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# The Language of Mathematics: Virginia Standards of Learning Mathematical Pictionary for Grades K-3.

Amanda Rashelle Collins-Browning  
*East Tennessee State University*

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The Language of Mathematics:  
Virginia Standards of Learning Mathematical Pictionary for Grades K-3

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A thesis  
presented to  
the faculty of the Department of Mathematics  
East Tennessee State University

In partial fulfillment  
of the requirements for the degree  
Master of Science in Mathematics

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by  
Amanda Collins-Browning  
August 2009

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Dr. Frederick Norwood, Chair

Dr. Jeff Knisley

Dr. Michel Helfgott

Keywords: Vocabulary, Pictionary, Mathematics, Instruction, Kindergarten-Grade Three

## ABSTRACT

### The Language of Mathematics:

Virginia Standards of Learning Mathematical Pictionary for Grades K-3

by

Amanda Collins-Browning

My experience teaching in Virginia schools, pacing and aligning instruction to the Virginia Standards of Learning, caused me to recognize the need for a mathematics tool to simplify and transition K-3 mathematics vocabulary usage and instruction. The language of mathematics uses three linguistic tools: words, symbols, and diagrams. Within this thesis I developed an instructional tool, a “Mathematics Pictionary”, to accommodate primary grades K-3 and transition mathematical language and vocabulary skills between the primary grades aligned to the instruction and guidelines of the Virginia Standards of Learning. The Pictionary may be used coherently with lesson plans, available from the Virginia Department of Education, for instructional use in teaching mathematical vocabulary usage throughout the primary grade levels, K-3.

## DEDICATION

I would like to extend thanks to the students, faculty, and staff of Copper Creek Elementary School. Thanks, faculty and staff, for your patience and encouragement through it all! Thanks students for being so patient and loving when the going got tough! Enormous thanks to my family! You are my inspiration, strength, and motivation to wake each day! You have provided endurance, continuous support, love, faith, and encouragement to succeed throughout my educational journey. Thanks Chris, Mom and Dad, Mamaw and Papaw, and Nan and Papaw, you are my life-long inspiration! I love you more than imaginable! Most importantly, I would like to thank God for all the blessings bestowed upon me daily. You are my shield, my faith, my trust, and my strength!

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## CHAPTER 1

### INTRODUCTION

As a kindergarten teacher I have found that building strong, rich vocabulary in the core subject areas is essential to student success in comprehension. The basis for this thesis is acquiring a strong foundation for mathematical literacy. I have found that children are non-proficient in mathematical literacy due to certain factors. The foremost factor is the lack of efficient materials and instructional tools. As I researched the materials available to primary teachers in my own school and district, I found very few tools were available to promote mathematical literacy in primary grades. The needed tools often are not present in the classroom to present adequate mathematical instruction. Many available tools were not developmentally appropriate or instructionally sound.

As a former fifth grade teacher I transferred to kindergarten three years ago, I found that students struggle in mathematics during intermediate grades and often do not score proficiently on standardized tests because they lack an understanding of mathematical vocabulary. Often vocabulary and terminology are not being properly and formally introduced. This adversely affects the natural progression of mathematical literacy. If the proper sequence of terminology and skills is not attained, students will not master needed skills and objectives required by the Virginia Standards of Learning. The proper sequence is vital because sometimes the understanding of one term depends on the understanding of other terms. For example, a student cannot understand “area” before learning the meaning of “square”.

## CHAPTER 2

### BACKGROUND

#### Statement of the Problem

Upon moving into a primary classroom from a middle school environment, my observations and teaching experiences have led me to deem that mathematical illiteracy is a growing problem. Within my school district, Russell County Public Schools, one of the causes is the lack of proper tools and manipulatives in the classroom. Another is that mathematical terminology is often not properly introduced. When this happens, children may not meet mastery of the proper terminology necessary for proficiency within mathematical achievement. The earlier students are exposed to meaningful, engaging mathematical experiences, driven by age-appropriate mathematical language the likelihood students may be proficient within mathematics. The Virginia Standards of Learning states that primary level teachers need to plan introduction of new vocabulary in an age appropriate context with relevant objects, pictures, stories, and diagrams (Learning 2-3).

As addressed in the current Virginia Department of Education Standards of Learning proper mathematical literacy and terminology is crucial to student's understanding and appreciation of the subject across grade levels. The Standards also iterate language of mathematics and proper vocabulary should be spoken and introduced in the earliest grades. Mathematics has its own language of terminology that builds a foundational connection between mathematics skills, from very basic skills through more complex skills. The Virginia Standards of Learning also address that all students should acquire a specialized vocabulary for mathematics and language patterns beginning at an early age (Learning 1-4). Each grade level of education should properly introduce and address specialized vocabulary and language patterns,

building on prior knowledge. Children naturally acquire concepts, skills, and problem solving strategies, along with a strong mathematical vocabulary when introduced to them in proper relationship (Learning 4). As children are introduced to integrated mathematical vocabulary through words, symbols, and diagrams, they may develop an understanding of quantitative concepts and relationships for mathematical proficiency.

Many teachers, regardless of experience, may feel overwhelmed by the responsibility and accountability placed by the Standards of Learning. This feeling may be due, in part, to the lack of instructional tools available to them. This thesis presents a Pictionary for primary teachers that addresses grades kindergarten through grade three. It provides developmentally and age appropriate terms, pictures, symbols, and diagrams and an apparatus guide that may enable children to become mathematically literate. Students will relate terms alphabetically by the use of pictures and brief definitions. The Pictionary provides a strong mathematical vocabulary foundation that will assist in building successful students and prepare students for formal assessments by grade three. Additional lesson plans, available from the Virginia Department of Education, to be implemented with the Pictionary provide suggestions for presentation of mathematical vocabulary and instructional practices in the primary classroom. The problem, then, is to develop a Pictionary that will accomplish these tasks.



## CHAPTER 3

### RESEARCH

*We owe our children no less than a high degree of quantitative literacy and mathematical knowledge that prepares them for citizenship, work, and further study. (NCTM 289)*

According to the National Council of Teachers of Mathematics (NCTM), quantitative literacy is a main goal for mathematics teachers in America. It is worth emphasizing that “our children” means *all children*. Equity is an interior principle for NCTM as well: “All students, regardless of their personal characteristics, backgrounds, or physical challenges, must have opportunities to study – and support to learn – mathematics” (NCTM 12). The earlier students are exposed to meaningful, engaging mathematics instruction, the greater the likelihood the students will be successful in future educational endeavors (Pre-K Now 4).

Children are exploring and observing elements of literacy and numeracy. Such explorations initiate in the earliest days of life and are a natural outgrowth of children’s curiosity and interest in how the world works. Based on experiences, children build a reservoir of knowledge about mathematics, language, and reading that they possess through kindergarten, first grade, and beyond (Kostelnik 57-61). Research indicates that teachers’ ability to generate stimulating numeracy and literacy experiences for young children is significantly influenced by three factors: the fundamental components of early literacy and numeracy, how children experience literacy and mathematical concepts in their play, and what teachers do intentionally to support literacy and numeracy in all areas of the curriculum throughout the day (Kostelnik 57-61). Mathematical and literacy visualizations, along with a solid, concrete curriculum, foster both conceptual skills and natural curiosity to generate a rich learning environment and appreciation for mathematics (Learning 2-3).

Manipulatives and visualizations are defined as concrete objects that "appeal to several senses and that can be touched, moved about, rearranged, and otherwise handled by children" (Kennedy 6). Representations are defined as "external manifestations of mathematical concepts" (Tchoshanov 126) expressed or designated by some term, character, or symbol. The purpose of using manipulatives is to facilitate and foster conceptual mathematics learning by making problems tangible. Instruction that makes explicit the connection or relationship between manipulatives and symbolic representations of mathematics concepts is critical for young or special needs students (Ball 14). The usefulness of manipulatives has been linked to Piaget's theories of 1970, which described children's learning as concrete (Wood 2), and to Bruner of 1966, who emphasized the use of concrete objects in instruction of young children (Bruner 176).

According to Jean Piaget's concept of active learning in the preoperational stage, in which average kindergarteners are functioning developmentally, experiences are vital to the development of thought processes because the child's logic develops from the exertion to interpret information gained through such experiences (Piaget 4). Active learning is both a concept and a process. As a concept, a child is actively involved with a variety of manipulatives in problem-solving activities. In relevance to both concept and process active learning becomes an inherent part of constructivism (Morrison 114).

In the Principles and Standards for School Mathematics, the National Council of Teachers of Mathematics noted that the ability to communicate mathematically should be the focus in all areas of assessment and instruction. Clearly, vocabulary, or the acquaintance of words and their meanings, is a crucial component of mathematics communication (Bryant 44). Many years ago, Wigg and Semel, pointed out that mathematics is "conceptually dense," meaning that students must comprehend the meaning of terms and mathematical symbols

(Bryant 44). Unlike in reading, there are few context clues to help support meaning. Other researchers, Miller and Schell, agree suggesting that mathematics language is complex and particularly abstract (Bryant 44).

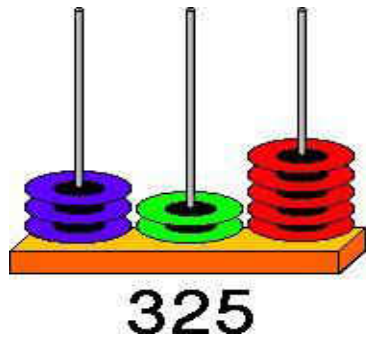
This thesis outlines a standards-based, age-appropriate mathematics Pictionary to support and develop mathematical language and understanding through concrete, colorful visualizations, supplemented by the use and exploration of manipulatives. The fundamental principle of this thesis is to foster children’s natural curiosity about mathematics by building connections in the classroom to form strong mathematical foundations. The National Council of Teachers of Mathematics express support for this principle in *Principles & Standards for School Mathematics*.

“Developing a solid mathematical foundation from prekindergarten through second grade is essential for every child. In these grades, students are building beliefs about what mathematics is, about what it means to know and do mathematics, and about themselves as mathematics learners. These beliefs influence their thinking about performance in, and attitudes toward mathematics and decisions related to studying mathematics in later years. All students deserve high-quality programs that include significant mathematics presented in a manner that respects both the mathematics and the nature of young children.... They (teachers) must be grounded in a knowledge of child development and provide environments that encourage students to be active learners and accept new challenges” (Mathematics 1-2).

# Aa is the 1<sup>st</sup> letter of the alphabet!

## abacus

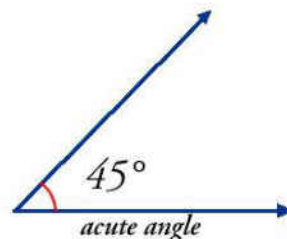
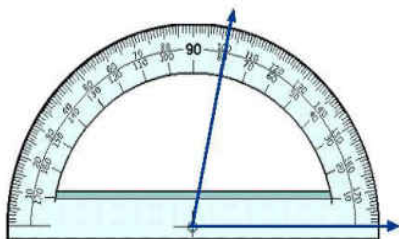
An **abacus** is a counting machine. The number of beads on each rod of the abacus indicates how many hundreds, tens, and ones are contained within the number. This abacus shows 3 hundreds, 2 tens, and 5 ones, giving 325.



three hundred twenty-five

## acute angle

An **acute angle** is an angle whose measure is less than 90 degrees.

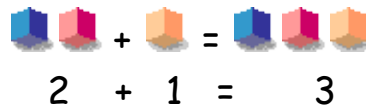
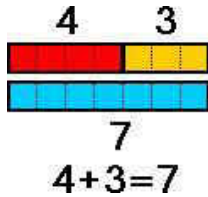


Related words:

angle, right angle, obtuse angle

## addition

**Addition** is finding the total (**sum**) of two or more numbers. We use the **plus** sign (+) when we add numbers together.



Related words:  
add, sum, term

## after

**After** means further down a list.

7 comes after 6  
February comes after January  
Tuesday comes after Monday

## algebra

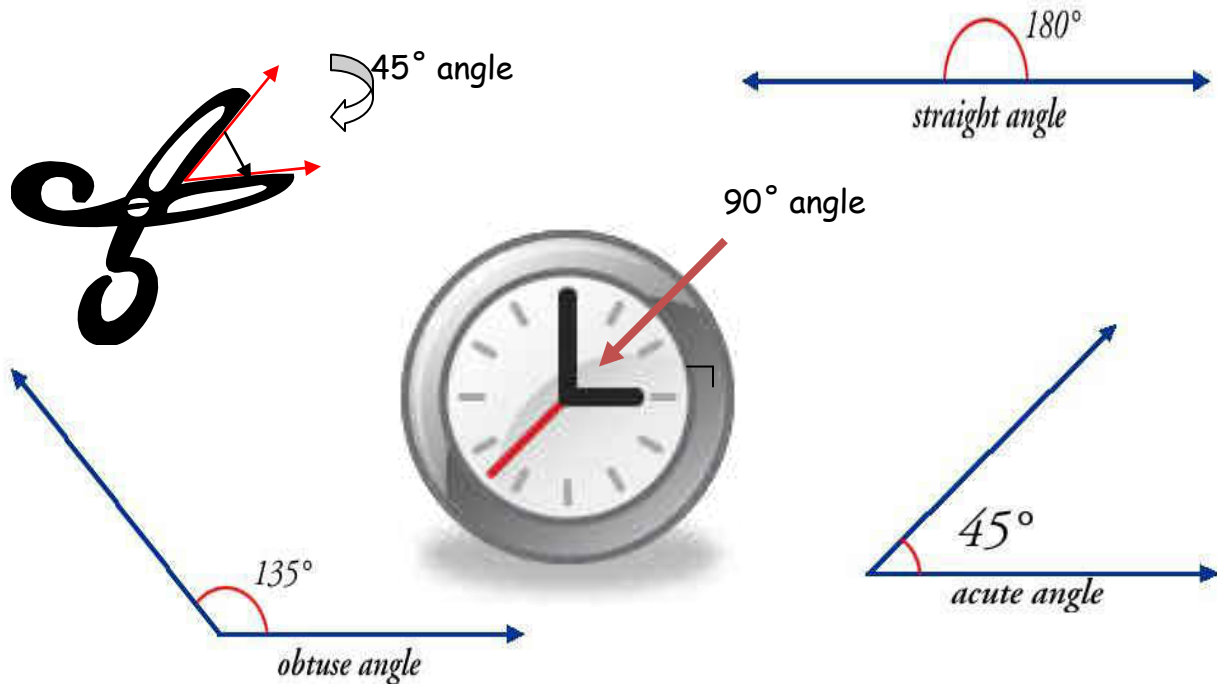
**Algebra** is a part of mathematics where letters stand for numbers. Scientists use algebra to solve problems and investigate number patterns.

$$6 + a = 7$$

a is equal to 1

## angle

An **angle** is a figure formed by two rays, called sides, having a common endpoint called the vertex. An **angle** is an amount of turn measured in **degrees** ( $^{\circ}$ ).

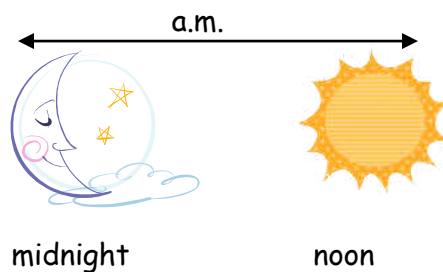


Related words:

ray, acute angle, right angle, obtuse angle, straight angle

## a.m.

The abbreviation **a.m.** stands for *ante meridiem*. It is used to show the time between midnight and midday (noon) when we use the twelve-hour clock.



Related words:

p.m.

## **analog clock**

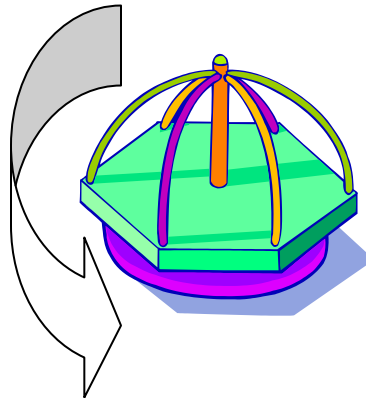
An **analog clock** is a clock that represents time by the position of hands on a dial.



Related words:  
clock, digital clock

## **anticlockwise**

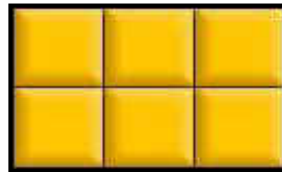
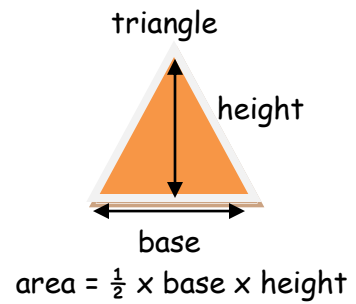
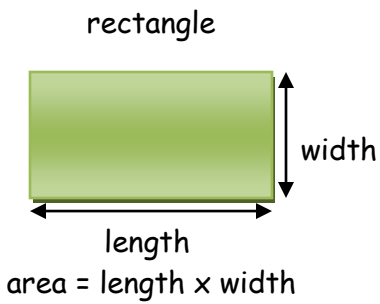
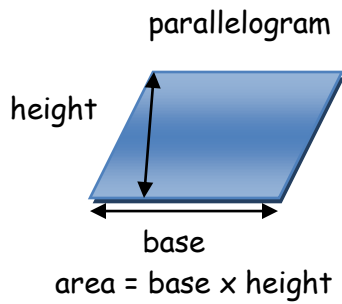
**Anticlockwise** is the opposite direction to the direction in which the hands of a clock move.



Related words:  
clockwise, counterclockwise

## area

**Area** is the size of a surface. Area is measured in square units.



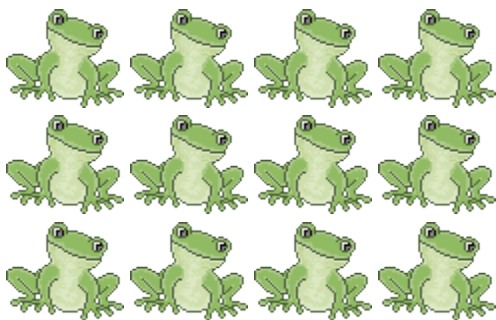
The area of this rectangle is six square units.

Related words:

length, volume, measurement

## array

An **array** is a set of objects or numbers arranged in rows and columns.



There are 3 rows of frogs.

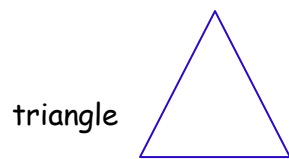
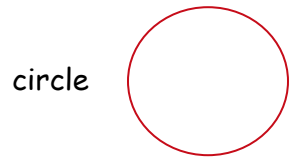
There are 4 columns of frogs.

There are 12 frogs in this *array*.

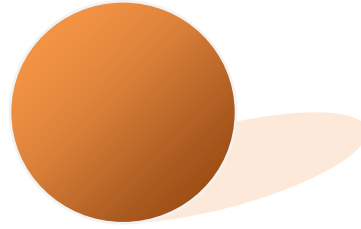


## attribute

An **attribute** is a quality or characteristic such as color, thickness, size, and shape.



small



large



blue



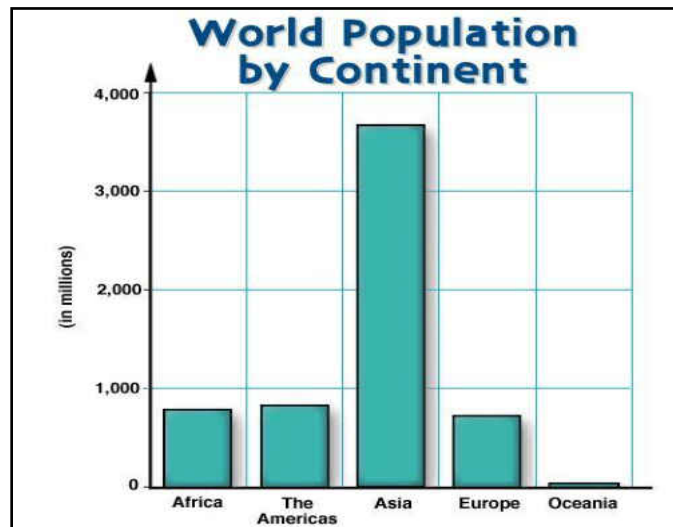
red

Related words:  
classify

**Bb** is the 2<sup>nd</sup> letter of the alphabet!

**bar graph**

A **bar graph** is a type of graph used to display data organized by categories; each axis of a bar graph should be labeled; the bar graph should be titled and have a key.



**before**

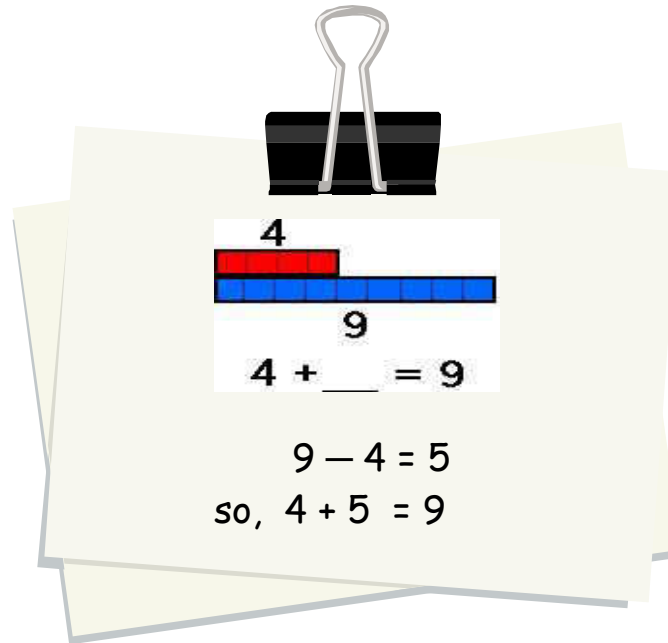
**Before** means nearer the beginning.

1 2 3 4 5 6 7 8 9 10  
5 comes before 6

# Cc is the 3<sup>rd</sup> letter of the alphabet!

## calculation

Calculation is the process of working out the answer.



Related words:  
calculate

## calendar

A calendar is an arrangement of time into days, weeks, months, and years.



## capacity

Capacity is how much something can hold.

This bucket has a capacity of 2 gallons.



Related words:  
volume

## cardinal number

Cardinal numbers are numbers used for counting or answering the question "how many?".



Related words:  
ordinal number

## Celsius

**Celsius** is a scale used to measure temperature. Celsius is measured in units of degrees ( $^{\circ}$ ) and is abbreviated by (C).

$100^{\circ}\text{C}$  = water boils  
 $0^{\circ}\text{C}$  = water freezes



Related words:  
degree, Fahrenheit

## century

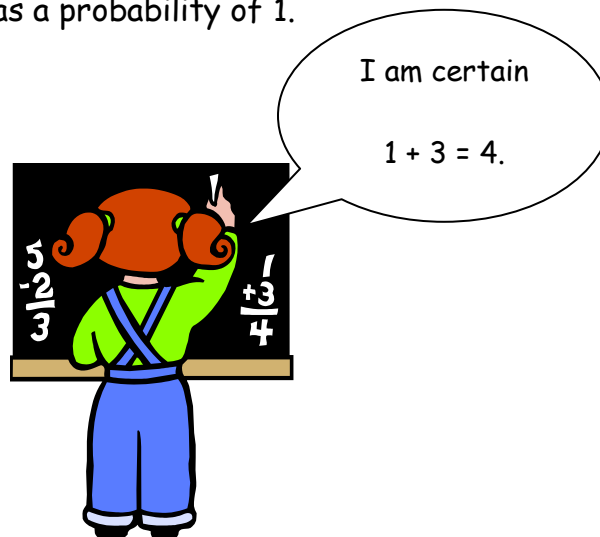
A **century** is a period of time that is one hundred years long.



century = 100 years

## certain (probability)

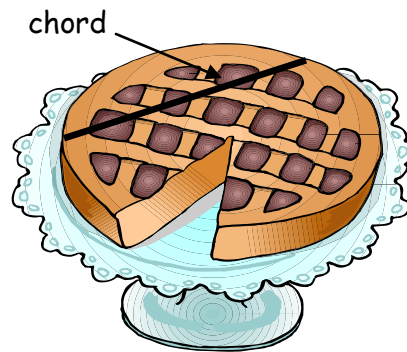
An event is **certain** to occur if it has a probability of 1.



Related words:  
impossible

## chord

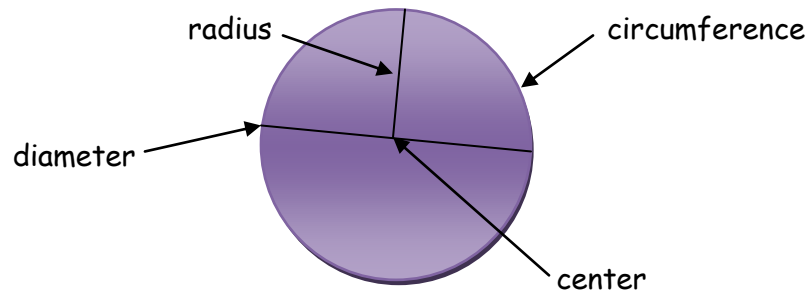
A **chord** is a line that joins two points on the circumference of a circle.



Related words:  
circle, circumference

## circle

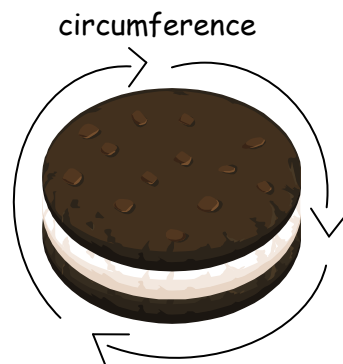
A **circle** is a closed curve with all points in one plane and the same distance (radius) from a fixed point, the center; the center is not part of the circle. A circle is a round, flat two-dimensional shape.



Related words:  
circumference, diameter, radius

## circumference

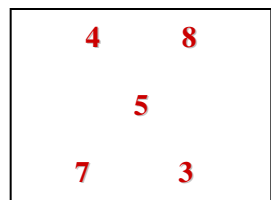
The **circumference** is the perimeter of a circle.



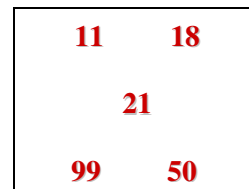
Related words:  
perimeter, circle

## classify

**Classify** means to sort into groups according to attribute(s).



**one-digit numbers**



**two-digit numbers**

Related words:  
attribute

## clock

A **clock** is a tool used to measure time. Time may be measured by a digital or analog clock.



analog clock



digital clock

Related words:

digital clock, analog clock

## clockwise

The hands of a clock move in a **clockwise** direction.



clockwise

Related words:

anticlockwise, counterclockwise



## coin

A **coin** is a piece of money.



## Commutative Property of Addition

The **Commutative Property of Addition** states that changing the order of the terms does not affect the sum.

$$6 + 7 = 7 + 6$$

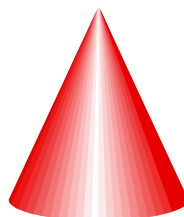
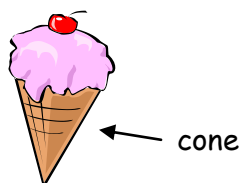
## Commutative Property of Multiplication

The **Commutative Property of Multiplication** states that changing the order of the factors does not affect the product.

$$8 \times 6 = 6 \times 8$$

## cone

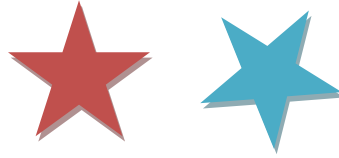
A **cone** is a solid figure formed by connecting every point on a curve in a plane to a point not on the plane. The most common cone connects the points on a circle to a point above or below the center of the circle.



Related words:  
geometric solids

## **congruent**

Figures are **congruent** if they are identical to each other in shape and size. Congruent figures can be in different positions.

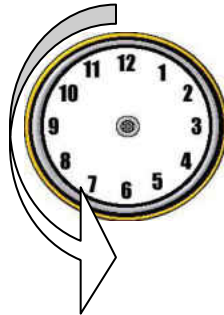


The two stars are congruent figures.

Related words:  
similar

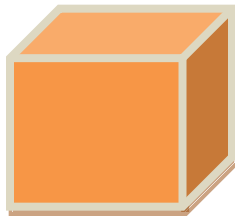
## **counterclockwise**

**Counterclockwise** is a direction opposite to that of the normal rotation of the hands of a clock; not clockwise.



## **cube**

A **cube** is a solid figure with six congruent, square faces; all edges are the same length; a cube has 8 vertices and 12 edges.



Related words:  
geometric solids, square, face, edge, vertex, length

## cylinder

A **cylinder** is a solid figure formed by connecting the corresponding points on the edges of two congruent shapes that lie in different planes. The most common cylinder connects corresponding points on two circles that lie one above the other in parallel planes.

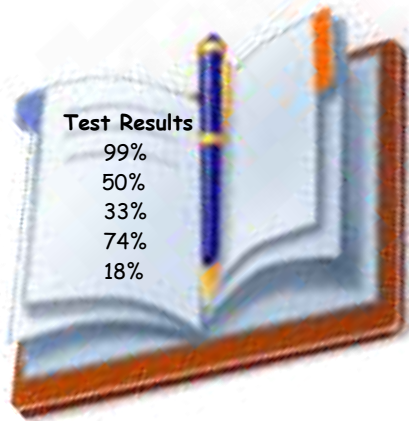


Related words:  
geometric solid

**Dd** is the 4<sup>th</sup> letter of the alphabet!

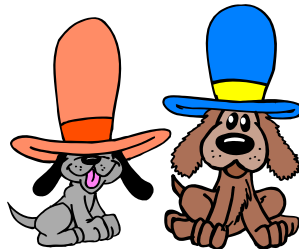
**data**

**Data** are pieces of information collected to answer a question.



**date**

A **date** includes the day, the month, and the year.



The puppies were born on January 21, 2008.

**decade**

A **decade** is a period of time that is ten years in length.

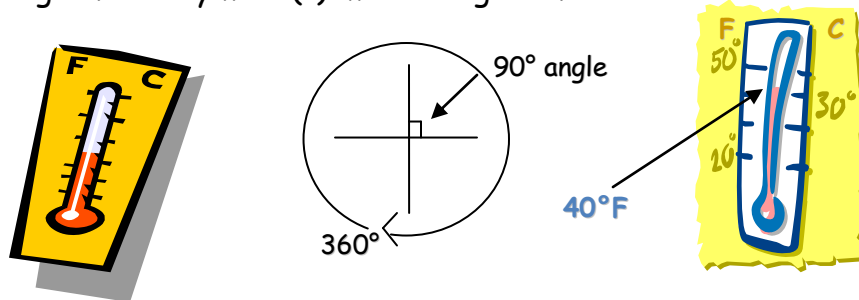


"The 60s"  
"The 60s"



## degree

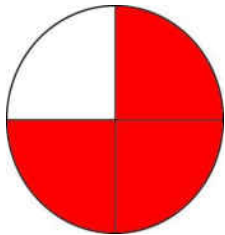
A **degree** is a unit of measurement. There are several different units of measurement with this name, including measurements of temperature and measurements of angles. The symbol ( $^{\circ}$ ) means degrees.



Related words:  
degrees Celsius, degrees Fahrenheit, angle

## denominator

A **denominator** is the number of equally-sized parts that make the whole or complete set.

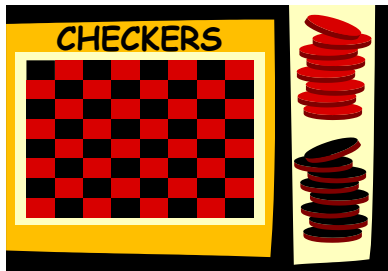


Numerator  $\longrightarrow$  3  $\longleftarrow$  Number of Equal Parts  
Denominator  $\longrightarrow$  4  $\longleftarrow$  Number of Equal Parts to  
Make up a Whole

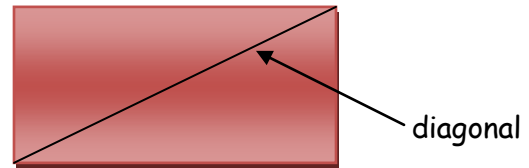
Related words:  
fraction, numerator

## diagonal

A **diagonal** is a line segment that joins two non-adjacent vertices in a polygon.



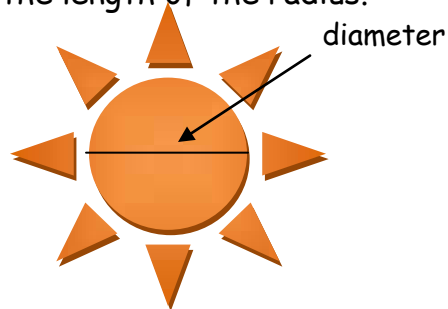
In the game of checkers, moves are made diagonally.



Related words:  
vertex, polygon

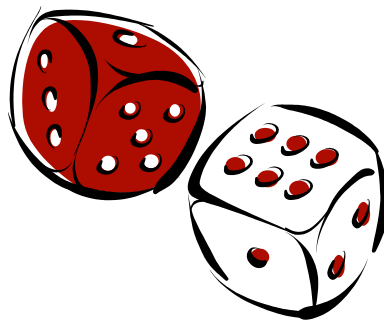
## diameter

The length of a **diameter** is the distance across a circle, passing through the center. Diameter is two times the length of the radius.



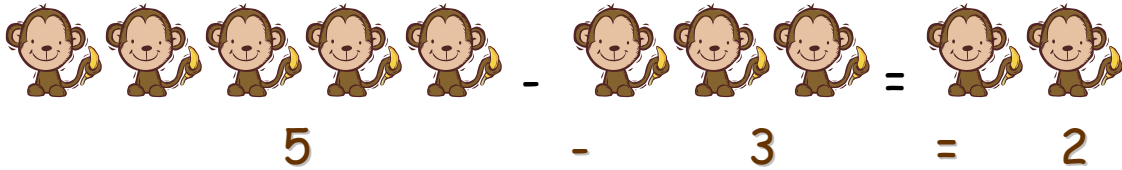
## dice

**Dice** are cubes with from one to six dots on their faces. The singular form of "dice" is "die", so we say "One **die**, two **dice**".



## **difference**

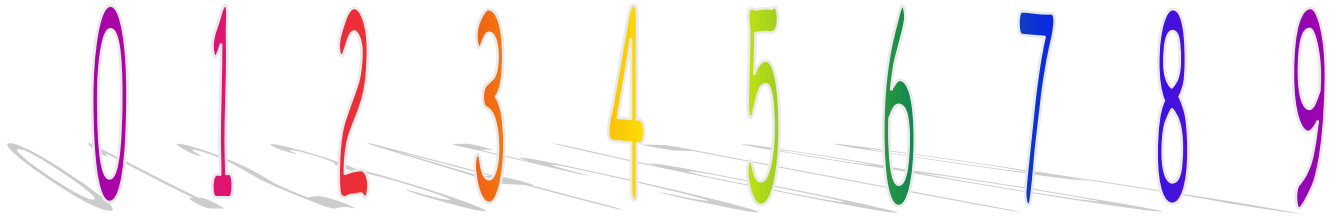
**Difference** is the distance between 2 numbers on a number line; the answer to a subtraction problem. The difference between two numbers is how much larger the bigger number is than the smaller number.



The difference between 5 and 3 is 2.

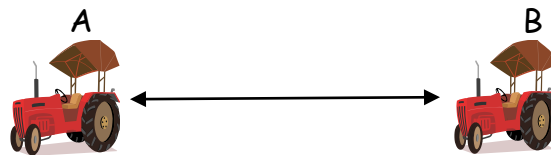
## **digit**

There are 10 **digits**; any one of the symbols, 0, 1, 2, 3, 4, 5, 6, 7, 8, or 9.



## **distance**

**Distance** is the measure of how far apart two points are on a line.



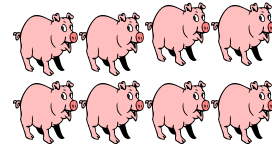
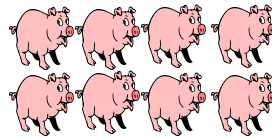
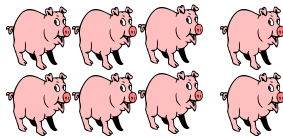
The distance from tractor A to tractor B is about 1 inch.

## dividend

A **dividend** is a number that is to be divided by a divisor.

$$24 \div 8 \quad 8 \overline{) 24}$$

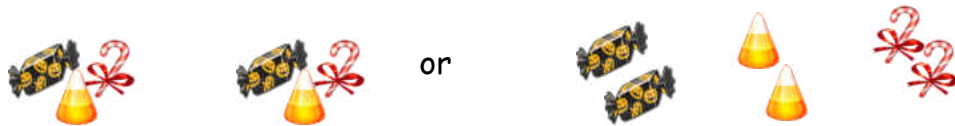
In both of these problems, the dividend is twenty-four.



## division

**Division** is sharing of things equally; or dividing things into equal groups or parts.

The following symbols are used for division:  $\div$ ,  $/$ , and  $\overline{)}$ . Division is the inverse of multiplication. Because 3 multiplied by 2 is 6, it follows that 6 divided by 3 is 2, and that 6 divided by 2 is 3.



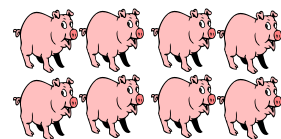
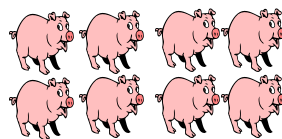
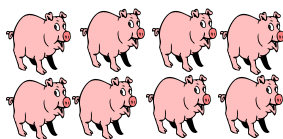
Six sweets can be divided into two groups of three sweets, or three groups of two sweets.

## divisor

A **divisor** is a number by which another number, the dividend, is divided.

$$24 \div 8 \quad 8 \overline{) 24}$$

In both of these problems, the divisor is eight.





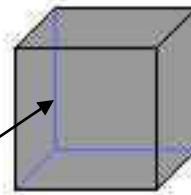
# Ee is the 5<sup>th</sup> letter of the alphabet!

## edge

An **edge** in a solid figure is a line segment where two faces of the solid meet.



edge



cube

A cube has twelve edges.

Related words:  
geometric solids

## equal

**Equal** means having the same amount or value.



$$2 + 3 = 5$$

Two plus three equals five.

## equally likely outcomes

**Equally likely outcomes** are outcomes that have the same probability. Events with equally likely outcomes have the same chance of happening. Tossing a fair coin has two commonly, equally likely outcomes: heads or tails.



Related words:  
probability

## equation

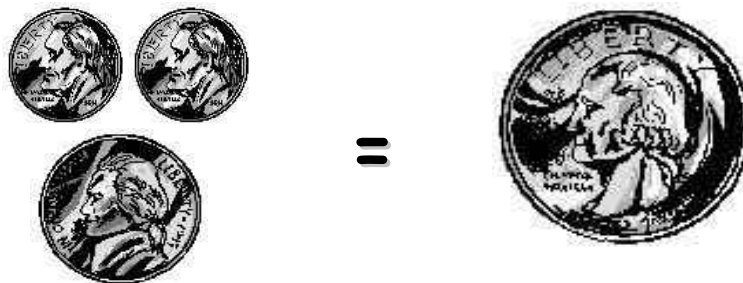
An **equation** is a number sentence, a statement that two expressions or numbers are equal. An equation is a mathematical sentence that uses an equal sign (=). The expression on the right hand side of an equal sign represents the same number or measurement as the expression on the left hand side of the equal sign.

$$2 + 3 = 5$$

$$x + 3 = 5, \text{ so } x = 2$$

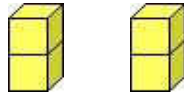
## equivalent

**Equivalent** means having the same value.



## even number

An **even number** is any number ending in 0, 2, 4, 6, or 8. Even numbers are numbers that can be divided by two and give whole numbers.

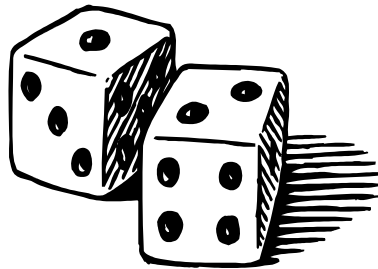


Related words:  
odd number

4 blocks

## event

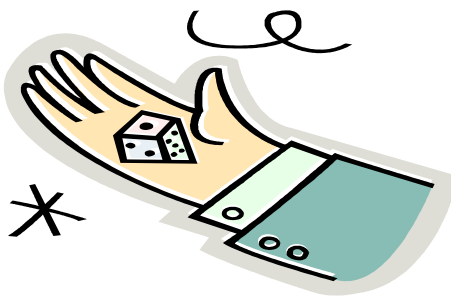
An **event** is an outcome or set of outcomes of an experiment or situation; for example, getting a 3 is one possible event produced by rolling two dice.



Related words:  
probability

## experiment

An **experiment** in probability is any activity involving chance.

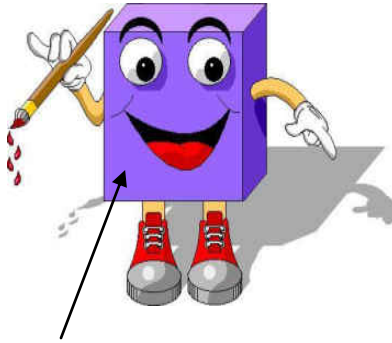


Related words:  
probability

**Ff** is the 6<sup>th</sup> letter of the alphabet!

**face**

A **face** is a polygon that serves as a side of a solid.



A cube has 6 faces.

Related words:  
geometric solids

**factor**

A **factor** is a number that is multiplied by another number. In whole-number arithmetic, the word factor is also used for a number that divides another number evenly. For example, in the problem 3 times 4 equals 12, 3 and 4 are the factors and 12 is the product. We also say that 3 is a factor of 12.

**The factors of 12 are  
1, 2, 3, 4, 6, and 12.**

## Fahrenheit

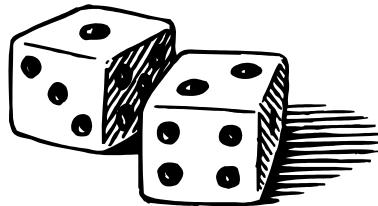
**Fahrenheit** is a scale used to measure temperature. Fahrenheit is measured in units of degrees ( $^{\circ}$ ) and is abbreviated by (F).

$32^{\circ}\text{F}$  = water freezes

$212^{\circ}\text{F}$  = water boils

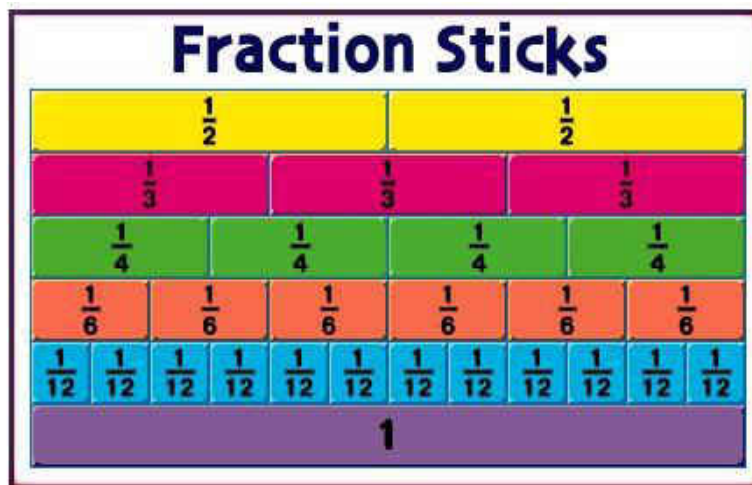
## fair

In a game of chance, an object is called "**fair**" if it produces equally likely outcomes. For example, a "fair die" is equally likely to roll to display any number from one to six.



## fraction

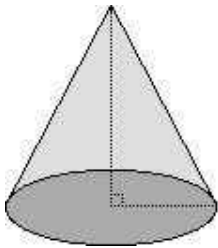
A **fraction** represents a number of equal parts of a whole. The top of the fraction, called the numerator, gives the number of equal parts. The bottom of the fraction, called the denominator, gives the number of equal parts that make up one whole.



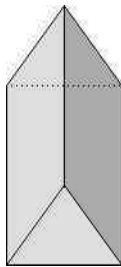
**Gg** is the 7<sup>th</sup> letter of the alphabet!

**geometric solids**

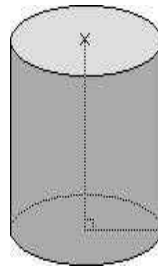
**Geometric solids** are three-dimensional figures such as cone, pyramid, prism, and cylinder.



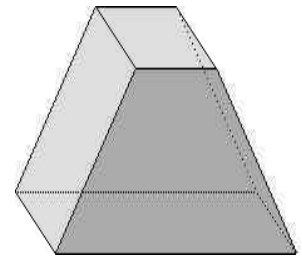
cone



prism



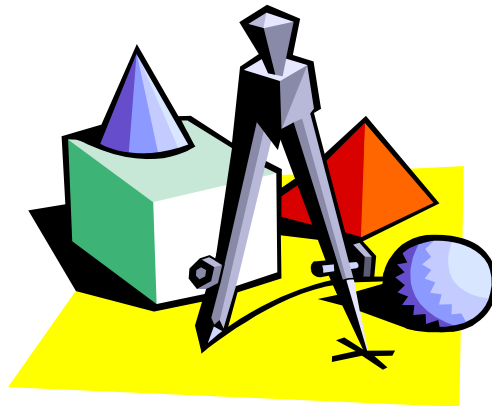
cylinder



truncated pyramid

**geometry**

**Geometry** is the branch of mathematics that studies shapes and sizes.

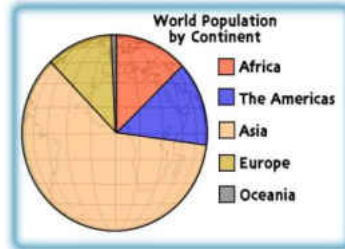


## graph

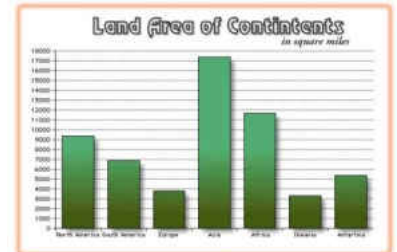
A **graph** is a method of displaying information as a picture to make it more easily understood. Some types of graphs include: bar-line graphs, block graphs, pictographs, and pie graphs.

| CONTINENT    | POPULATION (in millions) |
|--------------|--------------------------|
| AFRICA       | 794                      |
| THE AMERICAS | 833                      |
| ASIA         | 3672                     |
| EUROPE       | 727                      |
| OCEANIA      | 31                       |
| WORLD        | 6057                     |

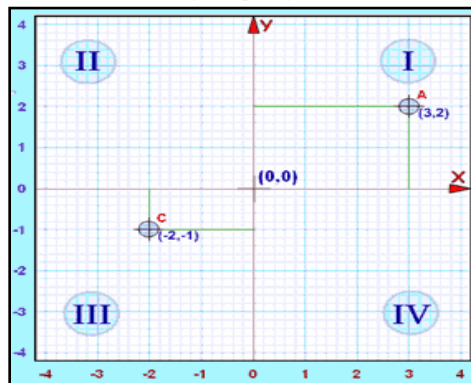
chart



pie graph



bar graph

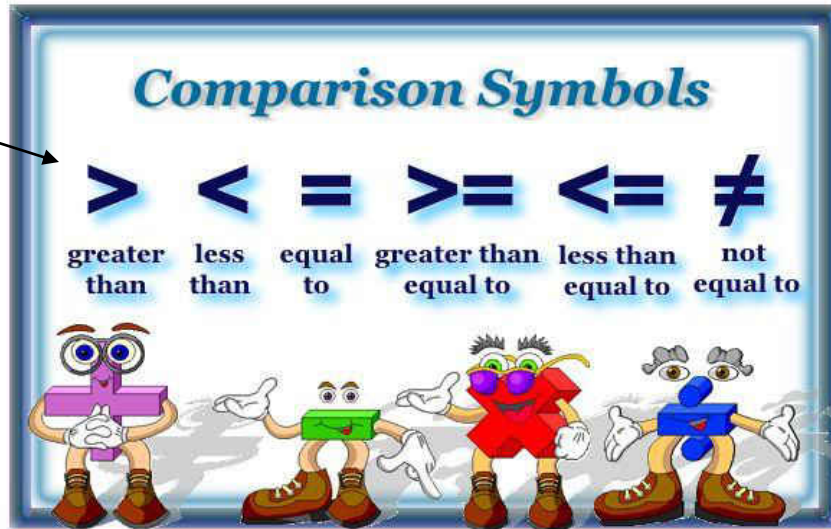


Cartesian graph

## greater than

Greater than means more than. The  $>$  sign is used to symbolize greater than. The symbol  $>$  points from the larger number to the smaller number.

greater than



$$10 > 6$$

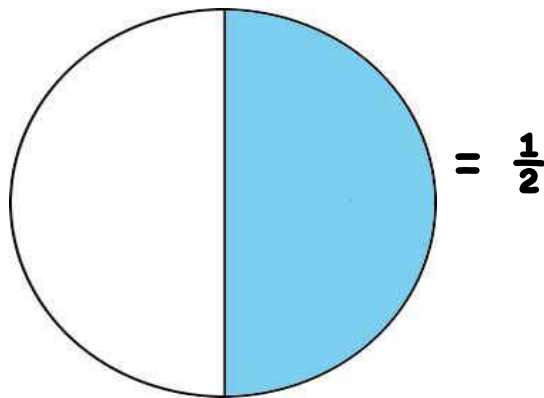
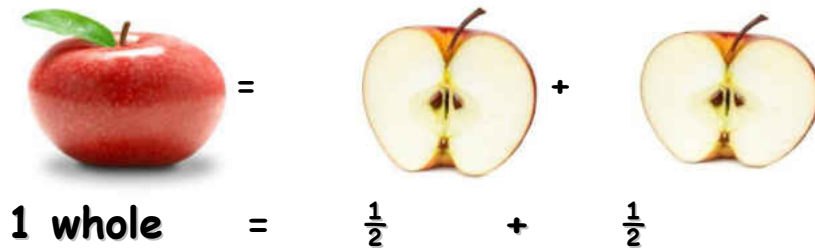
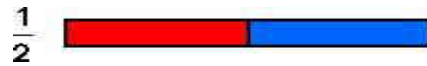
Ten is greater than six.



# Hh is the 8<sup>th</sup> letter of the alphabet!

## half

A **half** is one of two equal parts and can be written as a fraction ( $\frac{1}{2}$ ), a decimal (0.5), or a percentage (50%).



**Ii** is the 9<sup>th</sup> letter of the alphabet!

## identity properties

### addition identity property:

if 0 is added to any number, the sum is the same as the given number



$$3 + 0 = 3$$

$$0 + 3 = 3$$

### multiplication identity property:

if a given number is multiplied by 1, the product is the same as the given number

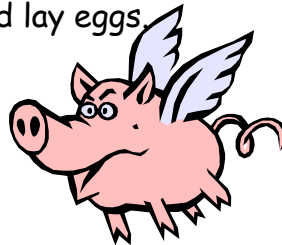


$$3 \cdot 1 = 3$$

$$1 \cdot 3 = 3$$

## impossible (probability)

An event is **impossible** if it has a probability of 0. Impossible in probability describes events that will definitely not happen. It is impossible for January to be June, or cows to grow feathers and lay eggs.



Related words:  
certain, probability

## input

**Input** is information used to solve a problem. The letter  $x$  is often used to represent the input.

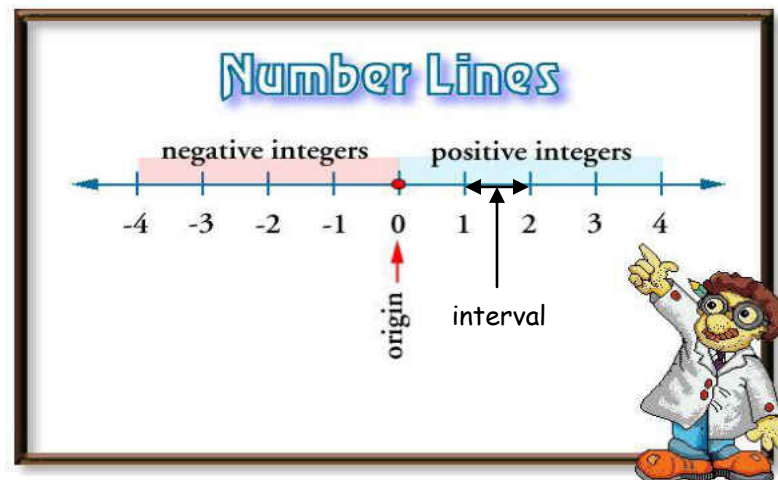
$$y = x + 3$$

↑

The input is  $x$ .

## interval

An **interval** is a part of the number line between two numbers.



## inverse operations

**Inverse operations** are operations that undo each other; addition and subtraction are **inverse operations**; multiplication and division are **inverse operations**.

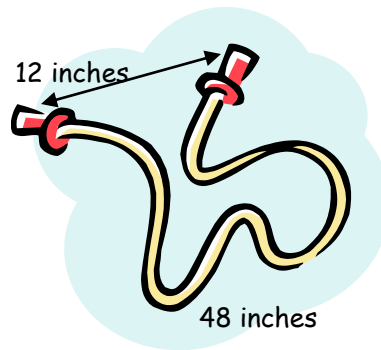
$$2 + 3 - 3 = 2$$

$$5 \times 3 \div 3 = 5$$

**L** is the 12<sup>th</sup> letter of the alphabet!

**length**

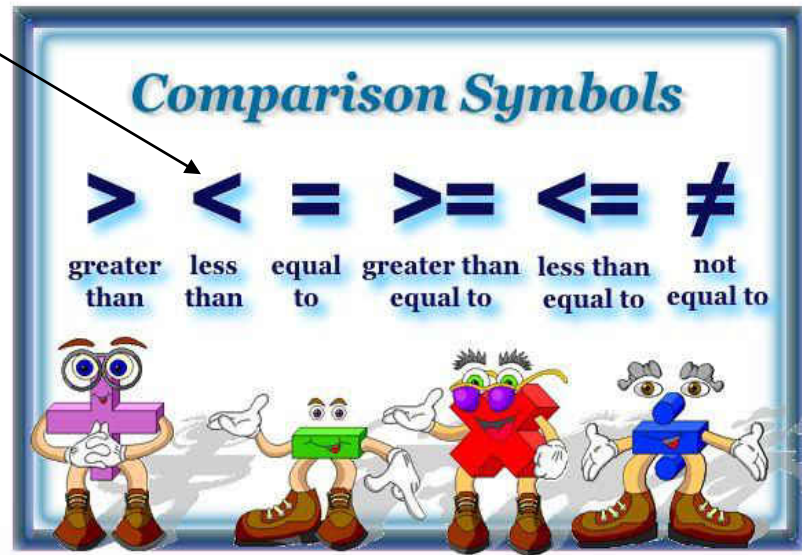
The **length** of an object or line is the distance along the object or line from one end to the other.



The skipping rope shown is about 48 inches in length,  
Even though its handles are only 12 inches apart.

## less than

Less than means not as many as. The  $<$  sign is used to symbolize less than.

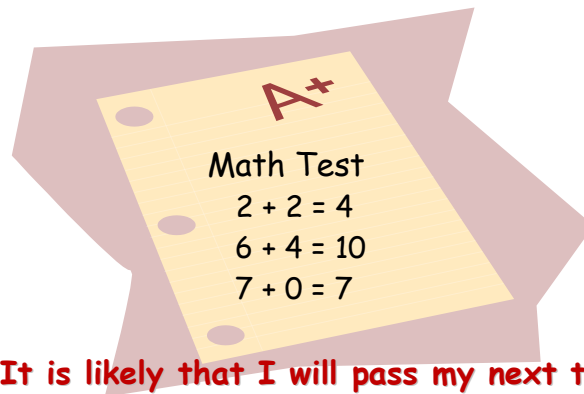


$$2 < 6$$

Two is less than six.

## likely

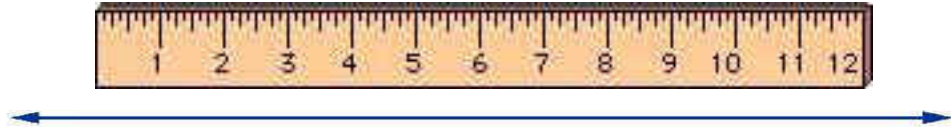
An event is **likely** if you expect it to happen. The probability of a likely event is close to 1.



It is likely that I will pass my next test.

## line

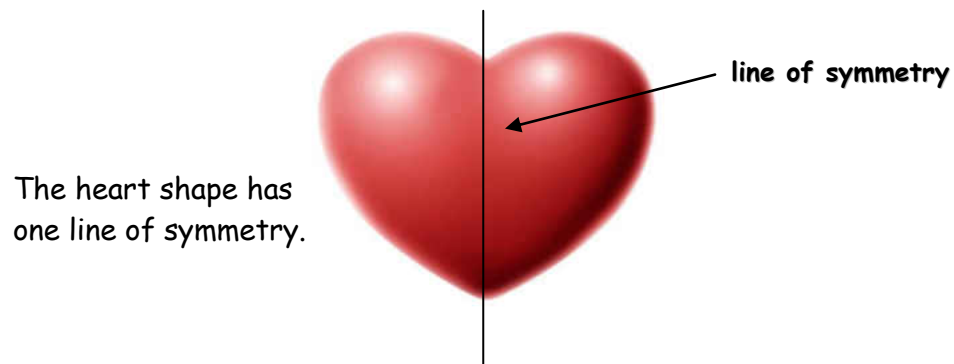
A **line** is the path of a moving point.



Related words:  
plane, point

## line of symmetry

A **line of symmetry** is a line dividing a figure or an arrangement of objects into two parts that are mirror images of each other. A shape folded along a line of symmetry will consist of halves, where one half will cover the other half exactly.



The heart shape has one line of symmetry.

Related words:  
symmetry

## line segment

A **line segment** is part of a line; a **line segment** has two endpoints.



# Mm is the 13<sup>th</sup> letter of the alphabet!

## mass

**Mass** is the amount of matter in an object; weight is determined by the pull of gravity on the mass of an object; the mass of an object remains the same even in outer space; the weight of an object changes depending on the gravitational pull at its location. People often use the word weight when they really mean mass.



weight is measured by a scale



mass is measured by the amount of matter  
an object contains  
The elephant is massive!

## minus

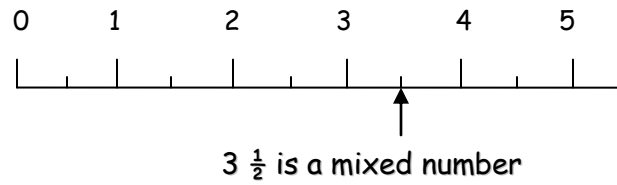
**Minus** means "take away" or subtract and is shown by the sign - .

$$10 - 8 = 2$$



## mixed number

A **mixed number** represents the sum of a whole number and a fraction. A mixed number such as  $3\frac{1}{2}$  contains a whole number (3) and a fraction ( $\frac{1}{2}$ ).



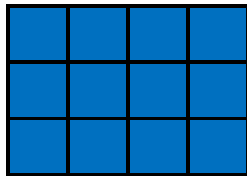
$$3 + \frac{1}{2} = 3\frac{1}{2}$$

## multiplication

**Multiplication** represents repeated addition. It also represents area. Instead of adding  $3 + 3 + 3 + 3$ , we can say "four times three" and we can write  $4 \times 3$ .

$$4 \times 3 = 12$$

Four times three equals twelve.





**Nn** is the 14<sup>th</sup> letter of the alphabet!

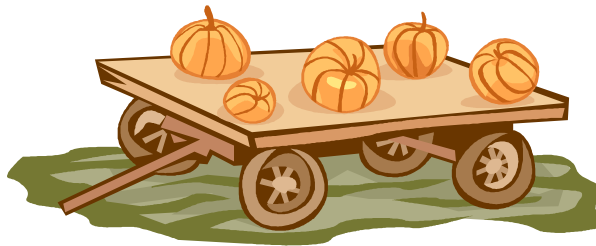
**natural number**

**Natural number** is another name for counting numbers, starting with 1. The natural numbers are 1, 2, 3, 4, 5, 6 and so on.



**number**

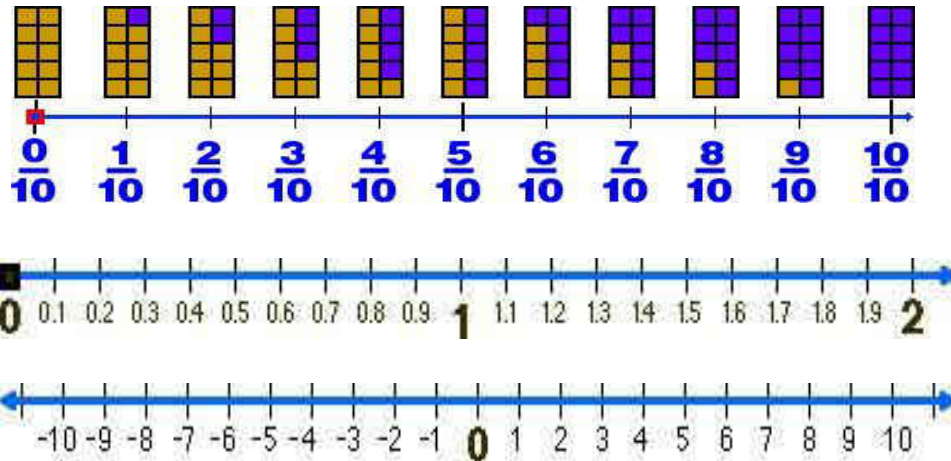
A **number** is a measure of how many there are of something, or how large something is.



There are 5 pumpkins on the wagon.

## number line

A **number line** arranges numbers in order on a scale. A ruler is a kind of number line. Number lines can include fractions and negative numbers.



## number sentence

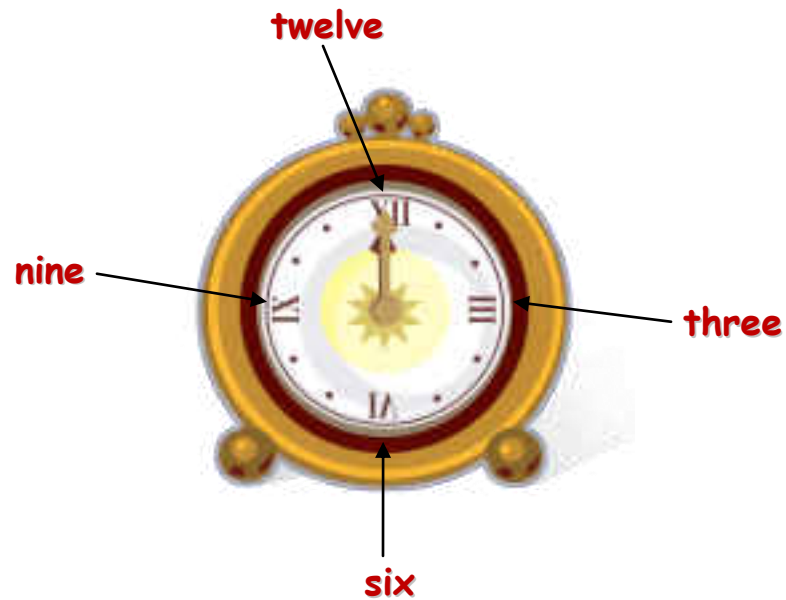
A **number sentence** is any statement about the relationship between numbers. Equations are one kind of number sentence, but inequalities are also number sentences.

$$2 + 4 = 6$$

Related words:  
equation

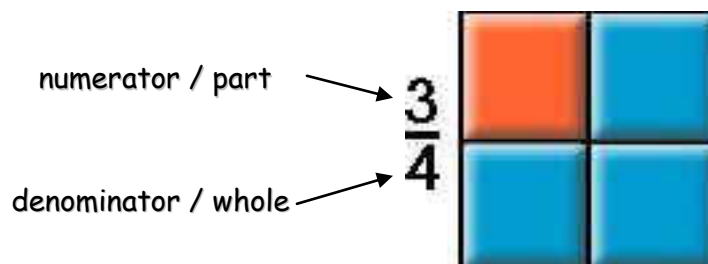
## numeral

A **numeral** is a symbol used to write or represent a number.



## numerator

The **numerator** represents how many equal parts of the whole or set we have; the number of equal parts of the whole or set being considered. In the fraction  $\frac{3}{4}$  the numerator is 3 and means three out of 4 equal parts.



Related words:  
fraction

**Oo** is the 15<sup>th</sup> letter of the alphabet!

**odd number**

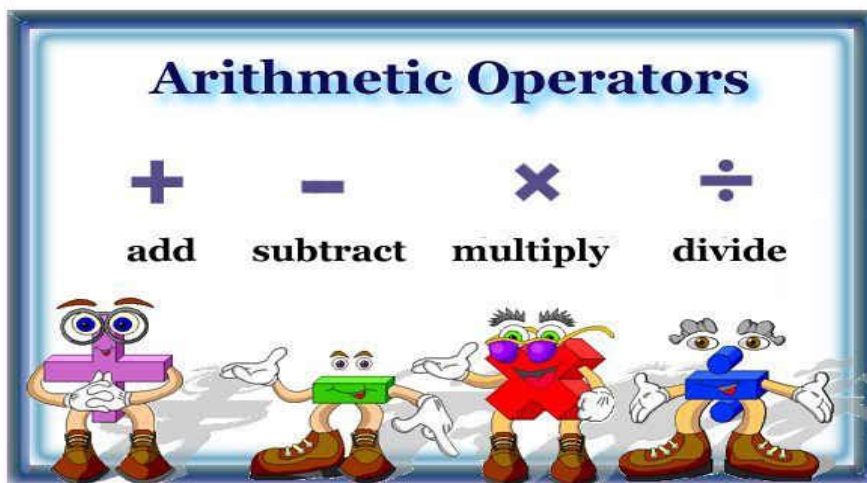
An **odd number** is any number ending in 1, 3, 5, 7, or 9. Odd numbers are whole numbers that cannot be divided exactly by 2 to give whole numbers.

All numbers that end in 1, 3, 5, 7, and 9 are odd!

Related words:  
even number

**operation**

An **operation** is a process of doing something to numbers or shapes. Addition, subtraction, multiplication, and division are all operations.



## ordinal number

An **ordinal number** is a number that names the place or position of an object in a sequence or set.



first  
1<sup>st</sup>



second  
2<sup>nd</sup>



third  
3<sup>rd</sup>



fourth  
4<sup>th</sup>

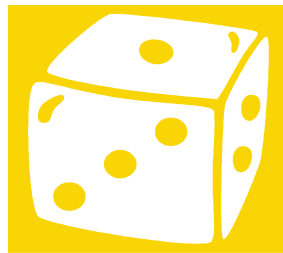


fifth  
5<sup>th</sup>

Related words:  
cardinal number

## outcome

An **outcome** is a result of an experiment. There are six possible outcomes of rolling a die, all of which are equally likely if the die is fair.



Related words:  
probability

## output

The answer to a problem is sometimes called the **output**. The letter "y" is often used to represent the **output**.

$$y = x + 3$$



The output is **y**.

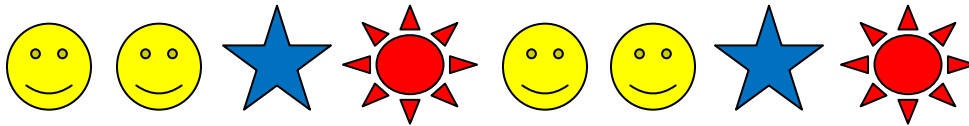
If the input is 2 then the output is 5.

# Pp is the 16<sup>th</sup> letter of the alphabet!

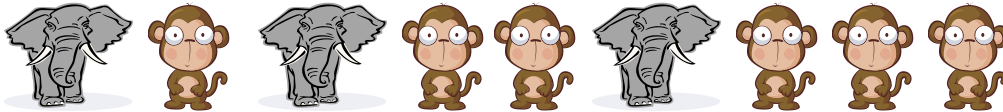
## pattern

A **pattern** consists of numbers or objects that follow a repeating or growing rule.

repeating pattern:



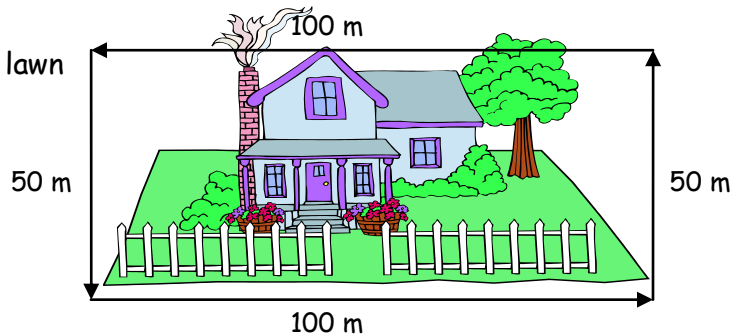
growing pattern:



## perimeter

**Perimeter** is the distance around any two-dimensional figure.

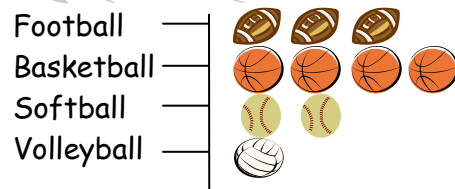
The perimeter of the lawn is 300 m.



## picture graph

A **picture graph** consists of a data display that uses pictures to represent the data.

## Most enjoyed sports in Ms. Amanda's Classroom!



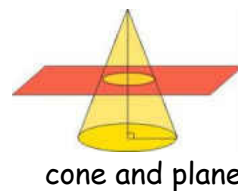
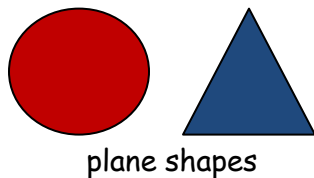
## place value

**Place value** is the value a digit represents depending on its place in the number. The position of a digit in a number shows how much it is worth.

| Thousands | Hundreds | Tens | Ones |
|-----------|----------|------|------|
|           |          | 2    | 0    |
|           | 1        | 0    | 0    |
| 3         | 0        | 0    | 0    |
|           |          |      | 9    |

## plane

A **plane** is a flat surface; it is two dimensional.



## plus

Plus means add and uses the symbol +.

$$5 + 3 = 8$$

Five plus three equals eight.



## point

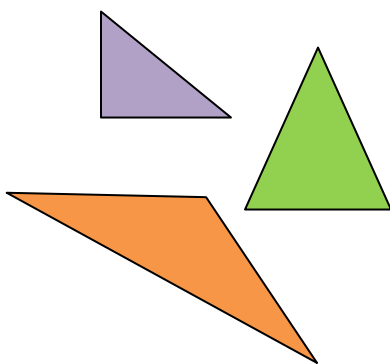
A **point** is a dot that has position, but no size.



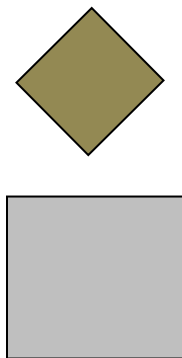
Related words:  
line, plane

## polygon

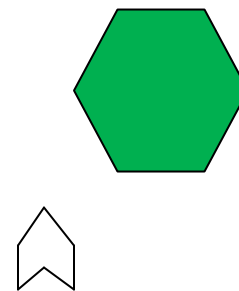
A **polygon** is a closed plane figure composed of line segments that do not cross.



triangles



squares

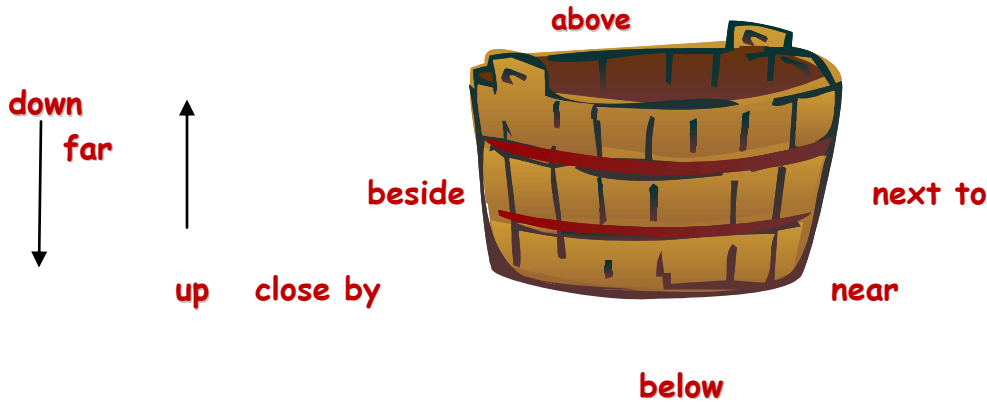


hexagons



## position

**Position** is the location of an object relative to another.  
(above, below, next to, beside, near, far, close by, up, down, etc.)



## probability

**Probability** is the chance of an event occurring. When tossing a fair coin, there stands an equal chance of throwing heads or tails. So, the probability of getting a "head" is one out of two or  $\frac{1}{2}$ . When rolling a fair die, the probability of getting a "four" is one out of six or  $\frac{1}{6}$ .



## product

A **product** of two numbers is the answer when the two numbers are multiplied. The product of 3 and 5 is 15.

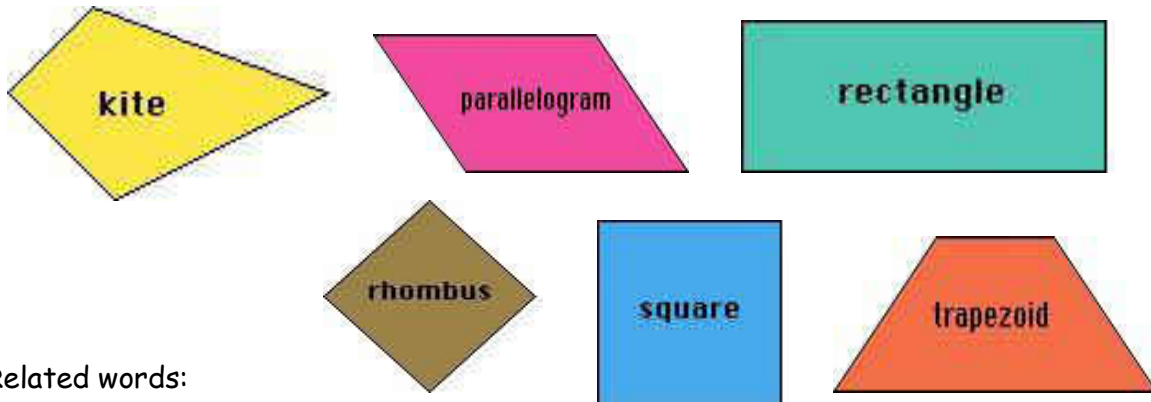
$$3 \times 5 = 15$$

The product of 3 and 5 is 15.

# Qq is the 17<sup>th</sup> letter of the alphabet!

## quadrilateral

A **quadrilateral** is any two-dimensional polygon with 4 straight sides.



Related words:  
polygon

All these shapes are quadrilaterals.

## quotient

A **quotient** is the answer in division.

$$24 \div 8 = 3$$
$$8 \overline{)24} \quad 3$$

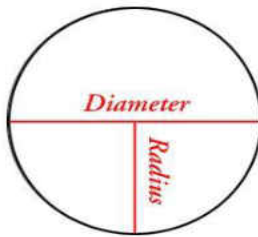
In both of these problems, the quotient is three.



# Rr is the 18<sup>th</sup> letter of the alphabet!

## radius

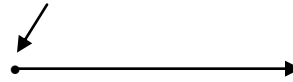
The **radius** of a circle is the distance from the center to any point on the circle. The radius is half the diameter. The plural form of radius is radii.



**radius =  $\frac{1}{2}$  diameter**

## ray

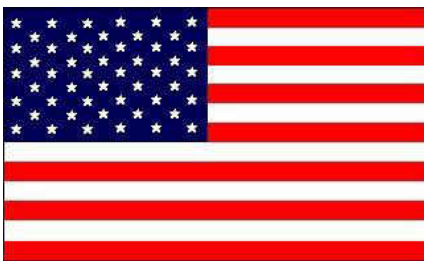
A **ray** is part of a line that starts at a point (the endpoint) and continues forever in one direction.



Related words:  
line

## rectangle

A **rectangle** is a quadrilateral with 4 right angles. A square is also a rectangle.

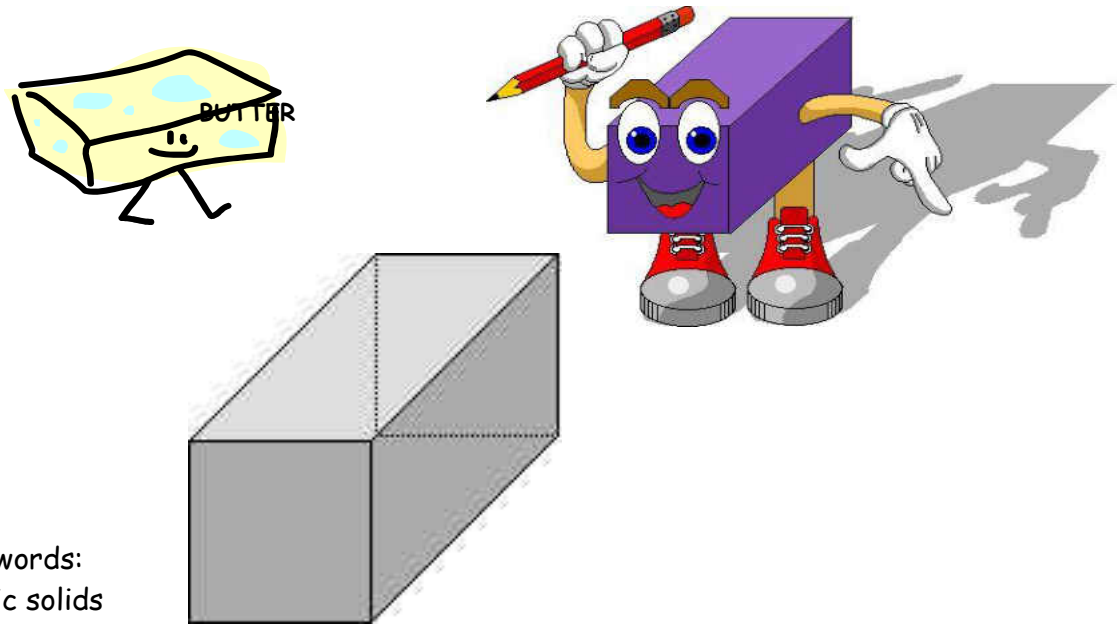


These are rectangles.

Related words:  
quadrilateral

## rectangular prism

A **rectangular prism** is a solid in which all 6 faces are rectangles.



Related words:  
geometric solids

## remainder

The **remainder** is what is left over after dividing numbers that do not divide evenly. For example,  $8 \div 3$  is 2 remainder 2.

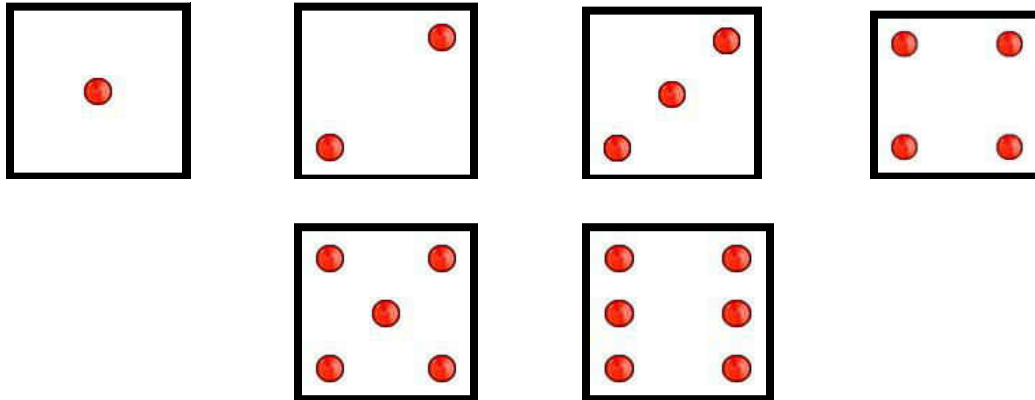


$$8 \div 3 = 2 \text{ remainder } 2$$

**Ss** is the 19<sup>th</sup> letter of the alphabet!

**sample space**

Sample space is the set of all possible outcomes of an experiment.



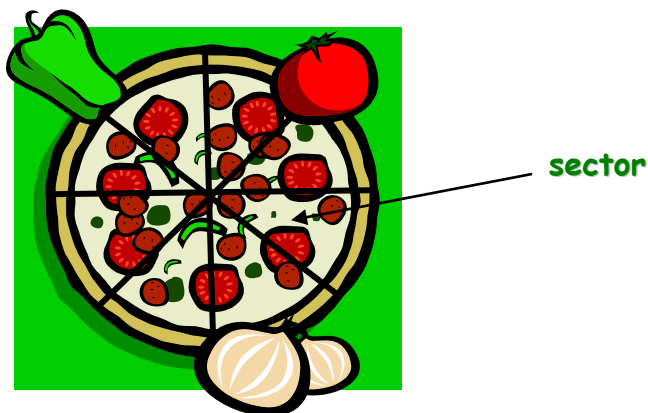
This is an example of "sample space" or all possible outcomes of rolling a die.

Related words:  
probability

**sector**

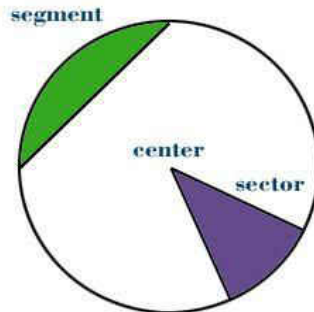
A **sector** is considered a slice of a circle. Its edges are 2 radii and the part of the circumference (arc) between them. A sector is like a slice of pizza.

This pizza contains eight sectors.



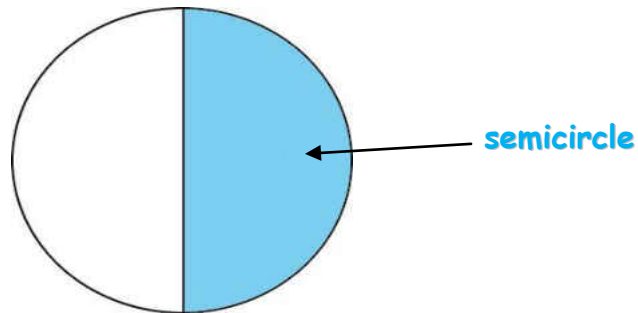
## segment

A **segment** is a part of something. A segment of a circle is a piece whose boundaries are a chord and part of the circumference (arc).



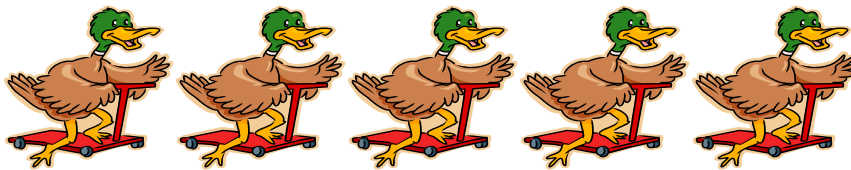
## semicircle

A **semicircle** is half of a circle.

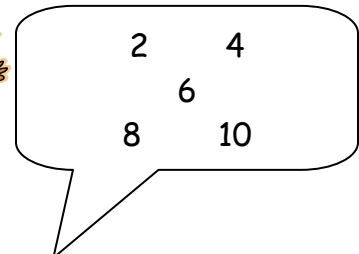


## set

A **set** is a collection of distinct items or elements.



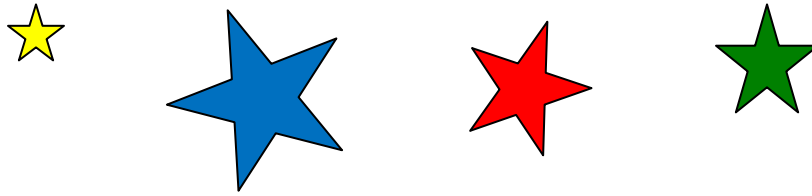
This is a set of 5 ducks.



The set of even numbers from 1 to 10.

## similar

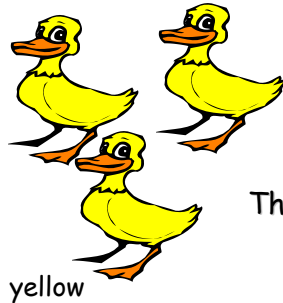
Figures are **similar** if they have or the same shape but not necessarily the same size.



These stars are similar.

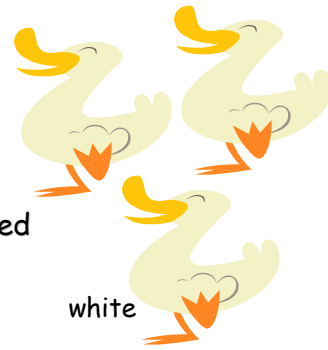
## sort

**Sort** means classify.



yellow

The ducks are sorted  
by color.

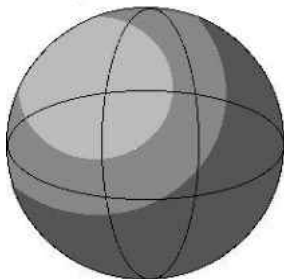


white

Related words:  
classify, attribute

## sphere

A **sphere** is a perfectly round, three-dimensional object with all of its points the same distance from its center.



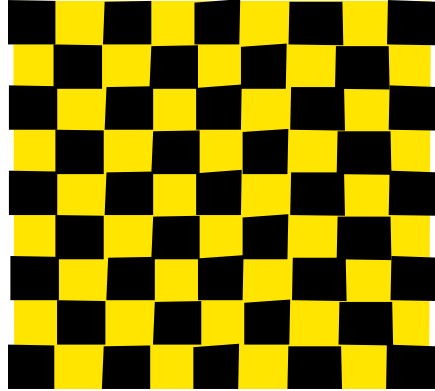
Related words:  
geometric solids



## square

A **square** is a special rectangle with all four sides congruent, meaning all four sides of the same length. A square has four angles of  $90^\circ$  (90 degrees). A square contains two pairs of opposite sides that are parallel.

This is one big square made up of 81 smaller squares.



Related words:  
quadrilateral, rectangle

## square pyramid

A square pyramid is a solid with a square base and 4 sloping triangular faces that share a vertex.



Related words:  
geometric solids

## standard form of a number

**Standard form of a number** is a method of writing numbers.

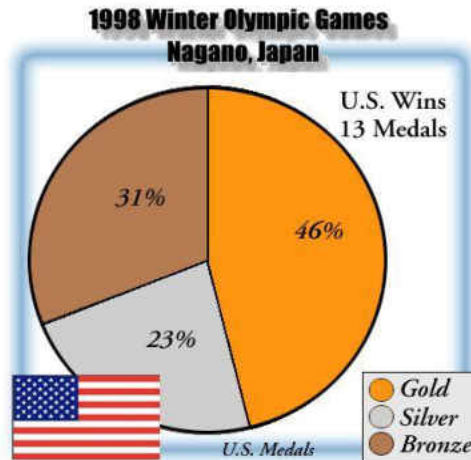
The standard form for the number  
*three thousand, four hundred twenty-one* is  
3,421.

Related words:  
number



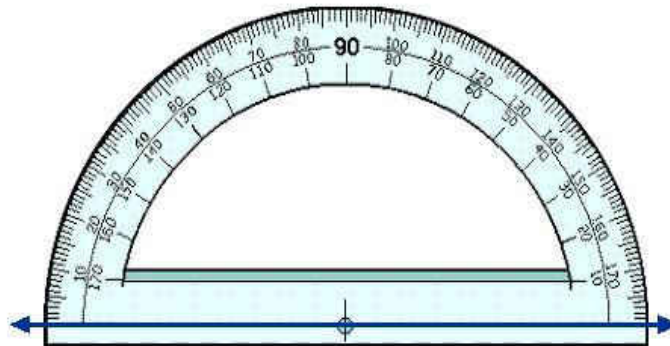
## statistics

**Statistics** is a science that studies methods for the collection, organization, and analysis of data.



## straight angle

A **straight angle** is a turn of  $180^\circ$ . It contains two right angles and is a half turn.



## subtraction

**Subtraction** means taking one number away from another or finding the difference between two numbers. Subtraction is the opposite of addition. The sign "-" is used to show subtraction.

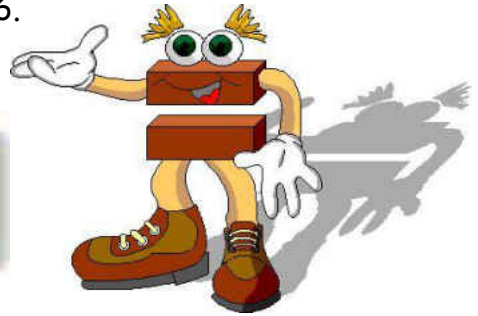
$$4 - 3 = 1$$



## sum

A **sum** is the answer in addition. The sum of 2 and 4 is 6.

|          |          |          |          |          |
|----------|----------|----------|----------|----------|
| <b>2</b> | <b>+</b> | <b>4</b> | <b>=</b> | <b>6</b> |
| addend   | +        | addend   | =        | sum      |



## survey

A **survey** is a method used to gather data.

### Boys & Girls in Our Class

1. How many boys are in our class?
2. How many girls are in our class?
3. Are there more boys or girls in our class?



Related words:  
statistics

**Tt** is the 20<sup>th</sup> letter of the alphabet!

**table**

A **table** consists of data organized using rows and columns.

**Addition Table**

|   |    |    |    |    |    |    |    |    |    |
|---|----|----|----|----|----|----|----|----|----|
| + | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  |
| 1 | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 |
| 2 | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 |
| 3 | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 |
| 4 | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 |
| 5 | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 |
| 6 | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 |
| 7 | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 8 | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |

Related words:

array

**take away**




**Take away** means "subtract" or "minus". Ten take away three is seven ( $10 - 3 = 7$ ).

A visual representation of the subtraction equation  $10 - 3 = 7$ . The equation is displayed using five yellow buttons with black text, arranged horizontally and separated by vertical lines. The buttons contain the numbers 10, the minus sign (-), the number 3, the equals sign (=), and the number 7.

## tally

**Tally** is a method of collecting data as they happen. Tallying uses one mark (tally) for each item of information; to make it easy to count the tallies, the fifth item is usually drawn across the others, IIII.

### Favorite Pets

| Pet   | Tally Marks | Number |
|---|-------------|--------|
|  | IIII II     | 10     |
|  | IIII I      | 6      |
|  | IIII        | 4      |

## term

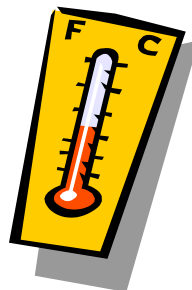
A **term** is a number that is one part of a sum or one number in a list of numbers. In  $2 + 3 = 5$ , the terms are 2 and 3 and the sum is 5. The word "**term**" is also used for the numerator and denominator of a fraction, as in "reduce the fraction to lowest terms".

In  $2 + 3$

2 and 3 are terms.

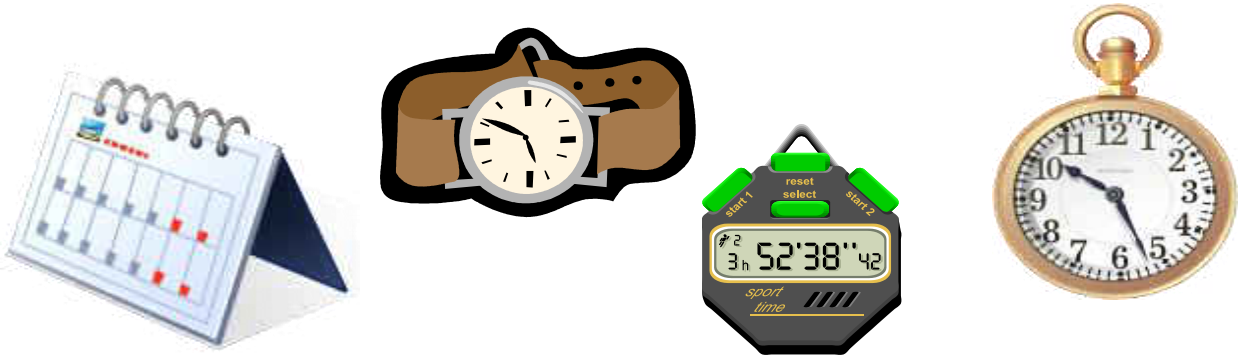
## thermometer

A **thermometer** is an instrument used to measure temperature in degrees; temperature can be measured in degrees Fahrenheit or degrees Celsius.



## time

**Time** is a period in which things happen. Time is measured in units such as seconds, minutes, hours, days, weeks, months, and years.

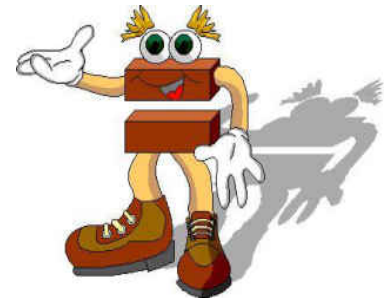


## total

The **total** is the answer when adding numbers together. The **total** is the sum.

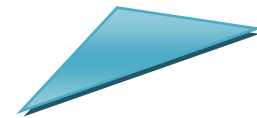
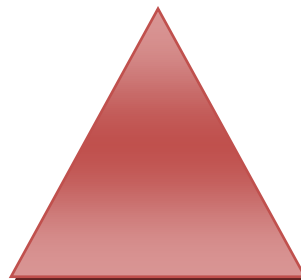


$$\begin{array}{r} 4 \quad 3 \\ \hline \hline 7 \\ 4+3=7 \end{array}$$



## triangle

A **triangle** is a two-dimensional polygon with 3 straight sides and three angles.

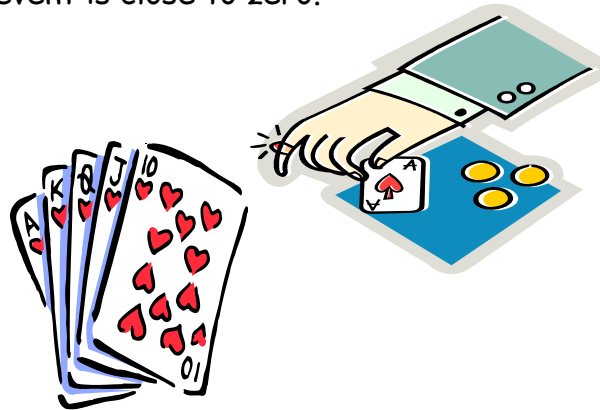


Related words:  
polygon

# Uu is the 21<sup>st</sup> letter of the alphabet!

## unlikely

In probability, an **unlikely** event is an event that will seldom happen by chance. The probability of an **unlikely** event is close to zero.



It is unlikely to be dealt a hand of cards all the same suit!  
A straight flush is even more unlikely and a royal flush as illustrated is extremely unlikely.

# Vv is the 22<sup>nd</sup> letter of the alphabet!

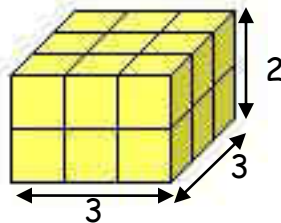
## vertex

A **vertex** is the point of where the rays of an angle intersect, where two adjacent sides of a polygon intersect, or where adjacent edges of a solid intersect. A **vertex** is a corner. The two plural forms of **vertex** are vertices and vertexes. A square has four vertices/vertexes and a cube has eight vertices/vertexes.



## volume

**Volume** is the amount a container can hold; the amount of space occupied by an object.

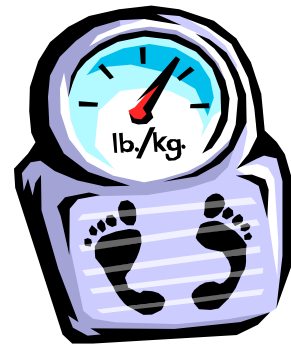
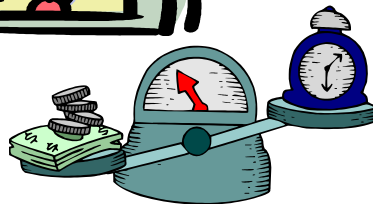


$$\text{volume} = 3 \times 3 \times 2 = 18 \text{ cubes}$$

**Ww** is the 23<sup>rd</sup> letter of the alphabet!

**weight**

**Weight** is determined by the pull of gravity on the mass of an object; mass of an object remains the same regardless of its location; weight of an object changes depending on the gravitational pull at its location. The weight of something is a measure of how heavy it is.



Related words:  
mass

**whole number**

A whole number is a number from the set {0, 1, 2, 3 . . . }.

$$y = x + 3$$

3 is a whole number



**Xx** is the 24<sup>th</sup> letter of the alphabet!

x

"x" is the letter used in algebra to stand for a number we do not know or for a number that changes. The letter x is often used to indicate an input.

$$y = x + 3$$



The input is x.

**Yy** is the 25<sup>th</sup> letter of the alphabet!

**y**  
"y" is the letter often used in algebra to indicate an output.

$$y = x + 3$$



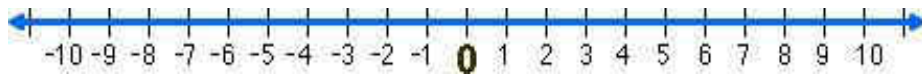
The output is y.

If the input is 2 then the output is 5.

**Zz** is the 26<sup>th</sup> letter of the alphabet!

**zero**

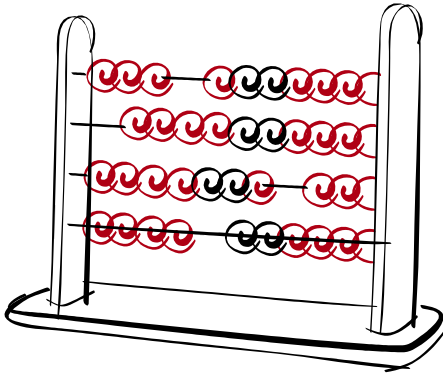
Zero is sometimes called nought and is written '0'.



There are zero recycled items in this box.

# Mathematics Apparatus

abacus



addition table

| + | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  |
|---|----|----|----|----|----|----|----|----|----|
| 1 | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 |
| 2 | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 |
| 3 | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 |
| 4 | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 |
| 5 | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 |
| 6 | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 |
| 7 | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 8 | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |

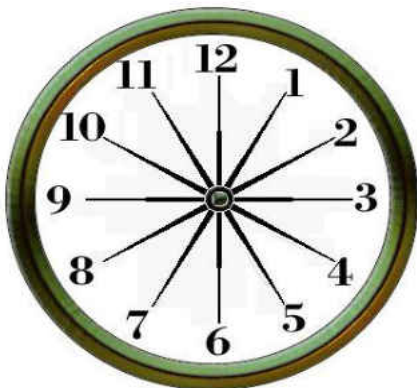
balance



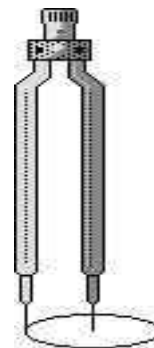
calculator



Clock



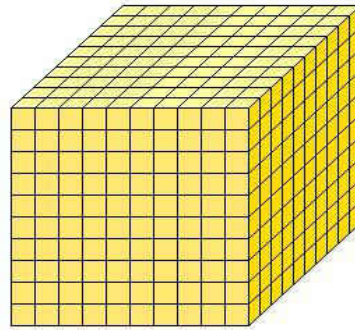
compass



counter cubes

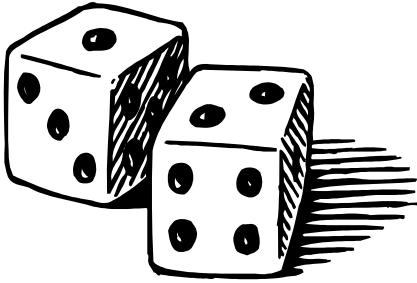


counting blocks

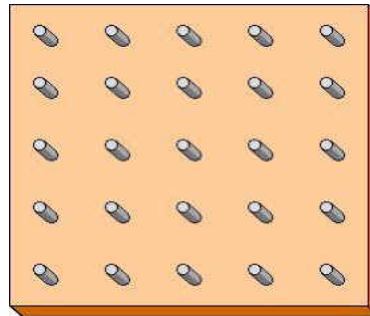


*One Thousand*

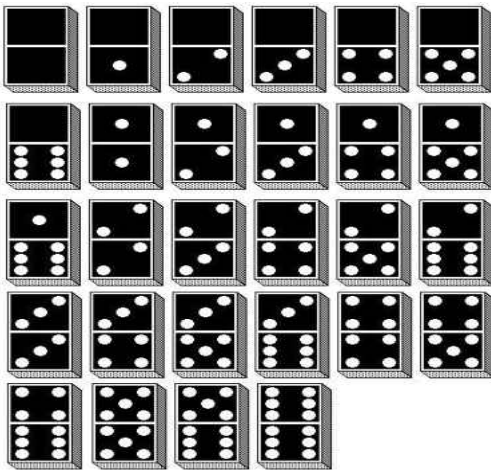
dice



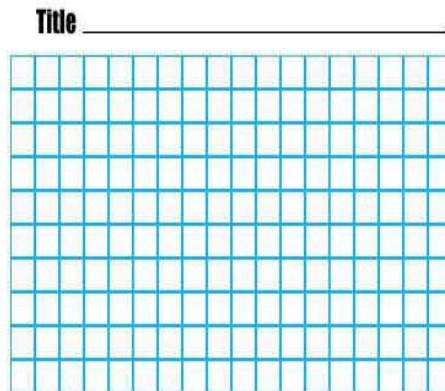
geoboard



dominoes



graph template



hourglass



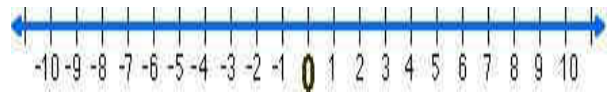
hundreds chart

|    |    |    |    |    |    |    |    |    |     |
|----|----|----|----|----|----|----|----|----|-----|
| 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10  |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20  |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30  |
| 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40  |
| 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50  |
| 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60  |
| 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70  |
| 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80  |
| 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90  |
| 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |

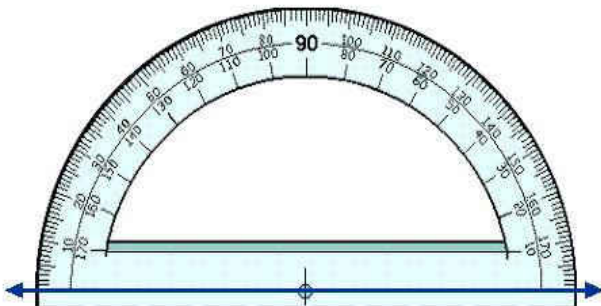
multiplication table

|   |   |    |    |    |    |    |    |    |    |
|---|---|----|----|----|----|----|----|----|----|
| × | 1 | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  |
| 1 | 1 | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  |
| 2 | 2 | 4  | 6  | 8  | 10 | 12 | 14 | 16 | 18 |
| 3 | 3 | 6  | 9  | 12 | 15 | 18 | 21 | 24 | 27 |
| 4 | 4 | 8  | 12 | 16 | 20 | 24 | 28 | 32 | 36 |
| 5 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 |
| 6 | 6 | 12 | 18 | 24 | 30 | 36 | 42 | 48 | 54 |
| 7 | 7 | 14 | 21 | 28 | 35 | 42 | 49 | 56 | 63 |
| 8 | 8 | 16 | 24 | 32 | 40 | 48 | 56 | 64 | 72 |
| 9 | 9 | 18 | 27 | 36 | 45 | 54 | 63 | 72 | 81 |

number line



protractor



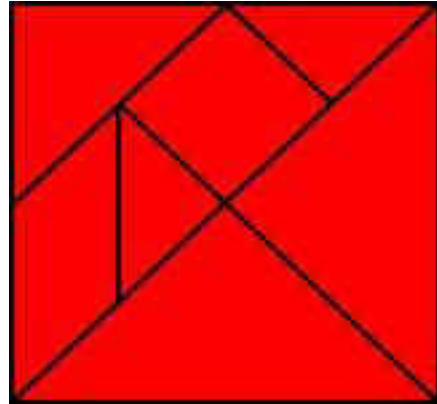
ruler



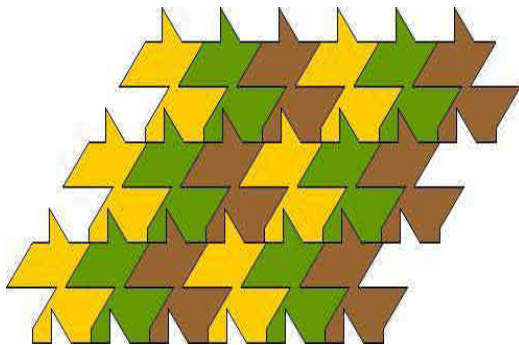
scale



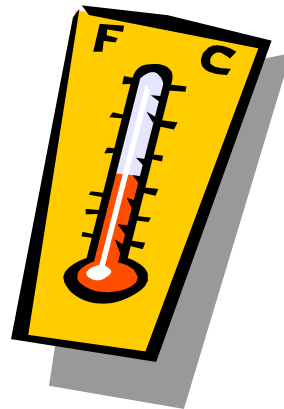
tanagram



tessellation



thermometer



## CHAPTER 5

### SUMMARY

The importance of an early mathematical knowledge and application is essential for potential and prospective mathematical competence. A mathematical Pictionary tool is an ideal primary introduction to reference books and supplemental mathematics resources. The alphabetical sequence of mathematical vocabulary aids children in locating words using the first letter of the word. Children will also learn how to interpret information from words, pictures, visualizations, and diagrams and see mathematical symbols used in context. The Pictionary is designed to foster children's natural curiosity about mathematics. Mathematics learning and new understanding builds from age-appropriate, engaging, and meaningful language through concrete, manipulated mathematical instruction. The Pictionary provides excellent support for varieties of mathematical tasks and develops a full range of vocabulary mandated by the Department of Education implemented by the Virginia Mathematics Standards of Learning. As educators, it is our responsibility to provide children with high-quality knowledge of mathematical language to ensure academic success in mathematics!



## WORKS CITED

- Ball, D.L. "Magical Hopes: Manipulatives and the Reform of Math Education." American Educator: The Professional Journal of the American Federation of Teachers (1992): 16.
- Brian R. Bryant, Kiane Pedrotty, Caroline Kethley, Sun A. Kim, Cathy Pool, You-Jin Seo. "Preventing Mathematics Difficulties in the Primary Grades." 28 February 2008. redOrbit. 30 June 2008 <<http://www.redorbit.com>>.
- Bruner, J. Toward a Theory of Instruction. Cambridge, MA: Harvard University Press, 1966.
- Fred Ventura, Ph.D. Clip-Art for Math Teachers. Ventura Educational Systems. Arroyo Grande, 2007.
- Kame'enui, E.J & D. Carnine. Effective Teaching Strategies That Accomodate Diverse Learners. Upper Saddle River, NJ: Simon & Schuster, 1998.
- Kay C. Wood, Harlan Smith, and Daurice Grossniklaus. "Piaget's Stages of Cognitive Development." Department of Educational Psychology and Instructional Technology. 8 June 2008 <[http://projects.coe.uga.edu/epltt/index.php?title=Piaget's\\_Stages](http://projects.coe.uga.edu/epltt/index.php?title=Piaget's_Stages)>.
- Kennedy, L.M. "Manipulatives: A rationale." Arithmetic Teacher (1986): 6-7.
- Koll, Hilary and Mills, Steve. Maths Dictionary. Chicago: Heinemann Educational Publishers, 1999.
- Kostelnik, Marjorie. "Academics in Early Childhood." Exchange: The Early Childhood Leaders' Magazine Since 1978 (2008): 57-61.
- Learning, Virginia Standards of. Virginia Department of Education. 30 June 2008 <<http://www.pen.k12.va.us>>.
- Learning, Virginia Standards of. Virginia Department of Education Instructional Services. 6

- October 2006. July 2008 <<http://www.pen.k12.va.us>>.
- Mathematics, National Council of Teachers of. Principles and Standards for School Mathematics. 2000-2004. 9 June 2008  
<<http://standards.nctm.org/document/chapter4/index.htm>>.
- Miller, D.L. "Making the Connection with Language." Arithmetic Teacher (1993): 311-316.
- Monroe, E.E. Math Dictionary: The Easy, Simple, Fun Guide to Help Math Phobics Become Math Lovers. Honesdale, PA: Boyds Mills Press, 2006.
- Morrison, George S. Early Childhood Education Today, 9th ed. Upper Saddle River, NJ: Pearson Education, Inc., 2004.
- National Council of Teachers of Mathematics (NCTM). Principles and Standards for School Mathematics. Reston, VA: National Council of Teachers of Mathematics, 2000.
- Office, Microsoft. Microsoft Office Clipart Online. 2008. October 2008  
<<http://office.microsoft.com/en-us/clipart/default.aspx>>.
- Patilla, Peter. Oxford First Maths Dictionary. Oxford New York: Oxford University Press, 2004.
- Piaget. "Funderstanding.com." July 2008 <<http://www.funderstanding.com/piaget/cfm>>.
- Pre-K Now. "Why All Children Benefit from Pre-K." 9 July 2008  
<<http://www.preknow.org/resource/abc/whyprek.cfm>>.
- Schell, V. J. "Learning Partners: Reading and Mathematics." The Reading Teacher (1982): 544-548.
- Tchoshanov, S. J. Pape & M.A. "The Role of Representation(s) in Developing Mathamtical Understanding." Theory Into Practice (2001): 118-127.
- Virginia, Commonwealth of. Mathematics Standards of Learning Enhanced Scope and

Sequence. 2004. July 2008 <<http://www.pen.k12.va.us>>.

## APPENDICES

### Appendix A

#### Virginia Standards of Learning Objectives (K-3)

##### Kindergarten

The kindergarten standards place 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 will investigate nonstandard measurement, collect data, and create graphs.

While learning mathematics, students will be actively engaged, using concrete materials and appropriate technologies such as calculators and computers. However, facility in the use of technology shall not be regarded as a substitute for a student's understanding of quantitative concepts and relationships or for proficiency in basic computations.

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. Students should be encouraged to use correctly the concepts, skills, symbols, and vocabulary identified in the following set of standards.

Problem solving has been integrated throughout the six content strands. The development of problem-solving skills should be a major goal of the mathematics program at every grade level. Instruction in the process of problem solving will need to be integrated early and continuously into each student's mathematics education. Students must be helped to develop a wide range of skills and strategies for solving a variety of problem types.

##### 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
- tell how many are in the set by counting the number of items orally;
  - select the corresponding numeral from a given set; and
  - 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, 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.

## Grade One

The first-grade standards place emphasis on counting, sorting, and comparing sets of up to 100 objects; recognizing and describing simple repeating and growing patterns; and drawing, sorting, and describing certain two-dimensional figures. Students' understanding of number is expanded through learning and applying the basic addition facts through the fives table and the corresponding subtraction facts; using nonstandard units to measure; and organizing and interpreting data. The idea of fractions is introduced.

While learning mathematics, students will be actively engaged, using concrete materials and appropriate technologies such as calculators and computers. However, facility in the use of technology shall not be regarded as a substitute for a student's understanding of quantitative concepts and relationships or for proficiency in basic computations.

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. Students should be encouraged to use correctly the concepts, skills, symbols, and vocabulary identified in the following set of standards.

Problem solving has been integrated throughout the six content strands. The development of problem-solving skills should be a major goal of the mathematics program at every grade level. Instruction in the process of problem solving will need to be integrated early and continuously into each student's mathematics education. Students must be helped to develop a wide range of skills and strategies for solving a variety of problem types.

### 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
- 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
  - 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
- identify the number of pennies equivalent to a nickel, a dime, and a quarter;
  - 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.

## Grade Two

The second-grade standards extend the study of number and spatial sense to include three-digit numbers and three-dimensional figures. Students will continue to learn, use, and gain proficiency in the basic addition facts through the nines table and the corresponding subtraction facts. Students will begin to use standard U.S. Customary and metric units of measurement; predict, using simple probability; and create and interpret picture and bar graphs. Students will work with a variety of patterns and will develop knowledge of equality by identifying missing numbers in addition and subtraction facts.

While learning mathematics, students will be actively engaged, using concrete materials and appropriate technologies such as calculators and computers. However, facility in the use of technology shall not be regarded as a substitute for a student's understanding of quantitative concepts and relationships or for proficiency in basic computations.

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. Students should be encouraged to use correctly the concepts, skills, symbols, and vocabulary identified in the following set of standards.

Problem solving has been integrated throughout the six content strands. The development of problem-solving skills should be a major goal of the mathematics program at every grade level. Instruction in the process of problem solving will need to be integrated early and continuously into each student's mathematics education. Students must be helped to develop a wide range of skills and strategies for solving a variety of problem types.

### 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
- 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;
  - count backward by tens from 100;
  - group objects by threes and fours; and
  - recognize even and odd numbers, using objects.

### **Computation and Estimation**

- 2.6 The student will recall basic addition facts — i.e., 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
- estimate the sum; and
  - 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
- estimate the difference; and
  - 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.,  $3 + \underline{\quad} = 7$ ,  $\underline{\quad} + 3 = 7$ ;  $7 - 3 = \underline{\quad}$ , and  $7 - \underline{\quad} = 3$ ).

### **Measurement**

- 2.11 The student will
- count and compare a collection of pennies, nickels, dimes, and quarters whose total value is \$2.00 or less; and
  - 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.
- 2.26 The student will solve problems by completing a numerical sentence involving the basic facts for addition and subtraction. Examples include:  $3 + \underline{\quad} = 7$ , or  $9 - \underline{\quad} = 2$ . Students will create story problems, using the numerical sentences.

## Grade Three

The third-grade standards place emphasis on learning multiplication and division facts through the nines table. Concrete materials and two-dimensional representations will be used to introduce addition and subtraction with fractions and decimals and the concept of probability as chance. Students will use standard units (U.S. Customary and metric) for temperature, length, liquid volume, and weight and identify relevant properties of shapes, line segments, and angles.

While learning mathematics, students will be actively engaged, using concrete materials and appropriate technologies such as calculators and computers. However, facility in the use of technology shall not be regarded as a substitute for a student's understanding of quantitative concepts and relationships or for proficiency in basic computations.

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. Students should be encouraged to use correctly the concepts, skills, symbols, and vocabulary identified in the following set of standards.

Problem solving has been integrated throughout the six content strands. The development of problem-solving skills should be a major goal of the mathematics program at every grade level. Instruction in the process of problem solving will need to be integrated early and continuously into each student's mathematics education. Students must be helped to develop a wide range of skills and strategies for solving a variety of problem types.

### 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  $8 - 3 = \underline{\quad}$ .
- 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
- collect and organize data on a given topic of his/her choice, using observations, measurements, surveys, or experiments; and
  - 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
- 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  $4 \cdot 3 = 2 \cdot 6$ .

## Appendix B

### Mathematics Curriculum / Instruction Survey and Results

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#### Mathematics Curriculum / Instruction Survey K-3 Teacher Survey

School: \_\_\_\_\_

Job Description:

\_\_\_\_\_ Kindergarten    \_\_\_\_\_ 1<sup>st</sup> Grade    \_\_\_\_\_ 2<sup>nd</sup> Grade    \_\_\_\_\_ 3<sup>rd</sup> Grade

1. Do you feel the students in your school / classrooms are proficient in mathematical vocabulary development?  
\_\_\_\_\_ Yes    \_\_\_\_\_ No
2. Does the mathematics textbook series used within your school / classroom meet your needs and align directly with the Virginia Mathematics Standards of Learning?  
\_\_\_\_\_ Yes    \_\_\_\_\_ No

If you chose no, please explain.

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3. Do you feel that students within your school / classroom have developed, discovered, and applied knowledge of the essential mathematical skills to be successful and proficient on the Virginia Mathematics Standards of Learning formal assessment?  
\_\_\_\_\_ Yes    \_\_\_\_\_ No
4. Would your K-3 students benefit from additional instructional material relating mathematical words to pictures of mathematical objects?  
\_\_\_\_\_ Yes    \_\_\_\_\_ No
5. Do you feel it would be beneficial for kindergarten students to begin using mathematics textbooks and visual aids to build a stronger mathematics vocabulary and essential knowledge foundation?  
\_\_\_\_\_ Yes    \_\_\_\_\_ No
6. Do the textbooks you currently use do a good job of giving illustrations and examples of mathematical vocabulary words?  
\_\_\_\_\_ Yes    \_\_\_\_\_ No

## **Mathematics Curriculum / Instruction Survey Results**

In support of my thesis research and defense, I distributed a survey to all kindergarten through grade three teachers in my school district, Russell County Public Schools. A total of 75 surveys were distributed, with 51 responses and 24 non-responses. The survey gathered data indicating textbooks used and teacher theories of student proficiency and success within mathematics. The survey indicated that kindergarten classes within the Russell County district implemented the *Big Math for Little Kids* curriculum, and grades one through three implemented a primary textbook series published by Harcourt Brace.

Teachers were also asked about success rate using the present mathematics curriculum and personal levels of comfort in teaching mathematics. The survey results indicated that many teachers feel inadequate and uncomfortable when providing mathematical instruction. Results indicated that teachers reflected weaknesses due to personal qualifications and/or instructional materials and lack of manipulatives provided within the school district. Many teachers reported supplementing the current mathematics curriculum with various additional materials other than those accompanying their classroom teaching kits.

Within Russell County Public School district, 51 kindergarten through grade three teachers participated in the Mathematics Curriculum / Instruction Survey. Fifty percent of those teachers who responded expressed concern that students were non-proficient in age-appropriate, mathematical vocabulary development. One hundred percent of responders conveyed confidence that kindergarten through grade three students would definitely benefit from additional instructional material relating mathematical words to pictures. One-hundred percent of teachers who responded also said it would be beneficial for Kindergarten students to begin using mathematics textbooks and visual aids to build a stronger mathematics vocabulary and

essential knowledge foundation. Teachers said that more pictures and illustrations would be an asset to the present mathematics curriculum.

## VITA

AMANDA COLLINS-BROWNING

- Personal Data:           Date of Birth: January 11, 1979
- Place of Birth: Bristol, Tennessee
- Marital Status: Married
- Education:                Russell County Public Schools, Russell County, Virginia
- Southwest Virginia Community College, Richlands,  
  Virginia; Arts and Sciences, General Studies,  
  A.A.S., 1999
- Virginia Intermont College, Bristol, Virginia;  
  Interdisciplinary Studies, B.A., 2002
- East Tennessee State University, Johnson City, Tennessee;  
  Mathematical Science, M.A., 2009
- Professional Experience: Standards of Learning Remediation, Cleveland Elementary  
  School; Cleveland, Virginia, Spring 2003
- Teacher, Copper Creek Elementary School; Castlewood,  
  Virginia, 2003-2009
- Honors and Awards:     Castlewood High School Graduate:
- The National Beta Club Membership Honor
- United States Achievement Academy Honor
- Southwest Virginia Community College Graduate:

Magna Cum Laude

PHI THETA KAPPA International Honor Society