take to...?
timetable, arrive, depart
hour, minute, second
o'clock, half past, quarter to, quarter past

clock, watch, hands
digital/analogue clock/watch, timer
how often?
always, never, often, sometimes, usually

Shape and space
shape, pattern
flat, line
curved, straight
round
hollow, solid
corner
point, pointed
face, side, edge, end
sort
make, build, construct, draw, sketch
centre, radius, diameter
net
surface
angle, right-angled
base, square-based
vertex, vertices
layer, diagram
regular, irregular
concave, convex
open, closed

3D shapes
3D, three-dimensional
cube
cuboid
pyramid
sphere, hemi-sphere, spherical
cone
cylinder, cylindrical
prism
tetrahedron, polyhedron

2D shapes
2D, two-dimensional
circle, circular, semi-circle
triangle, triangular
equilateral triangle, isosceles triangle
square
rectangle, rectangular, oblong
pentagon, pentagonal

hexagon, hexagonal
heptagon
octagon, octagonal
polygon
quadrilateral

Patterns and symmetry
size
bigger, larger, smaller
symmetrical
line of symmetry, line symmetry
fold
match
mirror line, reflection, reflect
pattern, repeating pattern, translation

Position, direction and movement
position
over, under, underneath
above, below, top, bottom, side
on, in, outside, inside, around
in front, behind, front, back
before, after, beside, next to
opposite, apart
between, middle, edge, centre
corner
direction
journey, route, map, plan
left, right
up, down, higher, lower
forwards, backwards, sideways, across
close, far, near
along, through, to, from, towards, away from
ascend, descend
grid
row, column
origin, coordinates
clockwise, anti-clockwise
compass point, north, south, east, west (N, S, E, W)
north-east, north-west, south-east, south-west
(NE, NW, SE, SW)
horizontal, vertical, diagonal
movement
slide, roll
whole turn, half turn, quarter turn, rotate
angle, ...is a greater/smaller angle than

right angle
degree
straight line
stretch, bend
ruler, set square
angle measurer, compasses

Instructions

listen, join in, say, recite
think, imagine, remember
start from, start with, start at
look at, point to, show me
put, place
arrange, rearrange
change, change over
split, separate
carry on, continue, repeat
what comes next? predict
describe the pattern, describe the rule
find, find all, find different
investigate
choose, decide
collect
use, make, build, construct
tell me, describe, name, pick out
discuss, talk about
explain
explain your method
explain how you got your answer
give an example of...
show how you...
show your working
justify
make a statement
read, write, record
write in figures
present, represent
interpret
trace, copy
complete, finish, end
fill in, shade, colour
label, plot
tick, cross
draw, sketch
draw a line between, join (up), ring, arrow

cost, count, tally
calculate, work out, solve
investigate, question
answer
check

General
same, different
missing number/s
number facts, number pairs, number bonds
greatest value, least value

number line, number track
number square, hundred square
number cards, number grid
abacus
counters, cubes, blocks, rods
die, dice
dominoes
pegs, peg board, pin board
geo-strips

same way, different way
best way, another way
in order, in a different order

not
all, every, each (National Numeracy Strategy <u>Mathematical Vocabulary</u>)

APPENDIX E

Virginia Standards of Learning Objectives (3-5)

Here is a list of the Virginia Standards of Learning Objectives for mathematics in the

third, fourth, and fifth grade levels. As one can see, these objectives just extend and

expand on the knowledge that is gained in the Primary grades.

<u>Third Grade Standards</u>

Number and Number Sense

3.1   The student will read and write six-digit numerals and identify the place value
           for each digit.

3.2   The student will round a whole number, 9,999 or less, to the nearest ten,
           hundred, and thousand.

3.3   The student will compare two whole numbers between 0 and 9,999, using
           symbols (>, <, or =) and words (*greater than, less than*, or *equal to*).

3.4   The student will recognize and use the inverse relationships between
           addition/subtraction and multiplication/division to complete basic fact
           sentences. Students will use these relationships to solve problems such as 5 +
           3 = 8 and 8 – 3 = ____.

3.5   The student will
           a) divide regions and sets to represent a fraction; and
           b) name and write the fractions represented by a given model (area/region,
               length/measurement, and set). Fractions (including mixed numbers) will
               include halves, thirds, fourths, eighths, and tenths.

3.6   The student will compare the numerical value of two fractions having like and
           unlike denominators, using concrete or pictorial models involving
           areas/regions, lengths/measurements, and sets.

3.7   The student will read and write decimals expressed as tenths and hundredths,
           using concrete materials and models.

Computation and Estimation
3.8   The student will solve problems involving the sum or difference of two whole

numbers, each 9,999 or less, with or without regrouping, using various computational methods, including calculators, paper and pencil, mental computation, and estimation.

3.9   The student will recall the multiplication and division facts through the nines table.

3.10   The student will represent multiplication and division, using area and set models, and create and solve problems that involve multiplication of two whole numbers, one factor 99 or less and the second factor 5 or less.

3.11   The student will add and subtract with proper fractions having like denominators of 10 or less, using concrete materials and pictorial models representing areas/regions, lengths/measurements, and sets.

3.12   The student will add and subtract with decimals expressed as tenths, using concrete materials, pictorial representations, and paper and pencil.

Measurement

3.13   The student will determine by counting the value of a collection of bills and coins whose total value is $5.00 or less, compare the value of the coins or bills, and make change.

3.14   The student will estimate and then use actual measuring devices with metric and U.S. Customary units to measure
a) length — inches, feet, yards, centimeters, and meters;
b) liquid volume — cups, pints, quarts, gallons, and liters; and
c) weight/mass — ounces, pounds, grams, and kilograms.

3.15   The student will tell time to the nearest five-minute interval and to the nearest minute, using analog and digital clocks.

3.16   The student will identify equivalent periods of time, including relationships among days, months, and years, as well as minutes and hours.

3.17   The student will read temperature to the nearest degree from a Celsius thermometer and a Fahrenheit thermometer. Real thermometers and physical models of thermometers will be used.

Geometry

3.18   The student will analyze two-dimensional (plane) and three-dimensional (solid) geometric figures (circle, square, rectangle, triangle, cube, rectangular solid [prism], square pyramid, sphere, cone, and cylinder) and identify

relevant properties, including the number of corners, square corners, edges, and the number and shape of faces, using concrete models.

3.19   The student will identify and draw representations of line segments and angles, using a ruler or straightedge.

3.20   The student, given appropriate drawings or models, will identify and describe congruent and symmetrical, two-dimensional (plane) figures, using tracing procedures.

Probability and Statistics

3.21   The student, given grid paper, will
   a) collect and organize data on a given topic of his/her choice, using observations, measurements, surveys, or experiments; and
   b) construct a line plot, a picture graph, or a bar graph to represent the results. Each graph will include an appropriate title and key.

3.22   The student will read and interpret data represented in line plots, bar graphs, and picture graphs and write a sentence analyzing the data.

3.23   The student will investigate and describe the concept of probability as chance and list possible results of a given situation.

Patterns, Functions, and Algebra

3.24   The student will recognize and describe a variety of patterns formed using concrete objects, numbers, tables, and pictures, and extend the pattern, using the same or different forms (concrete objects, numbers, tables, and pictures).

3.25   The student will
   a) investigate and create patterns involving numbers, operations (addition and multiplication), and relations that model the identity and commutative properties for addition and multiplication; and
   b) demonstrate an understanding of equality by recognizing that the equal sign (=) links equivalent quantities, such as $4 • 3 = 2 • 6$ (Virginia Department of Education).

Fourth Grade Standards

Number and Number Sense

4.1   The student will
   a) identify (orally and in writing) the place value for each digit in a whole number expressed through millions;

b) compare two whole numbers expressed through millions, using symbols (>, <, or =); and

c) round whole numbers expressed through millions to the nearest thousand, ten thousand, and hundred thousand.

4.2   The student will
a) identify, model, and compare rational numbers (fractions and mixed numbers), using concrete objects and pictures;
b) represent equivalent fractions; and
c) relate fractions to decimals, using concrete objects.

4.3   The student will compare the numerical value of fractions (with like and unlike denominators) having denominators of 12 or less, using concrete materials.

4.4   The student will
a) read, write, represent, and identify decimals expressed through thousandths;
b) round to the nearest whole number, tenth, and hundredth; and
c) compare the value of two decimals, using symbols (<, >, or =), concrete materials, drawings, and calculators.

Computation and Estimation

4.5   The student will estimate whole-number sums and differences and describe the method of estimation. Students will refine estimates, using terms such as *closer to, between*, and *a little more than*.

4.6   The student will add and subtract whole numbers written in vertical and horizontal form, choosing appropriately between paper and pencil methods and calculators.

4.7   The student will find the product of two whole numbers when one factor has two digits or fewer and the other factor has three digits or fewer, using estimation and paper and pencil. For larger products (a two-digit numeral times a three-digit numeral), estimation and calculators will be used.

4.8   The student will estimate and find the quotient of two whole numbers, given a one-digit divisor.

4.9   The student will
a) add and subtract with fractions having like and unlike denominators of 12 or less, using concrete materials, pictorial representations, and paper and pencil;
b) add and subtract with decimals through thousandths, using concrete materials, pictorial representations, and paper and pencil; and

c) solve problems involving addition and subtraction with fractions having like and unlike denominators of 12 or less and with decimals expressed through thousandths, using various computational methods, including calculators, paper and pencil, mental computation, and estimation.

Measurement

4.10   The student will
   a) estimate and measure weight/mass, using actual measuring devices, and describe the results in U.S. Customary/metric units as appropriate, including ounces, pounds, grams, and kilograms;
   b) identify equivalent measurements between units within the U.S. Customary system (ounces and pounds) and between units within the metric system (grams and kilograms); and
   c) estimate the conversion of ounces and grams and pounds and kilograms, using approximate comparisons (1 ounce is about 28 grams, or 1 gram is about the weight of a paper clip; 1 kilogram is a little more than 2 pounds).

4.11   The student will
   a) estimate and measure length, using actual measuring devices, and describe the results in both metric and U.S. Customary units, including part of an inch (1/2, 1/4, and 1/8), inches, feet, yards, millimeters, centimeters, and meters;
   b) identify equivalent measurements between units within the U.S. Customary system (inches and feet; feet and yards; inches and yards) and between units within the metric system (millimeters and centimeters; centimeters and meters; and millimeters and meters); and
   c) estimate the conversion of inches and centimeters, yards and meters, and miles and kilometers, using approximate comparisons (1 inch is about 2.5 centimeters, 1 meter is a little longer than 1 yard, 1 mile is slightly farther than 1.5 kilometers, or 1 kilometer is slightly farther than half a mile).

4.12   The student will
   a) estimate and measure liquid volume, using actual measuring devices and using metric and U.S. Customary units, including cups, pints, quarts, gallons, milliliters, and liters;
   b) identify equivalent measurements between units within the U.S. Customary system (cups, pints, quarts, and gallons) and between units within the metric system (milliliters and liters); and
   c) estimate the conversion of quarts and liters, using approximate comparisons (1 quart is a little less than 1 liter, 1 liter is a little more than 1 quart).

4.13   The student will
   a) identify and describe situations representing the use of perimeter and area; and

b) use measuring devices to find perimeter in both standard and nonstandard units of measure.

Geometry

4.14   The student will investigate and describe the relationships between and among points, lines, line segments, and rays.

4.15   The student will
a) identify and draw representations of points, lines, line segments, rays, and angles, using a straightedge or ruler; and
b) describe the path of shortest distance between two points on a flat surface.

4.16   The student will identify and draw representations of lines that illustrate intersection, parallelism, and perpendicularity.

4.17   The student will
a) analyze and compare the properties of two-dimensional (plane) geometric figures (circle, square, rectangle, triangle, parallelogram, and rhombus) and three-dimensional (solid) geometric figures (sphere, cube, and rectangular solid [prism]);
b) identify congruent and noncongruent shapes; and
c) investigate congruence of plane figures after geometric transformations such as reflection (flip), translation (slide) and rotation (turn), using mirrors, paper folding, and tracing.

4.18   The student will identify the ordered pair for a point and locate the point for an ordered pair in the first quadrant of a coordinate plane.

Probability and Statistics

4.19   The student will
a) predict the likelihood of outcomes of a simple event, using the terms *certain, likely, unlikely, impossible*; and
b) determine the probability of a given simple event, using concrete materials.

4.20   …..The student will collect, organize, and display data in line and bar graphs with …..scale increments of one or greater than one and use the display to interpret the …..results, draw conclusions, and make predictions.

Patterns, Functions, and Algebra

4.21   …..The student will recognize, create, and extend numerical and geometric …..patterns, using concrete materials, number lines, symbols, tables, and words.

4.22   …..The student will recognize and demonstrate the meaning of equality, using
        …..symbols representing numbers, operations, and relations [e.g., 3 + 5 = 5 + 3
        …..and 15 + (35 + 16) = (15 + 35) + 16] (Virginia Department of Education).

Fifth Grade Standards

Number and Number Sense

5.1   The student will
        a) read, write, and identify the place values of decimals through thousandths;
        b) round decimal numbers to the nearest tenth or hundredth; and
        c) compare the values of two decimals through thousandths, using the
            symbols >, <,
            or =.

5.2   The student will
        a) recognize and name commonly used fractions (halves, fourths, fifths,
        eighths, and tenths) in their equivalent decimal form, and vice versa, and
        b) order a given set of fractions and decimals from least to greatest. Fractions
        will include like and unlike denominators limited to 12 or less, and mixed
        numbers.

5.3   The student will create and solve problems with addition, subtraction,
        multiplication and division of whole numbers, using paper and pencil,
        estimation, mental computations and calculators.
5.4   The student will find the sum, difference, and product of two numbers
        expressed as decimals through thousandths, using an appropriate method of
        calculation, including paper and pencil, estimation, mental computation and
        calculators.

5.5   The student, given a dividend of four digits or fewer and a divisor of two
        digits or fewer, will find the quotient and remainder.

5.6   The student, given a dividend expressed as a decimal through thousandths and
        a single-digit divisor, will find the quotient.

5.7   The student will add and subtract with fractions and mixed numbers, with and
        without regrouping, and express answers in simplest form. Problems will
        include like and unlike denominators limited to 12 or less.

Measurement

5.8   The student will describe and determine the perimeter of a polygon and the
        area of a square, rectangle, and right triangle, given the appropriate measures.

5.9   The student will identify and describe the diameter, radius, chord, and circumference of a circle.

5.10   The student will differentiate between perimeter, area, and volume and identify whether the application of the concept of perimeter, area, or volume is appropriate for a given situation.

5.11   The student will choose an appropriate measuring device and unit of measure to solve problems involving measurement of
        a) length — part of an inch (1/2, 1/4, and 1/8), inches, feet, yards, miles, millimeters, centimeters, meters, and kilometers;
        b) weight/mass — ounces, pounds, tons, grams, and kilograms;
        c) liquid volume — cups, pints, quarts, gallons, milliliters, and liters;
        d) area — square units; and
        e) temperature — Celsius and Fahrenheit units.
        Problems also will include estimating the conversion of Celsius and Fahrenheit units relative to familiar situations (water freezes at 0°C and 32°F, water boils at 100°C and 212°F, normal body temperature is about 37°C and 98.6°F).

5.12   The student will determine an amount of elapsed time in hours and minutes within a 24-hour period.

5.13   The student will measure and draw right, acute, and obtuse angles and triangles, using appropriate tools.

Geometry

5.14   The student will classify angles and triangles as right, acute, or obtuse.

5.15   The student, using two-dimensional (plane) figures (square, rectangle, triangle, parallelogram, rhombus, kite, and trapezoid) will
        a) recognize, identify, describe, and analyze their properties in order to develop definitions of these figures;
        b) identify and explore congruent, noncongruent, and similar figures;
        c) investigate and describe the results of combining and subdividing shapes;
        d) identify and describe a line of symmetry; and
        e) recognize the images of figures resulting from geometric transformations such as translation (slide), reflection (flip), or rotation (turn).

5.16   The student will identify, compare, and analyze properties of three-dimensional (solid) geometric shapes (cylinder, cone, cube, square pyramid, and rectangular prism).

Probability and Statistics

5.17   The student will
        a) solve problems involving the probability of a single event by using tree
            diagrams or by constructing a sample space representing all possible
            results;
        b) predict the probability of outcomes of simple experiments, representing it
            with fractions or decimals from 0 to 1, and test the prediction; and
        c) create a problem statement involving probability and based on information
            from a given problem situation. Students will not be required to solve the
            created problem statement.

5.18   The student will, given a problem situation, collect, organize, and display a set
        of numerical data in a variety of forms, using bar graphs, stem-and-leaf plots,
        and line graphs, to draw conclusions and make predictions.

5.19   The student will find the mean, median, mode, and range of a set of data.

Patterns, Functions, and Algebra

5.20   The student will analyze the structure of numerical and geometric patterns
        (how they change or grow) and express the relationship, using words, tables,
        graphs, or a mathematical sentence. Concrete materials and calculators will be
        used.
5.21   The student will
        a) investigate and describe the concept of variable;
        b) use a variable expression to represent a given verbal quantitative
            expression involving one operation ; and
        c) write an open sentence to represent a given mathematical relationship,
            using a variable.

5.22   The student will create a problem situation based on a given open sentence using
        a single variable (Virginia Department of Education).

Middle School Mathematical Words

Numbers and the number system

Place value, ordering and rounding
units, ones
tens, hundreds, thousands
ten thousand, hundred thousand, million
digit, one-, two-, three- or four-digit number
numeral
'teens' number
place, place value
stands for, represents
exchange
the same number as, as many as
equal to
Of two objects/amounts:
>, greater than, more than, larger than, bigger than
<, less than, fewer than, smaller than
≥, greater than or equal to
≤, less than or equal to
Of three or more objects/amounts:
greatest, most, largest, biggest
least, fewest, smallest,
one... ten... one hundred... one thousand more/less
compare, order, size
ascending/descending order
first... tenth... twentieth
last, last but one
before, after
next
between, half-way between
guess how many, estimate
nearly, roughly, close to, about the same as
approximate, approximately
≈, is approximately equal to
just over, just under
exact, exactly
too many, too few, enough, not enough
round (up or down), nearest
round to the nearest ten/hundred/thousand
integer, positive, negative
above/below zero, minus

Properties of numbers and number sequences
number, count, how many...?
odd, even
every other
how many times?
multiple of
digit
next, consecutive
sequence
continue
predict
pattern, pair, rule
relationship
sort, classify, property
formula
divisible (by), divisibility, factor, factorise
square number
one squared, two squared....(1^2, 2^2...)
prime, prime factor

Fractions, decimals, percentages, ratio and proportion
part, equal parts
fraction, proper/improper fraction
mixed number
numerator, denominator
equivalent, reduced to, cancel
one whole
half, quarter, eighth
third, sixth, ninth, twelfth
fifth, tenth, twentieth
hundredth, thousandth
proportion, ratio, in every, for every
to every, as many as
decimal, decimal fraction
decimal point, decimal place
percentage, per cent, %

Calculations

Addition and subtraction
add, addition, more, plus, increase
sum, total, altogether
score
double, near double
how many more to make...?
subtract, subtraction, take (away), minus, decrease

leave, how many are left/left over?
difference between
half, halve
how many more/fewer is... than...?
how much more/less is...?
is the same as, equals, sign
tens boundary, hundreds boundary
units boundary, tenths boundary
inverse

Multiplication and division
lots of, groups of
times, multiplication, multiply, multiplied by
multiple of, product
once, twice, three times
four times, five times... ten times
times as (big, long, wide, and so on)
repeated addition
array, row, column
double, halve
share, share equally
one each, two each, three each...
group in pairs, threes... tens
equal groups of
divide, division, divided by, divided into
remainder
factor, quotient, divisible by
inverse

Using a calculator
calculator, display, key
enter, clear, sign change
constant, recurring, memory, operation key

Solving problems

Making decisions and reasoning
pattern, puzzle
calculate, calculation
mental calculation
method, strategy
jotting
answer
right, correct, wrong
what could we try next?
how did you work it out?

number sentence
sign, operation, symbol, equation

Money
money
coin, note
penny, pence, pound, (£)
price, cost
buy, bought, sell, sold
spend, spent
pay
change
dear, costs more, more/most expensive
cheap, costs less, cheaper, less/least expensive
how much...? how many...?
total, amount, value
discount, profit, loss
currency

Handling data

count, tally, sort, vote
survey, questionnaire
data, database
graph, block graph, line graph
pictogram,
represent
group, set
list, chart, bar chart, bar line chart
tally chart
table, frequency table
Carroll diagram, Venn diagram
label, title, axis, axes
diagram
most popular, most common
least popular, least common
mode, range, mean, average, median
statistics, distribution
maximum/minimum value
classify, outcome

Probability
fair, unfair
likely, unlikely, likelihood, equally likely
certain, uncertain
probable, possible, impossible

chance, good chance,
poor chance, no chance
equal chance, even chance, fifty-fifty chance
risk, doubt
biased, random

<u>Measures, shape and space</u>

Measures (general)
measure, measurement
size
compare
unit, standard unit
metric unit, imperial unit
measuring scale, division
guess, estimate
enough, not enough
too much, too little
too many, too few
nearly, roughly, about, close to
about the same as, approximately
just over, just under

Length
length, width, height, depth, breadth
long, short, tall, high, low
wide, narrow, deep, shallow, thick, thin
longer, shorter, taller, higher... and so on
longest, shortest, tallest, highest... and so on
far, further, furthest, near, close
distance apart/between... to... from
edge, perimeter, circumference
kilometre (*km*), metre (*m*), centimetre (*cm*), millimetre (*mm*)
mile, yard, feet, foot, inches, inch
ruler, metre stick, tape measure, compasses

Mass
mass: big, bigger, small, smaller, balances
weight: heavy/light, heavier/lighter, heaviest/lightest
weigh, weighs
tonne, kilogram (*kg*), half-kilogram, gram (*g*)
pound, ounce
balance, scales

Capacity
full, half full

empty
holds, contains
litre (*l*), half-litre, centilitre (*cl*), millilitre (*ml*)
pint, gallon
container, measuring cylinder

Area
area, covers, surface
square centimetre (cm^2), square metre (m^2)
square millimetre (mm^2)

Time
days of the week: Monday, Tuesday...
months of the year: January, February...
seasons: spring, summer, autumn, winter
day, week, fortnight, month
year, leap year, century, millennium
weekend, birthday
holiday
calendar, date, date of birth
morning, afternoon, evening, night
am, pm, noon, midnight
today, yesterday, tomorrow
before, after, next, last
now, soon, early, late, earliest, latest
quick, quicker, quickest, quickly
fast, faster, fastest, slow, slower, slowest, slowly
old, older, oldest, new, newer, newest
takes longer, takes less time
how long ago?/how long will it be to...?
how long will it take to...?
timetable, arrive, depart
hour, minute, second
o'clock, half past, quarter to, quarter past
clock, watch, hands
digital/analogue clock/watch, timer
24-hour clock, 12-hour clock
Greenwich Mean Time, British Summer Time
International Date Line
how often?
always, never, often, sometimes, usually

Shape and space
shape, pattern
flat, line
curved, straight

round
hollow, solid
corner
point, pointed
face, side, edge, end
sort
make, build, construct, draw, sketch
centre, radius, diameter
circumference, concentric, arc
net
surface
angle, right-angled
congruent
intersecting, intersection
plane
base, square-based
vertex, vertices
layer, diagram
regular, irregular
concave, convex
open, closed
tangram

3D shapes
3D, three-dimensional
cube, cuboid
pyramid
sphere, hemi-sphere, spherical
cone
cylinder, cylindrical
prism
tetrahedron, polyhedron, octahedron, dodecahedron

2D shapes
2D, two-dimensional
circle, circular, semi-circle
triangle, triangular
equilateral triangle, isosceles triangle, scalene triangle
square, rhombus
rectangle, rectangular, oblong
pentagon, pentagonal
hexagon, hexagonal
heptagon
octagon, octagonal
polygon
quadrilateral

kite
parallelogram, trapezium

Patterns and symmetry
size
bigger, larger, smaller
symmetrical
line of symmetry, axis of symmetry
line symmetry, reflective symmetry
fold
match
mirror line, reflection, reflect
pattern, repeating pattern, translation

Position, direction and movement
position
over, under, underneath
above, below, top, bottom, side
on, in, outside, inside, around
in front, behind, front, back
before, after, beside, next to
opposite, apart
between, middle, edge, centre
corner
direction
journey, route, map, plan
left, right
up, down, higher, lower
forwards, backwards, sideways, across
close, far, near
along, through, to, from, towards, away from
ascend, descend
grid, row, column
origin, coordinates
clockwise, anti-clockwise
compass point, north, south, east, west (N, S, E, W)
north-east, north-west, south-east, south-west
(NE, NW, SE, SW)
horizontal, vertical, diagonal
parallel, perpendicular
x-axis, y-axis
quadrant
movement
slide, roll
whole turn, half turn, quarter turn, rotate, rotation
angle, ...is a greater/smaller angle than

right angle, acute, obtuse, reflex
degree
straight line
stretch, bend
ruler, set square
angle measurer, compasses, protractor

Instructions

listen, join in, say, recite
think, imagine, remember
start from, start with, start at
look at, point to, show me
put, place
arrange, rearrange
change, change over
adjusting, adjust
split, separate
carry on, continue, repeat
what comes next?, predict
describe the pattern, describe the rule
find, find all, find different
investigate
choose, decide
collect
use, make, build, construct, bisect
tell me, define, describe, name, pick out, identify
discuss, talk about
explain
explain your method/answer/reasoning
give an example of...
show how you...
show your working
justify
make a statement
read, write, record
write in figures
present, represent
interpret
trace, copy
complete, finish, end
fill in, shade, colour
label, plot
tick, cross
draw, sketch
draw a line between, join (up), ring, arrow

cost, count, tally

calculate, work out, solve, convert

investigate, interrogate (data), question, prove
answer
check

General
same, identical, different
missing number/s
number facts, number pairs, number bonds
greatest value, least value

number line, number track
number square, hundred square
number cards, number grid
abacus
counters, cubes, blocks, rods
die, dice, spinner
dominoes
pegs, peg board, pin board
geo-strips

same way, different way
best way, another way
in order, in a different order

not
all, every, each (National Numeracy Strategy <u>Mathematical Vocabulary</u>)

APPENDIX G

Virginia Standards of Learning Objectives (6-8)

It is important that teachers become very familiar with the Standards of Learning

Objectives at each grade level. Here is a list of those objectives for the sixth, seventh, and

eighth grade mathematics classrooms.

Sixth Grade Standards

Number and Number Sense

6.1   The student will identify representations of a given percent and describe orally
        and in writing the equivalence relationships among fractions, decimals, and
        percents.

6.2   The student will describe and compare two sets of data, using ratios, and will
        use appropriate notations, such as *a/b, a to b*, and *a:b*.

6.3   The student will
        a) find common multiples and factors, including least common multiple and
           greatest common factor;
        b) identify and describe prime and composite numbers; and identify and
           describe the characteristics of even and odd integers.

6.4   The student will compare and order whole numbers, fractions, and decimals,
        using concrete materials, drawings or pictures, and mathematical symbols.

6.5   The student will identify, represent, order, and compare integers.

Computation and Estimation

6.6   The student will
        a) solve problems that involve addition, subtraction, multiplication, and/or
           division with fractions and mixed numbers, with and without regrouping,
           that include like and unlike denominators of 12 or less, and express their
           answers in simplest form; and
        b) find the quotient, given a dividend expressed as a decimal through
           thousandths and a divisor expressed as a decimal to thousandths with
           exactly one non-zero digit.

6.7   The student will use estimation strategies to solve multistep practical
        problems involving whole numbers, decimals, and fractions (rational
        numbers).

6.8   The student will solve multistep consumer-application problems involving fractions and decimals and present data and conclusions in paragraphs, tables, or graphs. Planning a budget will be included.

Measurement

6.9   The student will compare and convert units of measure for length, area, weight/mass, and volume within the U.S. Customary system and the metric system and estimate conversions between units in each system:
        a) length — part of an inch (1/2, 1/4, and 1/8), inches, feet, yards, miles, millimeters, centimeters, meters, and kilometers;
        b) weight/mass — ounces, pounds, tons, grams, and kilograms;
        c) liquid volume — cups, pints, quarts, gallons, milliliters, and liters; and
        d) area — square units.

6.10   The student will estimate and then determine length, weight/mass, area, and liquid volume/capacity, using standard and nonstandard units of measure.

6.11   The student will determine if a problem situation involving polygons of four or fewer sides represents the application of perimeter or area and apply the appropriate formula.

6.12   The student will
        a) solve problems involving the circumference and/or area of a circle when given the diameter or radius; and
        b) derive approximations for pi (π) from measurements for circumference and diameter, using concrete materials or computer models.

6.13   The student will
        a) estimate angle measures, using 45°, 90°, and 180° as referents, and use the appropriate tools to measure the given angles; and
        b) measure and draw right, acute, and obtuse angles and triangles.

Geometry

6.14   The student will identify, classify, and describe the characteristics of plane figures, describing their similarities, differences, and defining properties.

6.15   The student will determine congruence of segments, angles, and polygons by direct comparison, given their attributes. Examples of noncongruent and congruent figures will be included.

6.16   The student will construct the perpendicular bisector of a line segment and an angle bisector.

6.17   The student will sketch, construct models of, and classify solid figures (rectangular prism, cone, cylinder, and pyramid).

Probability and Statistics

6.18   The student, given a problem situation, will collect, analyze, display, and interpret data in a variety of graphical methods, including
            a) line, bar, and circle graphs;
            b) stem-and-leaf plots; and
            c) box-and-whisker plots.
            Circle graphs will be limited to halves, fourths, and eighths.

6.19   The student will describe the mean, median, and mode as measures of central tendency, describe the range, and determine their meaning for a set of data.

6.20   The student will
            a) make a sample space for selected experiments and represent it in the form of a list, chart, picture, or tree diagram; and
            b) determine and interpret the probability of an event occurring from a given sample space and represent the probability as a ratio, decimal or percent, as appropriate for the given situation.

Patterns, Functions, and Algebra

6.21   The student will investigate, describe, and extend numerical and geometric patterns, including triangular numbers, patterns formed by powers of 10, and arithmetic sequences.

6.22   The student will investigate and describe concepts of positive exponents, perfect squares, square roots, and, for numbers greater than 10, scientific notation. Calculators will be used to develop exponential patterns.

6.23   The student will
            a) model and solve algebraic equations, using concrete materials;
            b) solve one-step linear equations in one variable, involving whole number coefficients and positive rational solutions; and
            c) use the following algebraic terms appropriately: variable, coefficient, term, and equation (Virginia Department of Education).

Seventh Grade Standards

Number and Number Sense

7.1 The student will compare, order, and determine equivalent relationships between fractions, decimals, and percents, including use of scientific notation for numbers greater than 10.

7.2 The student will simplify expressions that contain rational numbers (whole numbers, fractions, and decimals) and positive exponents, using order of operations, mental mathematics, and appropriate tools.

7.3 The student will identify and apply the following properties of operations with real numbers:
a) the commutative and associative properties for addition and multiplication;
b) the distributive property;
c) the additive and multiplicative identity properties;
d) the additive and multiplicative inverse properties; and
e) the multiplicative property of zero. Computation and Estimation

7.4 The student will
a) solve practical problems using rational numbers (whole numbers, fractions, decimals) and percents; and
b) solve consumer-application problems involving tips, discounts, sales tax, and simple interest.

7.5 The student will formulate rules for and solve practical problems involving basic operations (addition, subtraction, multiplication, and division) with integers.

7.6 The student will use proportions to solve practical problems, which may include scale drawings that contain rational numbers (whole numbers, fractions, and decimals) and percents.

Measurement

7.7 The student, given appropriate dimensions, will
a) estimate and find the area of polygons by subdividing them into rectangles and right triangles; and
b) apply perimeter and area formulas in practical situations.

7.8 The student will investigate and solve problems involving the volume and surface area of rectangular prisms and cylinders, using concrete materials and practical situations to develop formulas.

Geometry

7.9 The student will compare and contrast the following quadrilaterals: parallelogram, rectangle, square, rhombus, and trapezoid. Deductive reasoning and inference will be used to classify quadrilaterals.

7.10   The student will identify and draw the following polygons: pentagon, hexagon, heptagon, octagon, nonagon, and decagon.

7.11   The student will determine if geometric figures quadrilaterals and triangles are similar and write proportions to express the relationships between corresponding parts of similar figures.

7.12   The student will identify and graph ordered pairs in the four quadrants of a coordinate plane.

7.13   The student, given a polygon in the coordinate plane, will represent transformations, rotations, and translation by graphing the coordinates of the vertices of the transformed polygon and sketching the resulting figure.

Probability and Statistics

7.14   The student will investigate and describe the difference between the probability of an event found through simulation versus the theoretical probability of that same event.

7.15   The student will identify and describe the number of possible arrangements of several objects, using a tree diagram or the Fundamental (Basic) Counting Principle.

7.16   The student will create and solve problems involving the measures of central tendency (mean, median, mode) and the range of a set of data.

7.17   The student, given a problem situation, will collect, analyze, display, and interpret data, using a variety of graphical methods, including
        a) frequency distributions;
        b) line plots;
        c) histograms;
        d) stem-and-leaf plots;
        e) box-and-whisker plots; and
        f) scatter grams.

7.18   The student will make inferences, conjectures, and predictions based on analysis of a set of data

Patterns, Functions, and Algebra

7.19   The student will represent, analyze, and generalize a variety of patterns, including arithmetic and geometric sequences, with tables, graphs, rules, and works in order to investigate and describe functional relationships.

7.20   The student will use the following algebraic terms correctly: equation, expression, and inequality.

7.21   The student will

   a) solve one-step linear equations and inequalities in one variable with strategies involving inverse operations and integers, using concrete materials, pictorial representations, and paper and pencil, and
   b) solve practical problems requiring the solution of one-step linear equations (Virginia Department of Education).

<u>Eighth Grade Standards</u>

Number and Number Sense

8.1   The student will
a) simplify numerical expressions involving positive exponents, using rational numbers, order of operations, and properties of operations with real numbers;
b) recognize, represent, compare, and order numbers expressed in scientific notation; and
c) compare and order decimals, fractions, percents, and numbers written in scientific notation.

8.2   The student will describe orally and in writing the relationship between the subsets of the real number system.

Computation and Estimation

8.3   The student will solve practical problems involving rational numbers, percents, ratios, and proportions. Problems will be of varying complexities and will involve real-life data,
such as finding a discount and discount prices and balancing a checkbook.

8.4   The student will apply the order of operations to evaluate algebraic expressions for given replacement values of the variables. Problems will be limited to positive exponents.

8.5   The student, given a whole number from 0 to 100, will identify it as a perfect square or find the two consecutive whole numbers between which the square root lies.

Measurement

8.6   The student will verify by measuring and describe the relationships among vertical angles, supplementary angles, and complementary angles and will measure and draw angles of less than 360°.

8.7   The student will investigate and solve practical problems involving volume and surface area of rectangular solids (prisms), cylinders, cones, and pyramids.

Geometry

8.8   The student will apply transformations (rotate or turn, reflect or flip, translate or slide, and dilate or scale) to geometric figures represented on graph paper. The student will identify applications of transformations, such as tiling, fabric design, art, and scaling.

8.9   The student will construct a three-dimensional model, given the top, side, and/or bottom views.

8.10   The student will
        a) verify the Pythagorean Theorem, using diagrams, concrete materials, and measurement; and
        b) apply the Pythagorean Theorem to find the missing length of a side of a right triangle when given the lengths of the other two sides.

Probability and Statistics

8.11   The student will analyze problem situations, including games of chance, board games, or grading scales, and make predictions, using knowledge of probability.

8.12   The student will make comparisons, predictions, and inferences, using information displayed in frequency distributions; box-and-whisker plots; scatter grams; line, bar, circle, and picture graphs; and histograms.

8.13   The student will use a matrix to organize and describe data.

Patterns, Functions, and Algebra

8.14   The student will
        a) describe and represent relations and functions, using tables, graphs, and rules; and
        b) relate and compare tables, graphs, and rules as different forms of representation for relationships.

8.15   The student will solve two-step equations and inequalities in one variable, using concrete materials, pictorial representations, and paper and pencil.

8.16   The student will graph a linear equation in two variables, in the coordinate plane, using a table of ordered pairs.

8.17   The student will create and solve problems, using proportions, formulas, and functions.

8.18   The student will use the following algebraic terms appropriately: domain, range, independent variable, and dependent variable (Virginia Department of Education).

APPENDIX H

Other Useful Information

Units of Measurement

CUSTOMARY   METRIC

Length   Length

1 foot (ft) = 12 inches (in.)   10 millimeters (mm) = 1 centimeter
1 yard (yd) = 3 feet   (cm)
1 yard = 36 inches   10 centimeters = 1 decimeter (dm)
1 mile = 5,280 feet   100 centimeters = 1 meter (m)
                                            1,000 meters = 1 kilometer (km)

Capacity
                                            Capacity
1 cup = 8 ounces (oz)   1,000 milliliters = 1 liter (L)
1 pint (pt) = 2 cups
1 pint = 16 ounces   Mass
1 quart (qt) = 2 pints
1,000 milligrams (mg) = 1 gram (g)
1 gallon (gal) = 4 quarts   1,000 grams = 1 kilograms (kg)
                                            1 ton = 1,000 kilograms

Weight   Abbreviations

1 pound (lb) = 16 ounces   in.   inch
1 ton (t) = 2,000 pounds   ft.   foot
                                               yd. yard
Time   mi. mile
                                               oz   ounce
60 seconds (s) = 1 minute (min)   c   cup
60 minutes = 1 hour (h)   pt   pint
24 hours = 1 day (d)   qt   quart
7 days = 1 week   gal gallon
365 days = 1 year   m   meter
366 days = 1 leap year   g   gram
12 months = 1 year   L   Liter
10 years = 1 decade   t   ton
100 years = 1 century   F   degrees Fahrenheit
                                               C   degrees Celsius

1,000 years = 1 millennium

Symbols in Mathematics

$\equiv$ – identically equal,

$\cong$, $\approx$ – approximately equal,

$\sim$ – approximately,

0.(12345) – the repeating decimal with the period 12345,

N – the set of natural numbers,

Z – the set of whole numbers (integers),

R – the set of real numbers,

$\emptyset$ – an empty set,

∞ – an infinity sign,

$x \in X$ – an element x belongs to a set X,

$x \notin X$ – an element x doesn't belong to a set X,

$X \subset Y$ – a set X is a subset of a set Y,

$X \cup Y$ – a union of sets X and Y,

$X \cap Y$ – an intersection of sets

$\Longrightarrow$ – it follows,

$\Longleftrightarrow$ – equivalent,

$\perp$ – perpendicular,

$\parallel$ – parallel,

$\triangle ABC$ – a triangle ABC

Mathematical Formulas

(pi = π = 3.141592...)

Area Formulas

Note: "ab" means "a" multiplied by "b". "a^2" means "a squared", which is the same as "a" times "a".

Be careful!! Units count. Use the same units for all measurements.
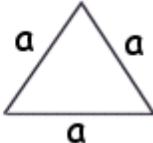
square = a^2

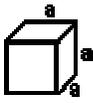rectangle = ab
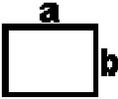
parallelogram = bh
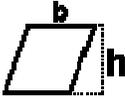
trapezoid = h/2 (b$_1$ + b$_2$)

circle = pi r^2
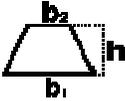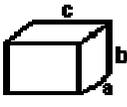
ellipse = pi r$_1$ r$_2$
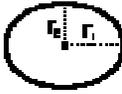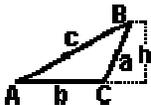
triangle =	$\frac{1}{2}(bh)$		one half times the base length times the height of the triangle

equilateral triangle =	$\frac{\sqrt{3}}{4}(a^2)$	

Volume Formulas

Cube = a^3

Rectangular prism = a b c

Irregular prism = b h
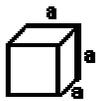
Cylinder = b h = *pi* r^2 h
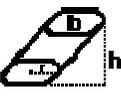
Pyramid = (1/3) b h

Cone = (1/3) b h = 1/3 *pi* r^2 h

Sphere = (4/3) *pi* r^3

Surface Area Formulas
In general, the surface area is the sum of all the areas of all the shapes that cover the surface of the object.
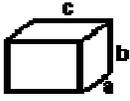
Surface Area of a Cube = 6 a^2

(a is the length of the side of each edge of the cube)

In words, the surface area of a cube is the area of the six squares that cover it. The area of one of them is a*a, or a^2 Since these are all the same, you can multiply one of them by six, so the surface area of a cube is 6 times one of the sides squared.

Surface Area of a Rectangular Prism = 2ab + 2bc + 2ac

(a, b, and c are the lengths of the 3 sides)

In words, the surface area of a rectangular prism is the are of the six rectangles that cover it. But we don't have to figure out all six because we know that the top and bottom are the same, the front and back are the same, and the left and right sides are the same.

The area of the top and bottom (side lengths a and c) = a*c. Since there are two of them, you get 2ac. The front and back have side lengths of b and c. The area of one of them is b*c, and there are two of them, so the surface area of those two is 2bc. The left and right side have side lengths of a and b, so the surface area of one of them is a*b. Again, there are two of them, so their combined surface area is 2ab.

Surface Area of Any Prism

(b is the shape of the ends)

Surface Area = Lateral area + Area of two ends

(Lateral area) = (perimeter of shape b) * L

Surface Area = (perimeter of shape b) * L+ 2*(Area of shape b)

Surface Area of a Sphere = 4 $pi \, r^2$

(r is radius of circle)

Surface Area of a Cylinder = 2 $pi \, r^2$ + 2 pi r h

(h is the height of the cylinder, r is the radius of the top)

Surface Area = Areas of top and bottom +Area of the side

Surface Area = 2(Area of top) + (perimeter of top)* height

Surface Area = 2(*pi* r^2) + (2 *pi* r)* h

In words, the easiest way is to think of a can. The surface area is the areas of all the parts needed to cover the can. That's the top, the bottom, and the paper label that wraps around the middle.

You can find the area of the top (or the bottom). That's the formula for area of a circle (*pi* r^2). Since there is both a top and a bottom, that gets multiplied by two.

The side is like the label of the can. If you peel it off and lay it flat it will be a rectangle. The area of a rectangle is the product of the two sides. One side is the height of the can; the other side is the perimeter of the circle, since the label wraps once around the can. So the area of the rectangle is (2 *pi* r)* h.

Add those two parts together and you have the formula for the surface area of a cylinder.

Surface Area = 2(*pi* r^2) + (2 *pi* r)* h

Definitions Related to Circles

arc: a curved line that is part of the circumference of a circle

chord: a line segment within a circle that touches 2 points on the circle.

circumference: the distance around the circle.

diameter: the longest distance from one end of a circle to the other.

origin: the center of the circle

pi (π): A number, 3.141592..., equal to (the circumference) / (the diameter) of any circle.

radius: distance from center of circle to any point on it.

Diameter = 2 x radius of circle

Circumference of Circle = PI x diameter = 2 PI x radius
    where <u>PI</u> = π = 3.141592...
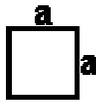
Area of Circle:
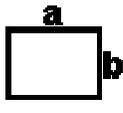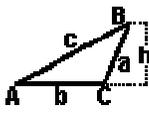

    area = PI r^2

Perimeter Formulas

The perimeter of any polygon is the sum of the lengths of all the sides.

Square = 4a

Rectangle = 2a + 2b

Triangle = a + b + c

Circle = *2pi* r

Circle = *pi* d (where d is the diameter)

Letters Used in Mathematics

In Sets:

I   Integers

N   Natural Numbers

Q   Rational Numbers

R   Real Numbers

W   Whole Numbers

In Geometry:

a, b, c, d,….   Sides of polygons, lengths of intervals, names of lines

A, B, C, D…   Points, vertices

A   Area of polygons

b   Base of polygons

B	Area of the base
C	Circumference of a circle
d	Diameter of a circle
h	Height
l	Length
p	Perimeter
r	Radius of a circle
s	Side
SA	Surface Area
V	Volume
w	Width

(Klerk Illustrated Math Dictionary)

Teacher Survey

Parent survey

Teacher Survey:

Check yes or no:

1. Do the students in your classroom have sufficient mathematical vocabulary development? _____yes _____no
2. Are you satisfied with the mathematics series used in your classroom? _____yes _____no
3. Do you know why this series was chosen for you to use? _____yes _____no
4. Are you concerned with your ability to teach mathematics? _____yes _____no
5. Would your students benefit from a more simplified method of teaching mathematics vocabulary? _____yes _____no
6. How many semester hours of instruction do you have in mathematics? _____
7. Are the definitions in the mathematics textbook easy to understand? _____yes _____no

Parent Survey:

Check yes or no:

1. Are your children proficient in the use of mathematical vocabulary? _____yes _____no
2. Do you feel that students need more mathematics vocabulary instruction? _____yes _____no
3. Are you satisfied with the mathematics textbook used by your child? _____yes _____no
4. Do you feel that your child is on grade level with mathematics vocabulary development? _____yes _____no

<u>Results of Teacher Survey</u>:

There were 140 teachers surveyed; 86% stated that students were not sufficiently prepared in mathematics vocabulary; 79% indicated approval of the textbook they were using; 94% did not know why they were using a specific series; 80% believe that students would benefit from a simplified method of teaching mathematics; 90% expressed concern of their ability to teach mathematics; 68% had fewer than 12 semester hours of college training to teach mathematics; 95% reported that the definitions in the mathematics textbook were not easy to understand.

<u>Results of Parent Survey</u>:

There were 250 parents surveyed; 74% believe that their child was not up to par when it came to mathematics vocabulary; 95% expressed a desire to see more mathematics vocabulary instruction; 80% indicated approval of the textbook; 87% believe that their child was on grade level.

VITA

BEVERLY OWENS

Personal Data:	Date of Birth: February 12, 1961 Place of Birth: Richlands, Virginia, Martial Status: Married
Education:	Public School: Haysi High School, Clinch Valley College, Wise Virginia B.S. 1982, East Tennessee State University, Johnson City, Tennessee, M.S., 2006
Professional Experience:	Teacher, Dickenson County School System, Clintwood, Virginia, 22 years, Teacher, Russell County School System, Lebanon, Virginia, 1 year
Honors and Awards:	Valedictorian, Haysi High School 1978, Who's Who Among American Teachers