HANDBOOK OF LESSONS AND ACTIVITIES TO SUPPLEMENT MATH SKILLS FOR PARENTS OF CHILDREN IN FIFTH GRADE

A Project
Presented to the
Faculty of
California State Polytechnic University, Pomona

In Partial Fulfillment
Of the Requirements for the Degree
Master of Arts
In
Education

By
Gina Lynn Davis
2018

SIGNATURE PAGE

PROJECT: HANDBOOK OF LESSONS AND ACTIVITIES TO SUPPLEMENT MATH SKILLS FOR PARENTS OF CHILDREN IN FIFTH GRADE

AUTHOR: Gina Lynn Davis

DATE SUBMITTED: Spring 2018

Education Department

Dr. Nancy Prince-Cohen
Project Committee Chair
Professor of Education and
Integrative Studies

Ms. Maureen Klauschie
M.A. Educational Psychology-MFCC
Counselor
Sierra Madre Middle School
Pasadena Unified School District

Mrs. Armine Manasarian
M.A. Education and Counseling
Lead Teacher
Sierra Madre Middle School
Pasadena Unified School District

ACKNOWLEDGEMENTS

First, I would like to thank Dr. Navarro, Dr. Pataray-Ching and the Graduate Studies Department for allowing me to continue my master's coursework.

I give my sincerest gratitude to my project advisor, Dr. Nancy Prince-Cohen. Without her help and encouragement, I would never had made it through this whole process. She was always there to answer my questions and guide me in the right direction. Dr. Prince-Cohen is by far an amazing advisor, and a phenomenal person. With her patience, support and guidance, she helped me achieve something that I have given up on so many times. Thank you, Mrs. NPC.

I would like to thank my husband Greg and our daughter Gwendolyn for being so patient and encouraging when I needed to be on my computer for hours and hours! You always take care of me.

I would like to acknowledge my work Lunch Peeps (Amy, Maureen, Kristine, Julie, Penny, Dan, Ravi & Patrick), who are some of the most supportive and amazing people I know! Thank you all for your kind and hilarious words that made this process easier. I would never had made it through this without you all!

Finally, I would like to dedicate this final project to my parents, Richard and Melinda Espinoza. My entire life I have always looked back at how loving, supportive, encouraging and understanding they've been. Their hard work, sacrifice and dedication to our family shines in all of us.

ABSTRACT

The purpose of this project was to develop a handbook for parents with fifth grade school age children to help support their math skills before entering the middle school level. Every activity in this handbook reinforces the California Common Core State Standards and provides learning and practice experiences. This project was designed based on research studies that indicated a positive correlation among parent involvement and student achievement.

TABLE OF CONTENTS

CHAPTER ONE

INTRODUCTION

Rationale

Purpose. The purpose of this project was to create a fifth-grade parent's handbook of summer enrichment activities for the improvement of basic math skills.

Need for the research. In 2013, states started adopting the Common Core State Standards (CCSS). These new math standards provided clarity and specificity, rather than broad, general statements. Studies of mathematics education in high-performing countries concluded that mathematics education in the United States must be more focused and coherent to improve mathematics achievement. The mathematics standards are designed to address the problem of a curriculum that was "a mile wide and an inch deep." (Common Core State Standards Initiative, 2018, para. 1). The Programme of International Student Assessment (PISA) concluded students in the United States ranked twenty-sixth out of the thirty-four participating countries, such as China, Singapore, Canada, Australia, and Japan. (Shivraj, 2017)

Acceleration, enrichment, and problem-based learning were common approaches to the learning process. Robinson, Shore, and Enersen (2014) discovered evidence that acceleration allowed students to cover the content more efficiently. An enriched or differentiated mathematics curriculum for elementary students resulted in higher test scores over students who received regular mathematics curriculum. (Robinson et al., 2007; Southern & Jones, 2014).

Acquisition of mathematical skills was crucial for today’s society. Digital or online games provided interesting possibilities to support and study mathematical development. Students learned mathematics when they played digital games but were also taught problem-solving, collaboration and critical thinking. According to Lewis and Smith, “higher order thinking consists of problem solving, critical thinking, creative thinking and decision making” (Kiili, Devlin and Multisilta, 2015).

There was evidence that home learning stimulation that included informal numeracy experiences promoted math-related learning in school. Research has examined parenting in relation to children’s math skills suggested that parents who engage in more frequent literacy and numeracy activities in their homes had children with better math skills in preschool and kindergarten (Baker, 2014).

Background. In 2015, thirty percent of fifth grade students met or exceeded state math standards. In 2016, thirty-three percent met or exceeded state math standards. In 2017, fifth grade students whom met or exceeded state math standards increased to thirty-four percent. These figures also indicated that sixty-six percent of fifth grade students were not performing at or above grade level (California Department of Education, 2016). In a report published in 2015 by the National Center for Education Statistics, seventy-five percent of twelfth-grade students performed below the proficient achievement level in mathematics.

Despite elementary student test scores increasing, teachers were not adequately prepared to teach the Common Core State Standards. Policymakers attempted to improve the quality of instruction in America’s classrooms. According to Coburn, Hill and

Spillane (2016), in the late 1980s, professional associations and state policymakers worked to articulate rigorous learning standards in core school subjects. If policies provided consistent instructional guidance for educators around rigorous learning standards, and aligned these standards to assessment, curriculum, and professional development, it would “contribute to improvement in classroom teaching and learning”. (Coburn, Hill and Spillane, 2016, p. 244).

Since the release of the Common Core State Standards, public perceptions of the CCSS and of policy makers and practitioners varied. By 2011, forty-five states and the District of Columbia adopted the CCSS. States needed at least two years to achieve full implementation of the standards. Reports discovered several implementation challenges: educator resistance, lack of aligned curriculum, time, funding, and difficulties in preparing special populations and orchestrating higher education transitions. (Smith and Thier, 2017).

Students who struggled early with mathematics, the probability that they became mathematically proficient was low. Research suggested that students who struggle to develop mathematical proficiency in the early grades were far more likely than other students to experience persistent difficulties in later mathematics. (Doabler et al., 2015). One factor with supporting all students in reaching their mathematical potential was the elementary mathematics curriculum. According to Wu (2009), “The main goal of the elementary mathematics curriculum is to provide children with a good foundation for mathematics”. (Wu, H. H, *American Educator*, 2009). A solid curriculum reflected the hierarchy of mathematics by forming a coherent connection between foundational concepts and skills within and across grade levels.

Methodology

The material in this handbook was based on peer-researched studies that focused on curriculum and best practices for enriching math skills for fifth grade students. The activities in this handbook were specific to the fifth-grade math standards.

Scope

Assumptions. The first assumption was that there was a relationship between the creation of education standards and policy and the academic performance of students. The second assumption was that there was a need for math enrichment between the elementary and middle school levels to help sustain math skills.

Limitations. This handbook was designed to strengthen the understanding of the fifth-grade common core standards, but not the standards of the previous grade levels. Time for parent work schedules, extracurricular activities and family vacations were not taken into account with the completion of this handbook.

Delimitations. The research for this handbook was limited to the years of 2015 to 2018. The research was limited to hands-on, engaging, light-hearted activities to keep the interest of the parent and student.

The handbook was designed to supplement existing knowledge of math standards and curriculum taught in a general education classroom.

CHAPTER TWO

REVIEW OF LITERATURE

Introduction

This chapter will use peer reviewed literature to discuss the importance of the Common Core State Standards, the need for math enrichment between the fifth and sixth grades, and the different learning modalities students use to demonstrate competence.

Other topics discussed include how parent involvement is linked to a child's academic achievement and best practices that promote mathematics at home. This chapter also includes a discussion of the specific format selected to create the parent handbook included in this project.

Common Core State Standards. To provide students with a rigorous, high-quality mathematics program, the State of California adopted the Common Core State Standards for Mathematics. The standards were adopted in August 2010 by the California State Board of Education, with full implementation by the 2014-2015 school year. The state's goal was to produce students who were able to compete successfully in the worldwide economy (California Department of Education, 1997). For the first time in the United States history, a set of standards were established that is going to be taught in almost every state: 44 states have already adopted these standards as of 2012 (Dacey and Polly, 2012). One of the main goals of the Common Core was to bring schools across the country to the same level of rigor and hold them accountable for the same set of standards. Carmichael (2012) and his associates evaluated each state's current set of standards for mathematics and concluded that at least 38 states had standards that were “clearly inferior” to the Common Core State Standards. The eight standards for mathematical practice that are the foundation of the Common Core (California Department of Education, 2010) were:

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

These standards focused more on the justification of solutions and the problems having more of a real-world approach to them than the previous standards. Students needed to explain and justify their solutions, along with critiquing other possibilities. The goal of the current standards was to hold students accountable at a math proficiency level that would give them more options in their future. According to Dessoff (2012), the new testing system, Smarter Balanced Assessment Consortium (SBAC) would assess students with extensive problem-solving and performance tasks where they would show their reasoning process.

Past Research

California's Mathematics Performance. California's mathematical performance on international assessments impacted the United States standing amongst other nations. Results from the 2015 Program for International Student Assessment (PISA) mathematics literacy scale assessment ranked 15-year old students from the United States 40th out of 70 participating countries, where only 6 percent scored at proficiency level, and 29 percent scored below proficiency level (Kastberg, 2016). Students from the United States were comparable to those in Hungary, Israel, Croatia and Argentina. Among the 52 states and territories, California's 4th grade students were at the 29 percent proficiency level, ten percentage points less than the national average, according to the National Assessment of Educational Progress (NAEP). In 8th grade, 27 percent performed at proficiency level, five percentage points less than the national average. (Bandeira de Mello, 2015).

Teacher Mathematics Knowledge. The basic math competencies of teacher candidates received much attention in the last two decades. Math content knowledge refers "to the basic math knowledge possessed by individuals considered to be mathematically literate" (Reid 2017, p. 853). Researchers emphasized "that content knowledge in math is an important construct that can either support or hinder progress toward exemplary classroom instruction" (Philipp et al., 2007, Thames & Ball, 2010, p. 853). Ball, Thames, and Phelps (2008) suggested that the absence of improved math instruction was resultant from teachers' lack of content knowledge within this subject area. "Teachers who do not themselves know a subject well are not likely to have the knowledge they need to help students learn this content" (Reid and Reid, 2017, para. 5).

Teachers required extensive knowledge of mathematics to be effective in their teaching to promote classroom discourse and foster conceptual understandings of mathematics (Hill, 2010, p. 516). Researchers aimed to define the exact mathematical knowledge needed for teaching, and several researchers (Ball and Forzani 2010; Ball, 2008; Hill 2010) have emphasized a specialized content knowledge characterized as "mathematical knowledge needed to perform the recurrent tasks of teaching mathematics to students" (Ball et al. 2008, p. 399). According to Hill, Thames and Ball (2010), the specialized content knowledge for teaching mathematics combined Shulman's (1986) conceptualizations of subject matter knowledge and pedagogical content knowledge, and includes teachers' abilities to: (a) analyze and interpret students' mathematical thinking and ideas, (b) use multiple representations of mathematical concepts, and (c) define terms in mathematically correct and accessible ways (Swars, Smith, S. Z., Smith, M. E., Carothers and Myers, 2016, para. 9).

In a study on teacher knowledge and beliefs about mathematics, Swars et al. (2016) found that,

> the participants spoke of how being required to engage in worthwhile mathematical tasks themselves increased their own knowledge of elementary mathematics content and how to use worthwhile tasks in their classroom practice across elementary grade levels and consistent with expectations of the mathematic standards. (Swars et al. 2016, p. 142)

Mathematics Writing and Vocabulary. Communication was an essential part of mathematics, and for this reason, students needed to be provided with instruction on using writing to express mathematical ideas (National Council of Teachers of Mathematics [NCTM], 2000, p. 60). Not only is writing highlighted by the NCTM (e.g., “use the language of mathematics to express mathematical ideas,” p. 63), mathematics writing is also emphasized within the Common Core State Standards. These standards stated that students should be able to communicate precisely to others, construct viable arguments, critique the mathematics reasoning of others, explain how to solve problems, and use clear definitions and vocabulary (Hebert and Powell, 2016, p. 1512).

A study by Hebert and Powell (2016, p. 1512), examined the significance of the two mathematical content areas featured within the mathematics-writing tasks: word problems and fractions. They presented methods for the measurement of writing quality, with an emphasis of mathematics-writing quality. They discussed the importance of written organization and how mathematics vocabulary and representations were important for mathematics writing. Word problems were the primary method for assessment of mathematics in the late elementary grades. Word-problem solving involved several components, including reading of the problem, planning for solution, setting up for solution, and conducting appropriate computations (Fuchs et al., 2010; Hegarty, Mayer, & Monk, 1995; Jitendra et al., 2013; Parmar, Cawley, & Frazita, 1996).

Hebert and Powell (2016) concluded that several other educators provided suggestions about mathematics writing. Ediger (2006) stated that mathematics writing must have a purpose. McCarthy (2008) suggested teachers use a graphic organizer. Burns (2004) provided strategies such as asking students to brainstorm and share ideas before writing, providing prompts for mathematics writing, and discussing important vocabulary (Hebert and Powell, 2016, p. 1514).

Hebert and Powell (2016) referred to mathematics vocabulary as, “written words that express mathematical concepts or procedures, and mathematics vocabulary is necessary for demonstration of mathematics proficiency” (p. 1515). Monroe and Panchyshyn (1995) described mathematical vocabulary as a component of one of four categories: (1) Vocabulary can be technical with one meaning only applicable in mathematics. (2) Vocabulary can be sub-technical with multiple meanings that vary across content areas or within mathematics (e.g., *degrees* of an angle versus *degrees* of temperature). (3) Mathematics vocabulary can be general vocabulary used in everyday language or reading (e.g., *shade* or *find*). (4) Vocabulary may also be symbolic, meaning it is represented using numerals or symbols (e.g., *$* or *three*). Other research teams used Monroe and Panchyshyn’s mathematics vocabulary categories for organizing types of mathematics vocabulary (Powell & Driver, 2015, Harmon, Hedrick, & Wood, 2005, Pierce & Fontaine, 2009, p. 1515).

At the university level, there is more emphasis on mathematics writing and vocabulary. Stonewater (2002) asked students in calculus classes to write about mathematics. Stonewater determined that higher scoring writers used mathematical vocabulary and appropriate notation and symbols, whereas lower scoring mathematics writers made irrelevant comments about mathematics and used mathematical notation incorrectly. According to Hebert and Powell (2016, p. 1515), there was not enough research on how elementary students used mathematics vocabulary terms in writing. Literature related to mathematics vocabulary at the elementary level was not evidence-based and was merely suggestions for approaches to teaching mathematics vocabulary. Suggestions were based on acquisition strategies taught in reading. In one study, Monroe and Pendergrass (1997) stated that students who learned mathematics vocabulary using graphic organizers, rather than only definitions, understood mathematics vocabulary better at posttest (Hebert and Powell, 2016, p. 1515).

In a summary of mathematics vocabulary presented in the glossaries of three mathematics curricula from kindergarten through eighth grade, Powell (2016) identified over 800 distinct mathematics vocabulary terms. Each term identified as falling into one or more of Monroe and Panchyshyn's (1995) categories of mathematics vocabulary (i.e., technical, sub-technical, general, or symbolic). Assuming that "students were responsible for knowing and understanding the meaning of hundreds of mathematics vocabulary terms, and because it is necessary for students to understand mathematics vocabulary in order to demonstrate competency in mathematics" (Schleppegrell, 2007, p. 1516), Hebert and Powell wanted to learn how students wrote *with* mathematics vocabulary with a focus *on* mathematics vocabulary used *in* mathematics writing (p. 1516).

Results from Hebert and Powell's study stated that the type of mathematics vocabulary, frequency of use, and accuracy of use, may inform future intervention development related to mathematics writing. "Future research about mathematics-writing assessment and how to provide effective instruction on mathematics writing may need to provide explicit instruction on the meaning and use of mathematics vocabulary terms, especially those terms necessary for explanations and elaboration" (Hebert and Powell, 2016, p. 1531). Teaching students to use numerator, denominator, and equal parts for mathematics writing about fractions and regroup, add, subtract, and multiply for mathematics writing about computation will lead to mathematics accuracy in writing, computation and application (Hebert and Powell, 2016, p. 1516).

Math language and vocabulary. Early language and vocabulary skills were learned through verbal interactions, and when children enter elementary school, substantial differences in vocabulary acquisition and language comprehension were apparent (Beck, McKeown, & Kucan, 2013; Hart & Risley, 1999). Knowledge of distinct mathematics language, such as quantity and spatial words, influenced early numeracy development (Purpura, Hume, Sims, & Lonigan, 2011; Toll & Van Luit, 2014). “These early numeracy skills were more predictive of later academic outcomes in both mathematics and reading than attention-related, behavioral, social, and early reading skills” (Forsyth, 2017, para. 3).

As students’ progress through elementary school, linguistic skills were related to the ability to master a variety of mathematics skills, including numeration, calculation, geometry, measurement, number line concepts, and magnitude comparison (Krajewski & Schneider, 2009; LeFevre et al., 2010). At the third-grade level, Vukovic and Lesaux (2013) determined that phonological skills and general language abilities were strongly associated to calculation and word-problem skills than working memory and visuospatial processing. By late elementary school, oral language skills also impacted fraction competence (Chow & Jacobs, 2016; Seethaler, Fuchs, Star, & Bryant, 2011).

Mastering mathematical vocabulary was compared to learning a second language (Wakefield, 2000). Conceptual meaning in mathematics was constructed using several systems of communication: symbolic notation, visual representations, and oral and written language (Schleppegrell, 2007). The symbolic notation required knowledge about written numbers, symbols, and their placement (Monroe & Panchyshyn, 1995). For example, the number “4” has different meanings in each of these expressions: (a) 492, (b) 1,004, (c) ¾, and (d) 3^4. Operations were written in several forms, such as the following for multiplication: 5 × 3, 5 * 3, (5)(3), and 5 • 3. Visual representations of information included graphs, data tables, geometric figures, and various models and diagrams (Schleppegrell, 2007).

Rubenstein and Thompson (2002, para. 7) noted 11 categories of difficulty that students encountered when learning mathematics vocabulary:

1. Certain common English terms have alternate meanings when used in mathematics, such as *expression*, *volume*, *face*, and *foot*
2. Certain terms have similar but more precise meanings in mathematics, such as *average, difference, similar*, and *area.*
3. Certain vocabulary terms used in mathematics are technical terms specific to mathematics, such as *parallelogram*, *quotient*, *exponent*, and *integer*.
4. Certain mathematical terms have more than one mathematical meaning, as in *round* circle versus *round* to the nearest one hundred, *degrees* of temperature versus *degrees* of an angle, and a *square* shape versus *square* a number.
5. Certain technical words may have discipline-specific meanings, such as a *variable* in an algebraic expression versus *variable* weather conditions in science.
6. Certain terms are homophones of everyday words, such as *sum* versus *some* and *pi* versus *pie.*

7. Certain terms have discrete differences in meanings, but are often confused, such as *divisor* and *dividend*, and *factor* and *multiple*.
8. Translations from Spanish (or other languages) may be confusing—for instance, the Spanish word *mesa* can be translated to the *table* we eat from, but not a data *table* (this would be *tabla*).
9. English spelling can be confusing, as in using the "u" to spell *four* and *fourteen*, but not *forty*.
10. Certain concepts can be verbalized in several ways, such as *one-quarter* and *one-fourth*.
11. Sometimes informal language is used in the classroom—for example, *diamond* for *rhombus*, and *corner* for *vertex*.

Teachers of mathematics failed to properly acknowledge the difficulty of mathematics language and vocabulary needs (Raiker, 2002; Riccomini, Smith, Hughes, & Fries, 2015; Schleppegrell, 2007). Mathematics vocabulary presented a greater challenge for students than general vocabulary because of the various difficulties described by Rubenstein and Thompson (2002). It was difficult to develop proficiency in mathematics vocabulary because there were fewer opportunities for exposure to these terms outside of the mathematics classroom (Monroe & Panchyshyn, 1995).

A report by Forsyth and Powell (2017), studied how students with mathematics difficulty (without reading difficulty), reading difficulty (without mathematics difficulty), combined mathematics and reading difficulty, and grade level students performed on a measure of mathematics-vocabulary terms. This measure included mathematics vocabulary terms frequently encountered on assessments throughout the elementary grades. They examined which specific mathematics terms were most understood by fifth-grade students overall, and which terms were universally difficult. Most of the 14 terms with an accuracy rate of higher than 80 percent were terms included in textbook glossaries from kindergarten. Ten terms first appeared in kindergarten, two terms in second grade (*odd* and *even*), and two terms in third grade (*parallel* and *perpendicular*/*intersecting lines*). None of the terms featured in glossaries at fourth grade or later had an overall accuracy rate of over 75 percent. These results demonstrated that the level of familiarity with mathematics vocabulary terms strengthened over time with use and multiple exposures. All students demonstrated difficulty with terms when prompted to generate a definition with words, or to produce a vocabulary term when a verbal description was provided. The results of this study indicated a need for a strong focus on vocabulary in the mathematics classroom for all students (Forsyth and Powell, 2017).

Learning Styles and Modalities. According to Martens, P., Martens, R., Doyle, Loomis, and Aghalarov (2013), people needed to communicate with others using various modes of communication. These modes were linguistic (e.g., language), visual (e.g., art, moving images), auditory (e.g., sound, music), gestural (e.g., movement, dance), and spatial (e.g., layout, design) (Anstey & Bull, 2006; Kress & Jewitt, 2008, p. 286). “We communicate by talking, writing, drawing, playing music, using gestures, in spatial and cultural contexts to share meanings with others. The meanings we created in different modes (e.g., texts we write, pictures we draw, movements we make) were signs that communicated our messages” (Martens et al., 2013, para. 6).

Researchers have confirmed the effects of learning style on learning performance (Balakrishnan & Gan, 2016; Felder & Henriques, 1995). The concept of learning style originated from the cognitive styles in psychology, which identified the distinctions of individual cognitive features. (González, Mendoza-González, Rodriguez-Martinez, & Rodríguez-Díaz, 2016). To achieve better learning effectiveness, scholars concluded that, "teachers should not assume that all students have an identical way of learning but should prepare adaptive instruction to fit the different preferences or demands of their students" (Hsu, 2016, para. 11).

Math students used their own methods of obtaining information and processing it (Ozerem & Akkoyunlu, 2015). Some students focused on data and operations, while others were better at theories and mathematical models. For others, written and verbal explanations were more effective, and for some, it was visual elements like drawings, shapes, and graphics. Certain learners preferred interactive environments, while others preferred working individually. "These distinctions in learning preferences were signs of their different learning styles" (Felder, 1996, p. 63). There were many definitions of learning styles in the research. Shuell (1986) explained that learning styles were the different ways used by individuals to process and organize information or to respond to environmental stimuli. Jensen (1998) defined learning style as a way of thinking, comprehending, and processing information. Keefe and Ferrell (1990) underlined learning style as the pattern of cognitive, emotional, and physiological characteristics affected partially by individuals' way of perceiving, interacting with, and reacting to learning environments. According to Dunn and Dunn (1993), learning style is a path that may vary from one person to another, which starts with concentration and continues when information is received and located in the mind. Jensen (1998) defined learning style as a way of thinking, understanding, and processing data. Wyman (2006) defined learning styles as an individual’s different way of receiving and processing information. “If an individual knows his or her learning style, he or she can upgrade his or her learning level to the maximum, which can result in lifelong learning success” (Wyman, 2006, p. 63). He divided learning styles into three categories: audio, visual, and kinesthetic. According to Wyman, if a student’s learning style was identified and arrangements were made, the student’s success would be enhanced (Ozerem & Akkoyunlu 2015, para. 10).

Harte and Law (2017) found that VARK (Visual, Aural, Read/write, Kinesthetic) was a validated acronym used in education to identify a student's learning style. VARK described visual learners as those who benefited from graphs and illustrations. They drew images and flowcharts to help understand and retain information. Aural learners gained more from listening to the words of the teacher, and the read/write learners gained from reading text. Kinesthetic learners benefited from “hands-on” experiences (para. 2). According to Taljaard (2016), VARK related to how we acquired new knowledge and does not involve intelligence. The VARK model allowed for all individual learners to attain knowledge in an interesting and gratifying environment that accommodated their preferred learning style. VARK resulted in the development of various multi-sensory learning strategies, although multi-sensory strategies and techniques were cultivated and have been refined over many years (Taljaard, 2016, p. 47).

Colak (2015) suggested that the central focus of ideology of learning styles was that different individuals exhibit different ways of learning, and that effective learning was achieved when the instructional process was consistent with these styles. Learning styles varied according to an individual’s personality, the approaches that he or she uses to process information, and/or his or her preference regarding social interactions (p. 19). According to Grasha (1990), whom conducted studies on the classification of learning styles, described six different learning styles: competitive, cooperative, avoidant, participative, dependent, and independent. In his study, Grasha (2002) found students who showed a competitive learning style engaged in learning mostly to perform better than other students in their class. Students with a cooperative learning style believed they learned by sharing their opinions and skills with other students. Students with an avoidant learning style were disinterested in the topics taught and showed unwillingness to participate in any class or learning activity. Students demonstrated a participative learning style, by contrast, enjoyed taking part in class and learning activities. Finally, students with a dependent learning style displayed very little interest towards the class and worked only to meet minimum requirements, while students with an independent learning style were confident in their skills and preferred to learn information that they considered important (Colak, 2015, p. 19).

The literature in the research of learning styles proposed that the process of learning is facilitated when the instructional methods match the learner’s style aptitude. Gokalp (2013) defined a learning style as the characteristics, strengths and preferences in the way people receive and process information (para. 2). He suggested that every person has his or her own method or set of strategies when learning. An awareness of differences in student learning styles was important for educators to recognize with aiding in the learning process. Effective instruction connected to all students, not just those with a specific learning style. Students taught entirely with methods contrary to their learning style, may be uncomfortable to learn effectively, but it was beneficial to have at least some exposure to other methods to develop a full range of learning skills and strategies (para. 14).

Most people extracted and retained more information from visual presentations than from written or spoken prose. Gokalp (2013) explained that students learned content better through their preferred learning style, although teachers tend to teach in their own preferred learning style. Learning style also included how students approached learning, experienced learning and utilizing the information (para. 16).

Verbal and Visual-Spatial Learning and Mathematics. The importance of the visual-spatial learning style for mathematics performance and attainment varied with age, the context of the material, and the specific math domain (Van de Weijer-Bergsma, Kroesbergen, & Van Luit, 2015). Van de Weijer-Bergsma et al. (2015) studied the correlations between verbal and visual-spatial working memory and elementary students' performances in four math domains (i.e., addition, subtraction, multiplication, and division) (p. 367). They found that the strength of the relationship between different working memory modalities and mathematics performance varied due to the type of mathematics domain used, and the strategies and mental models used to demonstrate the students' abilities. Although solving mathematical problems elicited visual-spatial and verbal representations and strategies, both visual-spatial and verbal working memory components were involved in learning mathematics (p. 368).

One study indicated that the relationship between working memory and mathematics changed with age (Van der Ven, Van der Maas, Straatemeier & Jansen, 2013). The results from this study suggested that during preschool, elementary school, and adolescence, younger children relied more on visual-spatial working memory when learning and applying new mathematical skills, whereas older children relied more on verbal working memory after skills were learned (p. 368).

Van der Ven et al. (2013) gave reasons for the decrease in the relationship between visual-spatial working memory and math performance for older students. First, according to the developmental explanation, “younger children rely more on visual-spatial representations (e.g., number lines) and use more visual-spatial strategies (e.g., finger counting)” (p. 368) As children grew older, and associations between math problems and their answers became verbally memorized, they relied on more verbal strategies and representations (DeSmedt, Jannsen, Bouwens, Verschaffel, Boets & Ghesquiere, 2009; Holmes & Adams, 2006). Second, the novelty explanation suggested the shift from visual-spatial to verbal strategies was caused by the novelty of the material. This explanation theorized that children of any age, as well as adults, relied on visual-spatial working memory when presented with novel and challenging math problems (Tronsky, 2005). Third, the math domain specificity explanation predicted the relationship between math and visual-spatial working memory differed between math domains. According to Van der Ven et al. (2013), addition and subtraction problems were performed by manipulation or visualization of the manipulation, while multiplication and division problems were solved by remembering verbally memorized facts (p. 368). Addition and subtraction problems showed the strongest relationship with visual-spatial working memory. The relationship with multiplication and division problems was smaller, giving support to the math domain specificity explanation. Visual-spatial working memory is not a significant predictor of addition, subtraction, and multiplication retention in 5th grade, or of division in 6th grade (p. 375).

Van der Ven et al. (2013) showed that "as grade level progressed, the predictive value of visual-spatial working memory for individual differences in level of mathematics performance waned, while the predictive value of verbal working memory increased" (p. 367).

Auditory Learning and Mathematics. There was not an extensive amount of literature regarding auditory learning associated with mathematics. Most of the literature involved auditory learning due to visual impairment.

Rahman and Amhar (2017) defined auditory learning as "a learning style in which people learn better when they hear what they are learning" (p. 75). They suggested that those who had an auditory learning style were known to have behavioral characteristics such as talking to themselves, easily distracted by a commotion, moved their lips and read out loud when reading, volunteered in class to read aloud and listen, repeated back and mimicked a tone and rhythm, found it difficult to write, but excellent at storytelling and spoke in a patterned rhythm. "When learning about a new math concept, for example, an auditory learner will remember the information if he or she can listen to the teacher explain it or sing it and then answer questions about it." (p. 75).

A study was done on a learning-style-based computer program by Ozyurt, O., Ozyurt, H., Baki & Guven, (2013). In their study, learning objects were prepared in three different ways in relation to visual, auditory and kinesthetic learning styles for each math domain. These learning objectives were appropriate for secondary school mathematics curriculum. Interviews of students in their study supported their results. Students were asked about the influence of being lectured (auditory style), different from their learning styles, and its effect on their learning. Several students expressed that this inhibited their learning. Students stated in relation to the issue,

> “*My learning style is kinesthetic, I learn through practicing.*
>
> *I was incapable of learning aurally. While listening to the conversations,*
>
> *I am losing myself in thoughts. I am a million miles away and it gets more*
>
> *difficult for me to learn*.” Another student stated, “*I must see and feel what*
>
> *I do to learn the subject (another student with kinesthetic learning style).*
>
> *Thus, I would not understand via hearing. For example, I must draw the*
>
> *triangle for trigonometry; I must feel even if I do not see*.” (p. 737).

According to Ren (2013), research claimed that the traditional schooling favored visual learners, but not auditory learners (Smith; 1964; Dunn & Griggs, 1998; Church, 2004). Learning-style researchers suggested that the traditional educational system favored visual learners, because many educators had visual preferences of their own (Haggart, 2003). Tests were generally in a written format, which were attainable for students with a visual learning style. Therefore, visual learners won the “game of school”, (Ren, 2013, p. 25.) “Kinesthetic and auditory learners were more likely to underachieve in school because they had limited opportunities to use their style strengths in the classroom” (Ren, 2013, p. 25).

Kinesthetic Learning and Mathematics. Math skills were crucial to functioning in today's world (Burns & Hamm, 2011; Carbonneau, Marley, & Selig, 2013). "These skills were not just important in school mathematical classes; they were important in our daily lives" (Liggett, 2017, p. 87) Golafshani (2013) stated, "There is no doubt that everyone believes that mathematics is important, however, many students have poor math skills, which indicates that changes are needed in the methodology of teaching mathematics" (p. 140).

The term kinesthetic learning referred to the ability to learn with physical activity instead of listening or watching. "This kind of learning was mainly used in the basic level of education such as kindergarten and early elementary students, when playing several games, learning about nature, time and space and in some cases, mathematics" (Ayala, Mendivil, Salinas, & Rios, 2013, p. 132). According to Okkonen, Sharma, Raisamo, and Turune (2016), studies showed that kinesthetic learning applications allowed restless students to be able to concentrate for longer durations (Sarver, Rapport, Kofler, Raiker, & Friedman, 2015) and retained the learned material longer (Chao, Huang, Fang, & Chen, 2013). Several interdisciplinary studies claimed that abstract mathematical concepts were rooted in our bodily experiences (Roth & Thom, 2009). Children learned to count by using their fingers and to understand quantities, such as one hand had five fingers without necessarily counting again to confirm (Moeller, Fischer, Link, Wasner, Huber, Cress, & Nuerk, 2012). "This created opportunities for combining the benefits of bodily interaction with learning of abstract mathematical content and provided an immersive and engaging learning environment, while still creating a state of flow" (Okkonen et al, p. 3).

Golafshani (2013) found that there was a growing consensus around the use of manipulatives in instructional practices. The goal of any math instruction was to focus on helping students understand concepts. “The use of manipulatives allowed students to see mathematics as integration by relating procedures used in one question to procedures used in an equivalent question” (Liggett, 2017, p. 88).

According to Uribe-Flórez, & Wilkins (2017), research showed the effectiveness of manipulative use on student mathematics learning. “In order for students to learn mathematics with understanding, it is important for them to have opportunities to be active participants in their learning” (National Council of Teachers of Mathematics (NCTM), 2000). Teachers provided students with opportunities to be engaged with the mathematics, options to solve problems, justify their thinking, critique other’s arguments when solving problems, and make sense of quantities and connect them to real-life situations (Council of Chief State School Officers (CCSSO), 2010; NCTM, 2000).

Tangible objects such as mathematical manipulatives were tools that helped students to understand mathematical concepts (Hiebert, Carpenter, Fennema, Fuson, Wearne, Murray & Human, 1997). Manipulatives were defined as objects that can be touched, moved about, and rearranged or stacked (Clement, 2004; Hynes, 1986; Kennedy, 1986). Manipulatives provided opportunities for enactive, iconic, and symbolic modes of representation (Bruner, 1966). With careful instruction, students were involved in active learning when using manipulatives. According to Uribe-Flórez, & Wilkins (2017, para. 3), they provided students with opportunities to visualize and maneuver abstract mathematical concepts in concrete ways. Additionally, manipulatives provided students a mechanism to further connect their concrete understandings to the symbolic language of mathematics. “It is important for learners to have the opportunity to interact with manipulatives for an extensive period to be able to use these tools in an effective way” (Dean & Kuhn, 2007) (para. 3).

According to Liggett (2017), educators understood that manipulative materials were designed to help students at all ages and learning levels. Research conducted by Driscoll (1983) found that results at every grade level supported the importance of manipulative activity lessons. Driscoll (1983) argued that “manipulatives have a place in the intermediate grades both in developing new mathematical concepts and skills and in providing remedial help to students who may be struggling” (p. 91). The use of manipulatives in teaching mathematics had developed over time. Golfashani (2013) noted that “teaching mathematics has moved from using beans or counters to linking cubes, fractions circles and other technologies” (p. 91). Johnson (1993) stated, “With the increased use of manipulatives, a new attitude is evolving towards mathematics” (p. 91). Mathematics was no longer a set of concrete rules to follow but rather a way of thinking. Research conducted by Moyer (2001) indicated that “teachers play an important role in creating mathematical environments that provide students with representatives that enhance their thinking” (p. 91). Vinson (2001) stated, “using appropriate and concrete instruction materials is necessary to ensure that children understand mathematical concepts” (p. 91). Swan and Marshall (2010) conducted research on the use of manipulatives in schools. They looked at different ways in teaching mathematics and the subsequent learning with the use of manipulatives. Swan and Marshall (2010) found that “there were gains by using mathematics manipulative materials where appropriate and employed in a systematic manner” (p. 91).

Technology and Mathematics. Technology was an important element of mathematics teaching and learning (National Council of Teachers of Mathematics 2000), with a range of tools offering access to digital representations of mathematical content (Tucker, Moyer-Packenham, Westenskow & Jordan, 2016, para. 1). Human cognition was grounded in perception of and interaction with the physical (and/or virtual) environment (Alibali and Nathan 2012). Therefore, to learn mathematics, children interacted with representations of mathematics in the physical (and virtual) surroundings. These interactions were evidence of mathematical thinking, and changes in these interactions were evidence of mathematical learning (Nemirovsky et al. 2013). The physical environment afforded possibilities for interacting with representations of mathematics. However, children interacted with representations of mathematics in many ways, which lead to an array of outcomes. According to Tucker et al. (2016), based on Gibson's work (1986), Greeno (1994) defined an affordance as something that "relates attributes of something in the environment to an interactive activity by an agent who has some ability based on its own attributes, which are characteristics of the environment or agent" (p. 342). Tucker et al. (2016) defined affordance as relationships that contributed to children's interactions with mathematics while using technology, and therefore were important to consider, for those who worked with mathematics education technology (p. 342).

Virtual manipulatives (VM) were "an interactive, visual representation of a dynamic object that presented opportunities for constructing mathematical knowledge" (Moyer, Balyard & Spikell, 2002, p. 373). The effectiveness of virtual manipulatives was well established, with a "meta-analysis of studies comparing virtual manipulatives with other instructional treatments yielding a moderate effect in favor of virtual manipulatives" (Moyer-Packenham and Westenskow, 2013, p. 343). Instruction with virtual manipulatives contributed to the comparison of achievement across demographic groups (Moyer-Packenham et al. 2014). However, interaction modality influenced achievement results, as long-term interaction with touchscreen virtual manipulatives were more effective than long-term interaction with mouse-controlled virtual manipulatives (Paek 2012). According to Tucker et al. (2016) researchers found that children adjusted their external representations of mathematical content by refining their input gestures when interacting with touchscreen virtual manipulatives (Barendregt et al. 2012; Ladel & Kortenkamp 2012). Research suggested that interactions with multi-touch virtual manipulatives had potential to support development of specific mathematical skills and strategies (Baccaglini, F. & M., 2015). These interactions influenced children's performance and efficiency on mathematics tasks differently across grade levels and content areas (Moyer-Packenham et al. 2015), and student characteristics influenced access to features of virtual manipulatives (Moyer-Packenham & Suh 2012).

In their analysis of affordance using virtual manipulatives, Moyer-Packenham and Westenskow (2013) identified five categories that contribute to learning mathematics:

1.) *focused constraint* (i.e., VMs focused and constrained student attention on mathematical objects and processes),

2.) *creative variation* (i.e., VMs encouraged creativity and increased the variety of students' solutions),

3.) *simultaneous linking* (i.e., VMs simultaneously linked representations with each other and with students' actions),

> *4.)* *efficient precision* (i.e., VMs contained precise representations allowing accurate and efficient use),
>
> *5.)* *motivation* (i.e., VMs motivated students to persist at mathematical tasks). (p. 343)

These affordances related to scaffolding, which involved control of task components that may be too difficult for a learner (Wood et al. 1976). Technology tools used scaffolding for various purposes (Quintana et al. 2004) and changed scaffolding as children master instructional objectives (Murray and Arroyo 2002). “Children may ignore scaffolding offered by virtual manipulatives as task proficiency increases, such as decreasing use of audio feedback” (Paek 2012, p. 343). Research on virtual manipulatives also suggested links between scaffolding and affordance categories such as simultaneous linking (McLeod et al. 2012) and focused constraint (Tucker, 2015).

Research focused on affordances of touchscreen virtual manipulatives. Tucker et al. (2016) concluded that children’s affordance access varied depending on their ability. For example, when interacting with Motion Math: Zoom (an interactive program that emphasizes place value using a number line), “efficient precision was evident when children with greater technological proficiency chose specific places to use the app’s features to zoom in within a given range” (p. 343). Affordance access varied by approach and degree, changed over time, and lead to different outcomes (Tucker et al., 2016). This research suggested that virtual manipulative touchscreen tablet apps offered an array of affordances that influenced learning, and that children accessed these affordances in different ways (Tucker et al., 2016, p. 343).

Parent Involvement and Mathematics. Children's math anxiety was a critical factor affecting their mathematics performance and achievement (Soni & Kumari, 2017). A student's confidence to learn and perform in math was affected by negative feelings associated with math anxiety (Bekdemir, 2010; Ho et al., 2000; Ma,1999). In addition, negative emotions were initiated while performing mathematical tasks due to mathematics anxiety (Sparks, 2011). Woodard (2004) observed a negative relationship between math anxiety and math achievement. According to Zakaria and Nordin (2008), students who were high in math anxiety scored low in mathematics achievement compared with students who had moderate or low math anxiety (p. 332).

Children's attitude toward mathematics affected their perception of their own mathematical competence (Soni & Kumari, 2017). There was a strong and significant relationship between mathematics attitude and mathematics achievement (Ma & Kishor, 1997; Schenkel, 2009). A positive attitude toward mathematics lead to a more efficient math performance (Schreiber, 2002). Mohd, Mahmood, and Ismail (2011) found that, "a positive attitude toward problem solving played an important role in mathematics achievement" (p. 332). Environmental factors such as parental math anxiety and math attitude influenced the math achievement of children (Soni & Kumari, 2017, p. 333).

Family played an important role with determining the academic achievements and attitudes of children (Soni & Kumari, 2017). Rossnan (2006) found that student's prior negative experiences of learning mathematics in the classroom or at home was a paramount reason for math anxiety. According to Soni & Kumari (2017), a study found that parental academic pressure and support were negatively related to students' math grades (Levpuscek & Zupancic, 2009). Studies showed that parenting practices negatively influenced their children’s mathematics education, and children of uninvolved or authoritarian-style parents obtained poor mathematics scores (Chao, 1994; Feldman & Wentzel, 1990; Leung, Lau, & Lam, 1988; Weiss & Schwarz, 1996, p. 333). The results of the study by Suni & Kumari (2017), found that “parents math anxiety and math attitude acts as precursors to their children’s math anxiety and math attitude which further influences their children’s math achievement” (p. 343).

Parental support and encouragement in learning mathematics was also positively related to mathematics achievement (Cruz, 2012). According to Fan and Chen (2001), parental involvement had a direct impact on student’s academic achievement. Aunola, Nurmi, Lerkkanen, and Puttonen (2003) found that parent expectations in children’s competence with mathematics was positively related to children’s high math performance. Parental mathematics attitude had a significant influence on children achievement and behavior (Eccles, 1983). According to Soni & Kumari (2017), “the level of importance placed by parents on mathematics has a tremendous impact on the mathematics performance of their children. If parents do not value mathematics, their ward(s) are unlikely to value mathematics either” (p. 333). Dahmer (2001) noted that parental math anxiety is negatively related to children’s mathematics achievement.

According to Kung & Lee (2016), parental involvement was defined in numerous ways, ranging from parental aspiration, expectation, interest, and attitudes and beliefs regarding education to a more active parental participation and practice in specific activities at home or school. Studies indicated that parental involvement was a multidimensional design and that different dimensions influenced students' academic achievement (Fan, 2001, Fan & Chen, 2001, Grolnick & Slowiaczek, 1994, Hong & Ho, 2005, Kung, 2002). Grolnick and Slowiaczek (1994) proposed a multidimensional design for exploring parents' influence on their children's learning process and suggested a three-dimensional model:

1. personal involvement (e.g., sharing the affective experience of caring about school)
2. behavior involvement (e.g., participating in school activities)
3. intellect/cognition involvement (e.g., exposing the child to cognitively stimulating materials) (p. 267).

Based on Grolnick and Slowiaczek's (1994) multidimensional approach of parental involvement, and in combination with Chao (2000) and Wong-Lo and Bai's (2013) the study by Kung & Lee (2016) proposed a modified three-dimensional model of personal involvement, managerial involvement, and structural involvement. The first component, personal involvement, referred to children sharing the affective experience of their parents' beliefs and expectations. This type of involvement focused on parents' academic beliefs. The second component, managerial involvement referred to parental instruction, monitoring, and hands-on practices, such as directly helping children with their homework. It was parallel to behavior involvement but emphasized home-based involvement instead of participation in school-based activities (Wong-Lo & Bai, 2013). The last component, structural involvement (intellect/cognition involvement based on Grolnick and Slowiaczek's (1994) classification), was more indirect. According to Kung and Lee (2016), the child was exposed to cognitively-stimulating materials, and the home was structured to support learning and provide resources (p. 267).

Explorations of factors that contributed to children's early mathematics achievement identified parental involvement as a significant predictor (Huang, Zhang, liu, Yang & Song, 2017). According to Huang, et al., studies examining home numeracy activities focused on two categories: formal and informal numeracy activities (LeFevre et al., 2009; Skwarchuk et al., 2014). In formal numeracy activities, parents taught their children numeracy knowledge intentionally and directly. For example, they taught simple numbers, sums, arithmetic, and quantity (e.g., Skwarchuk et al., 2014). LeFevre et al. (2009) proposed that formal numeracy activities were further divided into number skill activities (e.g., counting objects, writing numbers, and learning simple sums) and number book activities (e.g., using number activity books and reading number storybooks) (p. 329). With informal numeracy activities, children's acquisition of numeracy knowledge occurred through playing number-related games and applying numerical knowledge in their daily lives. According to Huang, et al., (2017), “informal numeracy activities are ‘real-world’ tasks that entail various numeracy skills.” LeFevre et al. (2009) suggested that informal activities were divided into numeracy game activities (e.g., playing board games, playing card games, and making collections) or application activities (e.g., talking about money when shopping, playing with calculators, and having children wear watches) (p. 329). These activities often related to children's zone of proximal development (Skwarchuk et al., 2014). Both formal and informal mathematical activities involved the communication of numbers. Past studies (Berkowitz et al., 2015, Gunderson & Levine, 2011, Levine, Suriyakham, Rowe, Huttenlocher, & Gunderson, 2010) found that the more parent–child number talk occurred, the better the childs’ later numerical comprehension. According to Huang, et al., (2017), both formal and informal activities were considered to contribute to children's numeracy competency by leading to a variety of practices and discussions about numbers, quantities, and mathematical concepts (p. 329).

Children began to grasp their numeracy knowledge at an early age (Purpura, Hume, Sims, & Lonigan, 2011). Researchers found that children acquired a considerable body of mathematical concepts and knowledge prior to formal schooling (Anderson, 1997). The development of these concepts and knowledge were closely associated with parents’ involvement in their children's mathematical learning (Anderson, 1997, Starkey & Klein, 2000). According to Bicknell (2014), parents played crucial roles as motivators, resource providers, monitors, mathematics content advisers, and mathematical learning advisers. Baker (2015) found that children of mothers who were involved in more frequent home learning activities that included daily life mathematical experiences (e.g., recognizing prices, playing counting games) entered kindergarten with better numeracy skills (p. 330).

Best Practices and Mathematics

In terms of mathematics instruction, best practices were determined as teaching strategies or lesson structures that promoted a concrete model for students’ understanding of mathematics (Swars et al., 2018). The National Council of Teachers of Mathematics (2014) found research-based teaching practices were essential for a high-quality mathematics education for students, that were combined with core principles to build a successful mathematics program at all levels. According to the NCTM (2014), researchers created a list of instructional strategies that were considered best practices in mathematics education:

1. ***Establish mathematics goals to focus learning.*** Effective teaching of mathematics establishes clear goals for the mathematics that students are learning, situates goals within learning progressions, and uses the goals to guide instructional decisions.
2. ***Implement tasks that promote reasoning and problem solving***. Effective teaching of mathematics engages students in solving and discussing tasks that promote mathematical reasoning and problem solving and allow multiple entry points and varied solution strategies.
3. ***Use and connect mathematical representations.*** Effective teaching of mathematics engages students in making connections among mathematical representations to deepen understanding of mathematics concepts and procedures and as tools for problem solving.
4. ***Facilitate meaningful mathematical discourse.*** Effective teaching of mathematics facilitates discourse among students to build shared understanding of mathematical ideas by analyzing and comparing student approaches and arguments.
5. ***Pose purposeful questions***. Effective teaching of mathematics uses purposeful questions to assess and advance students' reasoning and sense making about important mathematical ideas and relationships.
6. ***Build procedural fluency from conceptual understanding.*** Effective teaching of mathematics builds fluency with procedures on a foundation of conceptual understanding so that students, over time, become skillful in using procedures flexibly as they solve contextual and mathematical problems.

7. ***Support productive struggle in learning mathematics***. Effective teaching of mathematics consistently provides students, individually and collectively, with opportunities and supports to engage in productive struggle as they grapple with mathematical ideas and relationships.
8. ***Elicit and use evidence of student thinking***. Effective teaching of mathematics uses evidence of student thinking to assess progress toward mathematical understanding and to adjust instruction continually in ways that support and extend learning (p. 3).

Goals to Focus Learning. Ignacio & Reyes (2017) stated that goals were defined as "a cognitive representation linking certain actions with desired outcomes, as well as a motive that influences actions to engage in particular favorable achievement outcomes" (p. 19). Each person adopted and accepted goals which give meaning, purpose and direction to their action. An analysis on the learning styles and achievement goals provided future researchers with a good baseline for understanding mathematics scenarios for students (p. 19). Ignacio & Reyes (2017) found that present researchers were interested in determining whether learning styles affected each mathematics achievement goals attainment. The results of the study by Ignacio & Reyes (2017) gave sufficient evidence on classroom scenarios, especially on understanding achievement goals through student's learning styles (p. 19).

Reasoning and Problem Solving. Bartell (2013) stated that education helped students analyze inequities and highlighted how these issues connected to their lives and engaged them in challenging those inequitable situations. Skovsmose (1994) examined projects focused on mathematics, relevant to students' lives, and "related to important processes in society, to support students in achieving a greater awareness of the extent to which mathematics is involved in day-to-day life, and to prepare them for democratic citizenship" Skovsmose (1994) (p. 131). One project, Economic Relationships in the World of a Child, engaged students in analyzing their personal use of money, examined a social program that awarded money to families based on the number of children in the family, and designed a budget for a youth club (p. 131).

Connecting Mathematical Representations. Volk, Cotic, Zajc & Starcic (2017), stated that, in the past, math education focused on teaching students the steps needed to find answers to mathematical problems. It was after they had mastered the ability to manipulate numbers, that they were introduced to real-life applications for these skills (p. 2). The shift was made to integrate conceptual and procedural knowledge (Crooks & Alibali, 2014) which was acquired through learning imbedded in children's lives and provided grounding for process-oriented curricula (Ellis, 2005). The National Council of Teachers of Mathematics (NCTM) emphasized learning mathematics for participation in society and incorporated the understanding of concepts and their integration in life contexts. According to Volk et al., (2017), a reformed elementary school's math curriculum focused on the students' acquisition of process knowledge as higher-order learning outcomes and facilitated the autonomy of teachers to design learning outcomes and content in their classroom practice, while connecting math knowledge with knowledge in other subjects (p. 2). This curriculum incorporated concrete manipulatives and computer programs, which developed mathematical ideas in meaningful contexts (Billstein & Williamson, 2008) and placed importance on the student's ability to engage in mathematics mentally, with symbols, graphics or using physical materials and objects (Principles and Standards for School Mathematics, 2000) (p.2).

Mathematical Discourse. Among the collaborative techniques, Think-Pair-Share provided positive aspects towards students' learning (Braun et al., 2017; Siswati & Corebima, 2017). McTighe & Lyman (1988) defined the Think-Pair-Share technique as a multi-mode discussion cycle that is divided into three stages: (1) 'Think': Students were given time to think individually after a question is posed; (2) 'Pair': Discussed the ideas with each other within a paired setting to produce a final answer; and finally (3) 'Share': Each pair shared their new improved answer with the rest of the class (p. 50). According to Lee, Li & Shahril (2018), the difference between Think-Pair-Share and other collaborative techniques was that each student was given time to think quietly and that students worked in small groups (pairs). The purpose of the thinking time in Think-Pair Share aimed to improve the quality of the students' answers. Incorporating the important concept of 'wait time' allowed students to come up with more elaborated answers (Rowe, 1987). Dedicating time for students to work individually gave them a moment to organize their thoughts and had an equal chance of contributing to the discussion when they are paired (Lom, 2012). Students who work in pairs had more speaking and listening time, and resulted in increased observations and communications skills (Carroll, 2007). This reduced the effect of silent observation, as the students played an active role in decision-making and determining the outcome (p. 50).

Purposeful Questioning. Early studies on teacher questioning, which were grounded in the process–product paradigm, focused on the relationship between observable teacher questioning practices and students outcome (Koizumi, 2013). Higher-order questioning corresponded to the levels of analysis, synthesis, and evaluation in Bloom's Taxonomy (Bloom 1956). Questioning that required recalling simple information was regarded as lower-order questioning (p. 48). Koizumi (2013) stated that researchers realized that creative thinking in a classroom was a complex activity and couldn't be captured in a simple cause–effect sequence. Researchers paid more attention to interactional questioning. The context in which the teacher's questioning occurred was recognized as a key element for investigating questioning (p. 48). Carlsen (1991) argued that, "the meaning of questions was dependent on the context of their discourse, and classroom questions were not based on the teachers' behavior but were mutual constructions of teachers and students" (p. 48).

Paoletti, Krupnik, Papadopoulos, Olsen, Fukawa-Connelly, & Weber (2018) stated that studies categorizing teachers' questions in K-14 mathematics, were organized into four categories of questions: factual, probing, generative, and orienting questions. Factual questions asked students to provide something already known, including facts, rules, or procedures. Probing questions asked students to explain or elaborate on their thinking. Generative questions asked students to provide mathematical information or a next step that is not factual. Finally, orienting questions directed students' attention to specific ideas or solution strategies (p. 48).

Building Procedural Fluency from Conceptual Understanding. According to Burns, Walick, Simonson, Dominguez, Harelstad, Kincaid, & Nelson (2015), The National Mathematics Advisory Panel (2008) identified three foundational aspects that were essential to developing proficiency with algebraic concepts: fluency with whole numbers, fluency with fractions, and aspects of geometry and measurement. The first skill set, fluency with whole numbers, involved developing number sense and grasping the basic mathematical operations of addition, subtraction, multiplication, and division, having the ability to compute problems, and knowing how to solve problems using these basic operations (Burns et al., 2015). National Council of Teachers of Mathematics (NCTM, 2000) identified five components, or strands, for what constitutes math proficiency, (1) conceptual understanding, (2) procedural fluency, (3) adaptive reasoning, (4) strategic competence, and (5) productive disposition (p. 52). Procedural fluency was the knowledge of rules, symbols, and sequences of steps required to complete math problems (Zamarian, Lopez-Rolon, & Delazer, 2007), and was demonstrated by students retrieving correct answers and completing the algorithm to compute mathematical operations (p. 52). Conceptual understanding was recognizing and understanding the core underlying ideas of a subject such as the relationships and reasons that guide the math problems in a certain area or direction (Byrnes & Wasik, 1991; Hiebert & Lefevre, 1986). Researchers measured conceptual understanding by having students complete conceptual-based math items (Helwig, Anderson, & Tindal, 2002) or by assessing underlying mathematics principles such as inversion and the commutative property (Canobi, Reeve, & Pattison, 1998; Geary, 2006) (p. 52).

Supporting Productive Struggle. Students' struggles with learning mathematics were viewed as a problem and casted in a negative way in mathematics classrooms (Hiebert and Wearne 2003, Borasi, 1996). Teachers, parents, educators and policymakers looked for ways to overcome this perceived ‘‘problem,’’ regarding it as a learning deficiency, and attempted to remove the cause of the struggle through diagnosis and remediation (Adams and Hamm 2008; Borasi 1996). According to Warshauer (2015), with this vision, the students’ struggles in mathematics were not viewed as meaningful learning opportunities. Hiebert and Grouws (2007) suggested that struggling to make sense of mathematics was a necessary component of learning mathematics with understanding. Hiebert and Wearne (2003) stated ‘‘all students need to struggle with challenging problems if they are to learn mathematics deeply’’ (p. 376). While struggle may be internal, it was also observable in most classrooms. Warshauer (2015) found that, “the depiction of what a student’s productive struggle looked like in the naturalistic setting of classroom instruction provided insight into how aspects of teaching can support rather than hinder this instructional process” (p. 376). Research suggested that productive struggle was of benefit to students’ understanding of mathematics (Kilpatrick et al. 2001, Hiebert and Grouws 2007). The kind of guidance and structure teachers provided may either facilitate or undermine the productive efforts of students’ struggles (Tarr et al. 2008, Stein et al. 2000, Doyle 1988). Productive struggles referred to a student’s ‘‘effort to make sense of mathematics, to figure something out that is not immediately apparent’’ (Hiebert and Grouws 2007, p. 376). Warshauer (2015) found that an examination of interactions in the classroom between teacher and students (and among students) revealed the nature of the struggles that students were having with mathematics (p. 376).

Evidence of Student Thinking. Shulman (1987) made a case for the construct of pedagogical content knowledge as, “the integration of content knowledge and pedagogical knowledge, providing the catalyst for mathematics educators to examine teacher knowledge as having aspects of subject matter content and teaching” (p. 286). Carney, Cavey & Hughes (2017), found that mathematics educators used the construct

Mathematical Knowledge for Teaching (MKT) when referring to the integrated mathematical knowledge specific to the work of teaching mathematics (Ball et al., 2008). Ball et al. (2008), expanded on Shulman's work by describing MKT as "interconnected components of knowledge that included mathematical ideas along with how those ideas related to certain aspects of teaching, such as curriculum, teaching strategies, and students' ways of knowing" (p. 286). Knowledge of students' ways of knowing built up over time by observing and reflecting on how students responded to certain classroom tasks related to specific mathematical ideas, what instructional prompts promoted different types of mathematical thinking, and what mathematical ideas students came up with (Carney et al., 2017). MKT's knowledge of content included the ability to recognize common ways students conceptualize particular ideas (Ball et al., 2008, p. 401). Carney et al. (2017) found that being able to recognize student thinking and relate it to specific learning goals enabled teachers to respond to students' ideas in ways that take both students' ideas and the learning goals into account. Attending to and building on students' ideas in support of formalizing mathematics required the ability to recognize and interpret student thinking in relation to important mathematical ideas. This required knowledge of how students' ideas developed over time, how a formal conceptualization was related to less formal ideas, and how to effectively press students to consider their ideas in new ways (p. 287).

Format

Differences Between Math Handbooks

The Audience of Math Handbooks. Some handbooks were geared toward the parents, while others were written for students. In the handbook, *Math at Home: Helping Your Children Learn and Enjoy Mathematics* published by the Sonoma County Office of Education, (2018) there were ideas and resources on how to support math learning at home. This handbook was written for parents and included suggestions to help their children with math, such as counting household objects, to finding the area and volume of kitchen cookware. In addition to suggesting activities for home, the handbook listed approximately 40 resources of children's literature that supported mathematics with reading in kindergarten through grade four. Most of the information was listed in bullet point form and concise with the information. It gave the parents ideas on how to help their children see if their answers to the problems made sense, such as guessing and checking or looking for patterns. This handbook provided ideas on how to make a math kit for their student with all the necessary tools needed for solving problems, such as compasses, pencil sharpeners, erasers, and graph paper. This handbook did not have any actual math pages, but gave different websites where parents could go to print some out.

One handbook, *Momentum Math* by Kaplan K-12 Learning Services (2013), gave an overview to the parents on what to expect in the book, but it was mostly geared towards the student. Each lesson gave definitions, examples, space to work and a small quiz at the end. The language in this book was geared towards students, giving simplified terms and cartoon characters that gave the explanations.   At most, there were eight math problems on each page, giving the students plenty of room to show their work.

Organization of Content in Math Handbooks. These two handbooks differed in the presentation of the math elements and knowledge. In the handbook, *Math at Home: Helping Your Children Learn and Enjoy Mathematics*, there were different ideas on how to use household items with reinforcing the mathematics application, such as creating a scale drawing map of the inside of the house. The organization of this handbook started with simpler concepts for younger children, and then ending with ideas for middle school students. There were few sample questions to guide parents on the standards that were being taught in class.

In *Momentum Math*, the introduction page was directed at the student. It introduced the cartoon characters that were throughout the book that was going to "help" them with their math. The second introduction page was for the parent, explaining what was in the lesson and what standards it covered. Each lesson started with a pre-test, to tap into what the student already knows and what they still need to learn. At the end of the lesson, there was a post-test that gave similar problems as the first one. There was a test-track sheet where the students could write their scores down and compare them.

In the handbook titled, *Parent Handbook for Mathematics* by the California Department of Education (2018), there was an overview of the importance of mathematics and steps a parent can take to help their child succeed. This handbook had an acknowledgements section that included the names and titles of all the people who worked on putting it together. It also gave different websites where parents could go to find different worksheets, videos and services to help their child.

References to Standards. In the first handbook, *Math at Home: Helping Your Children Learn and Enjoy Mathematics*, the specific math standards were not addressed.

The parent would have to figure out what standard the handbook was referring to. For example, the idea for finding the area of a room can also be used for finding the volume. In *Momentum Math*, each standard was listed at the bottom of the first page of each lesson. In *Parent Handbook for Mathematics*, it gave a link to the California Department of Education's website to see the specific math standards.

CHAPTER THREE

METHODOLOGY

Target Population

The population targeted for this handbook were parents of fifth grade students entering the middle school level.

Content

The handbook was determined and developed using peer reviewed research and best practices.

Format

The format of this handbook was developed using peer reviewed handbooks, best practices and peer reviewed research.

CHAPTER FOUR

CONCLUSION

Although this has not yet been used, the intent of this handbook was to support parents with helping their children practice and maintain their fifth grade math skills. This was based on peer reviewed research accumulated in Chapter Two. The contents included units on definitions, examples and practice problems, and activities incorporating the different strands of the math content standards.

The intent of the researcher for this handbook was to use it during the summer break to strengthen the child’s math competence before entering their sixth grade year.

Further research is required to see if there are additional strategies and activities that would help parents to support their children’s education. A possibility for future research and usage would include an online component that reinforces the math in this handbook, or an extension into other grade levels.

REFERENCES

Alibali, M. W., & Nathan, M. J. (2012). Embodiment in Mathematics Teaching and Learning: Evidence from Learners' and Teachers' Gestures. *Journal of the Learning Sciences*, 21(2), 247–286

Anderson, A. (1997). Families and Mathematics: A Study of Parent–Child Interactions. *Journal for Research in Mathematics Education*, 28(4), 484–511.

Anstey, M., & Bull, G. (2006). Teaching and Learning Multiliteracies: Changing times, Changing Literacies. Newark, DE: International Reading Association.

Aunola, K., Nurmi, J. E., Lerkkanen, M. K., & Puttonen, H. (2003). The Roles of Achievement Related Behaviors and Parental Beliefs in Children's Mathematical Performance. *Educational Psychology*, 23(4), 403–421

Avelino G. Ignacio Jr, & Joseph D. Reyes. (2017). Exploring Mathematics Achievement Goals Using Kolb's Learning Style Model. *Asia Pacific Journal of Multidisciplinary Research*, 5(1.2), 19-24.

Ayala, Mendívil, Salinas, & Rios. (2013). Kinesthetic Learning Applied to Mathematics Using Kinect. *Procedia Computer Science*, 25, 131-135.

Baccaglini-Frank, A.,& Maracci, M.(2015).Multi-touch Technology and Preschoolers' Development of Number Sense. *Digital Experiences in Mathematics Education*, 1(1), 7–27.

Baker, C. (2014). Does Parent Involvement and Neighborhood Quality Matter for African American Boys' Kindergarten Mathematics Achievement? *Early Education and Development*, 26(3), 1-14.

Baker, C. E. (2015). Does Parent Involvement and Neighborhood Quality Matter for African American Boys’ Kindergarten Mathematics Achievement? *Early Education and Development*, 26, 342–355.

Balakrishnan, V., C.L. Gan, C. L. (2016). Students' Learning Styles and Their Effects on the Use of Social Media Technology for Learning. *Telematics and Informatics,* 33 (3), 808-821

Ball, D. L., & Forzani, F. M. (2010). What does it take to make a teacher? *Phi Delta Kappan*, 92, 8–12.

Ball, D. L., Hoover Thames, M., & Phelps, G. (2008). Content Knowledge for Teaching: What Makes it Special? *Journal of Teacher Education*, 59, 389–407.

Bandeira de Mello, V., Bohrnstedt, G., Blankenship, C., & Sherman, D. (2015). Mapping State Proficiency Standards onto NAEP Scales: Results from the 2013 NAEP Reading and Mathematics Assessments. NCES 2015-046. *National Center for Education Statistics.*

Barendregt, W., Lindstro, B., Rietz-Leppa, E., Holgersson, I., & Ottosson, T. (2012). Development and Evaluation of Fingu: A Mathematics iPad Game Using Multi-Touch Interaction. *Proceedings of the 11th International Conference on Interaction Design and Children* (pp. 204–207). New York, NY

Bartell, T. (2013). Learning to Teach Mathematics for Social Justice: Negotiating Social Justice and Mathematical Goals. *Journal For Research In Mathematics Education*, 44(1), 129-163.

Beck, I. L., McKeown, M. G., & Kucan, L. (2013). Bringing Words to Life: Robust Vocabulary Instruction (2nd ed.). New York, NY: Guilford.

Bekdemir, M. (2010). The Pre-Service Teachers' Mathematics Anxiety Related to Depth of Negative Experiences in Mathematics Classroom While They Were Students. *Educational Studies in Mathematics,* 75, 311

Berkowitz, T., Schaeffer, M. W., Maloney, E. A., Peterson, L., Gregor, C., Levine, S. C., & Beilock, S. L. (2015). Math at Home Adds up to Achievement in School. *Science*, 350, 196–198.

Bicknell, B. (2014). Parental Roles in the Education of Mathematically Gifted and Talented Children. *Gifted Child Today*, 37, 82–93.

Bloom, B. S. (Ed.). (1956). Taxonomy of Educational Objectives: Handbook I, Cognitive Domain. New York: David McKay.

Borasi, R. (1996). Reconceiving Mathematics Instruction: A Focus on Errors. Norwood, NJ: Ablex.

Braun, B., Bremser, P., Duval, A.M., Lockwood, E., & White, D. (2017). What Does Active Learning Mean for Mathematicians? *Notices of the AMS*, 64, 124-129.

Bruner, J. S. (1966). Toward a Theory of Instruction. New York, NY: W.W. Norton & Company.

Burns, B. A., & Hamm, E. M. (2011). A Comparison of Concrete and Virtual Manipulative Use in Third-and Fourth-grade Mathematics. *School Science and Mathematics*, 111(6), 256-261.

Burns, M. (2004). Writing in Math. *Educational Leadership*, 62(2), 30–33.

Burns, M., Walick, C., Simonson, G., Dominguez, L., Harelstad, L., Kincaid, A., & Nelson, G. (2015). Using a Conceptual Understanding and Procedural Fluency Heuristic to Target Math Interventions with Students in Early Elementary. *Learning Disabilities Research & Practice*, 30(2), 52-60.

Byrnes, J. P., & Wasik, B. A. (1991). Role of Conceptual Knowledge in Mathematical Procedural Learning. *Developmental Psychology*, 27, 777–786.

California Department of Education, (2011). Fifth Grade Content Standards

Retrieved from March 1, 2018, from http://www.cde.ca.gov

Canobi, K.H., Reeve,R.A., & Pattison, P.E .(1998).The Role of Conceptual Understanding in Children's Addition Problem Solving. *Developmental Psychology*, 34, 882–891.

Carbonneau, K. M., Marley, S., & Selig, J. (2013). A Meta-analysis of the Efficacy of Teaching Mathematics with Concrete Manipulatives. *Journal of Educational Psychology*, 105(2), 380-400.

Carmichael, S. B., Martino, G., Porter-Magee, K., & Wilson, W. S. (2010). The State of State Standards--and the Common Core--in 2010. Thomas B. Fordham Institute.

Carney, M., Cavey, L., & Hughes, G. (2017). Assessing Teacher Attentiveness to Student Mathematical Thinking: Validity Claims and Evidence. *The Elementary School Journal*, 118(2), 281-309.

Chao, K. J., Huang, H. W., Fang, W. C., & Chen, N. S. (2013). Embodied Play to Learn: Exploring Kinect-Facilitated Memory Performance. *British Journal of Educational Technology*, 44(5), E151-E155

Chao, R. (1994). Beyond Parental Control and Authoritarian Parenting Style: Understanding Chinese Parenting Through the Cultural Notion of Training. *Child Development*, 65, 1111–1119

Chao, R. K. (2000). Cultural Explanations for the Role of Parenting in the School Success of Asian American Children, *Family, Work, Culture, and Community* (pp. 333–363). Mahwah, NJ: Lawrence Erlbaum Associates Inc.

Chow, J. C., & Jacobs, M. (2016). The Role of Language in Fraction Performance: A Synthesis of Literature. *Learning and Individual Differences*, 47, 252–257.

Church, S. (2004). Learning styles. Retrieved 8 May 2011 from: http://www.teresadybvig.com/learnsty.htm

Clement, L. (2004). A Model for Understanding, Using, and Connecting Representations. *Teaching Children Mathematics*, 11(2), 97–102.

Closing the Achievement Gap. Best Practices in Teaching Mathematics, *Education Alliance* (W. Va.), Charleston, W. Va. Education Alliance, 2006

Coburn, Cynthia E, Heather C Hill, and James P Spillane, (2016). Alignment and Accountability in Policy Design and Implementation. *Educational Researcher* 45, (4) 243-51.

Çolak, Esma. (2015). The Effect of Cooperative Learning on the Learning Approaches of Students with Different Learning Styles. *Eurasian Journal of Educational Research*, (59), 17-34.

Crooks, N. M., Alibal, M.W. (2014). iDefining and Measuring Conceptual Knowledge in Mathematics, *Developmental Review*, (34), 344-377

Cruz, Y. D. L. (2012). Learning Math with my Father: A Memoir. *Journal of Unschooling and Alternative Learning*, 6(11), 20–33

Dacey, L., & Polly, D. (2012). CCSSM: The Big Picture. *Teaching Children's Mathematics*, 18(6), 378-383.

Dahmer, S. L. (2001).What are the Relationships Between Math Anxiety and Educational Level in Parents and Math Achievement in their Children? (Unpublished doctoral dissertation). Tennessee State University, Nashville, TN.

De Smedt, B., Janssen, R., Bouwens, K., Verschaffel, L., Boets, B., & Ghesquière, P. (2009). Working Memory and Individual Differences in Mathematics Achievement: A Longitudinal Study from First Grade to Second Grade. *Journal of Experimental Child Psychology*, 103, 186–201.

Dean, D. & Kuhn, D. (2007). Direct Instruction vs. Discovery: The Long View. *Science Education,* 91(3), 384–397.

Dessoff, A. (2012). Are You Ready for Common Core Math? *District Administration*, 48(3), 53.

Doyle, W. (1988). Work in Mathematics classes: The context of students' thinking during instruction. Educational Psychologist, 23, 167–180.

Driscoll, M. (1983). The Role of Manipulatives in Elementary School Mathematics. Research Within Reach: *Elementary School Mathematics* (pp. 21-28). Reston, Virginia: National Council of Teachers in Mathematics.

Dunn, R., & Dunn, K. (1993). Teaching Secondary Students Through Their Individual Learning Styles: Practical Approaches for Grades 7-12. Massachusetts: Allyn and Bacon.

Dunn, R. and Griggs, S. (1998). Learning Styles and the Nursing Profession. New York: National League for Nursing.

Eccles, J. (1983). Expectancies, Values, and Academic Behaviors. In J. T. Spence (Ed.), Achievement and Achievement Motives. Psychological and Sociological Approaches. San Francisco, CA: Freeman & Co

Ediger, M. (2006). Writing in the Mathematics Curriculum. *Journal of Instructional Psychology*, 33, 120–123.

Ellis, Mark W., & Berry, Robert Q., III. (2005). The Paradigm Shift in Mathematics Education: Explanations and Implications of Reforming Conceptions of Teaching and Learning. *Mathematics Educator, 15*(1), 7-17.

Fan, X. (2001). Parental Involvement and Students' Academic Achievement: A Growth Modeling Analysis. *The Journal of Experimental Education*, 70 (1) (2001), 27-61

Fan, X. & Chen, M. (2001). Parental Involvement and Students’ Academic Achievement: A Meta-Analysis. *Educational Psychology Review*, 13(1), 1–22

Felder, R. M. (1996). Matters of Style. ASEE American Society of Engineering Education, *ASEE Prism*, 6(4), 18-23.

Feldman, S.S. & Wentzel, K. R. (1990). Relations Among Family Interaction Patterns, Classroom Self-restraint, and Academic Achievement in Preadolescent Boys. *Journal of Educational Psychology*, 82, 813–819.

Forsyth, Suzanne R., & Powell, Sarah R. (2017). Differences in the Mathematics-Vocabulary Knowledge of Fifth-Grade Students with and without Learning Difficulties. *Learning Disabilities Research & Practice*, 32(4), 231-245

Fuchs, L. S., Zumeta, R. O., Schumacher, R. F., Powell, S. R., Seethaler, P. M., Hamlett, C. L., et al. (2010). The Effects of Schema-Broadening Instruction on Second Graders’ Word-problem Performance and Their Ability to Represent Word Problems with Algebraic Equations: A Randomized Control Study. *The Elementary School Journal*, 110, 440–463.

Galligan, Linda. (2016). Creating Words in Mathematics. *Australian Mathematics Teacher*, 72(1), 20-29.

Geary, D. C. (2006). Development of Mathematical understanding. In D. Kuhl & R. S. Siegler (Eds.), Cognition, Perception, and Language (Vol 2, pp. 777–810). W. Damon (Gen. Ed.), *Handbook of Child Psychology* (6th ed.). New York: John Wiley & Sons.

Gibson, J. J. (1986). The Ecological Approach to Visual Perception. Hillsdale, NJ: Lawrence Erlbaum.

Golafshani, N. (2013) Teachers’ Beliefs and Teaching Mathematics with Manipulatives. *Canadian Journal for Education*, 36(3), 137-159.

González, S. J., Mendoza-González, R., Rodriguez-Martinez, L. C. & Rodríguez-Díaz, M., (2016). MOOCs and Multiple Learning Styles User-Centered Design Strategies for Massive Open Online Courses (MOOCs), 30

Grasha, A. F. (2002). Teaching with Style: A Practical Guide to Enhancing Learning by Understanding Teaching and Learning Style. CA: Alliance.

Grasha, T. (1990). The Naturalistic Approach to Learning Styles. *College Teaching*, 38(3), 106–113.

Greeno, J. G. (1994). Gibson’s Affordances. *Psychological Review*, 101(2), 336–342

Grolnick, W., & Slowiaczek, M. (1994). Parents' Involvement in Children's Schooling: A Multidimensional Conceptualization and Motivational Model. *Child Development*, *65*(1), 237-252.

Guild, P.B. and Garger, S. (1998). Marching to Different Drummers (2nd Ed.). Alexandria, VA: Association for Supervision & Curriculum Development.

Gunderson, E. A., & Levine, S. C. (2011). Some Types of Parent Number Talk Count More than Others: Relations Between Parents' Input and Children's Cardinal-number Knowledge. *Developmental Science*, 14, 1021–1032

Haggart, W. (2003). Discipline and Leaning Styles: An Educator's Guide. Cadiz, KY: Performance Learning Systems.

Halliday, M.A.K. (1975). Learning How to Mean: Explorations in the Development of Language. London: Edward Arnold.

Hart, B., & Risley, T. R. (1999). The Social World of Children Learning to Talk. Baltimore, MD: Brookes.

Harte, & Law. (2017). Incorporating Different Learning Styles into a Home Exercise Program. *Journal of Hand Therapy*, 8(1)

Hebert, M.A. & Powell, S.R. (2016) Examining Fourth-Grade Mathematics Writing: Features of Organization, Mathematics Vocabulary, and Mathematical Representations, *Reading and Writing*, 29, (7), 1511–1537

Hegarty, M., Mayer, R. E., & Monk, C. A. (1995). Comprehension of Arithmetic Word Problems: A Comparison of Successful and Unsuccessful Problem Solvers. *Journal of Educational Psychology*, 87, 18–32

Helwig, R., Anderson, L., & Tindal, G. (2002). Using a Concept-Grounded Curriculum-Based Measure in Mathematics to Predict Statewide Test Scores for Middle School Students with LD. *The Journal of Special Education*, 36, 102–112.

Hiebert, J, Carpenter, T.P., Fennema, E., Fuson K.C., Wearne D., Murray, H., … Human, P., (1997). *Making Sense: Teaching and Learning Mathematics with Understanding.* Portsmouth, NH: Heinemann.

Hiebert, J., & Grouws, D. A. (2007). The Effects of Classroom Mathematics Teaching on Students' Learning. In J. Frank & K. Lester (Eds.), *Second Handbook of Research on Mathematics Teaching and Learning* (pp. 371–404). Charlotte: Information Age.

Hiebert, J., & Lefevre, P. (1986). Conceptual and Procedural nowledge in Mathematics: An Introductory Analysis. In J. Hiebert (Ed.), *Conceptual and Procedural Knowledge: The Case of Mathematics* (pp. 1–28). Hillsdale, NJ: Erlbaum.

Hiebert, J., & Wearne, D. (2003). Developing Understanding Through Problem Solving. In H. L. Schoen & R. I. Charles (Eds.), Teaching Mathematics Through Problem Solving: Grades (pp. 6–12). Reston, VA: NCTM.

Hill, H. C. (2010). The Nature and Predictors of Elementary Teachers' Mathematical Knowledge for Teaching. *Journal for Research in Mathematics Education*, 41, 513–545.

Ho, H .Z., Senturk, D., Lam, A. G., Zimmer, J. M., Hong, S., Okamoto, Y. & Wang, C.P. (2000).The Affective and Cognitive Dimensions of Math Anxiety: *A Cross-National Study. Journal for Research in Mathematics Education,* 31, 362

Hong, Sehee, & Ho, Hsiu-Zu. (2005). Direct and Indirect Longitudinal Effects of Parental Involvement on Student Achievement: Second-Order Latent Growth Modeling Across Ethnic Groups. *Journal of Educational Psychology, 97*(1), 32-42.

Hsu, T. (2017). Learning English with Augmented Reality: Do Learning Styles Matter? *Computers & Education*, 106, 137-149.

Huang, Qi, Zhang, Xiao, Liu, Yingyi, Yang, Wen, & Song, Zhanmei. (2017). The Contribution of Parent-Child Numeracy Activities to Young Chinese Children's Mathematical Ability. *British Journal of Educational Psychology*, 87(3), 328-344.

Hynes, M. C. (1986). Selection Criteria. *Arithmetic Teacher*, 33(6), 11–13.

Jensen, E. (1998). Introduction to Brain-Compatible Learning. San Diego, CA: The Brain Store Inc.

Jitendra, A. K., Petersen-Brown, S., Lein, A. E., Zaslofsky, A. F., Kunkel, A. K., Jung, P. G., et al. (2013). Teaching Mathematical Word Problem Solving: The Quality of Evidence for Strategy Instruction Priming the Problem Structure. *Journal of Learning Disabilities*, 48, 51–72

Johnson, K. (1993). Manipulatives Allow Everyone to Learn Mathematics. *Contemporary Education*, 65(1), 10-11.

Kastberg, D., Chan, J. Y., & Murray, G. (2016). Performance of US 15-Year-Old Students in Science, Reading, and Mathematics Literacy in an International Context: First Look at PISA 2015. NCES 2017-048. *National Center for Education Statistics.*

Keefe, J. W., & Ferrell, B. G. (1990). Developing a Defensible Learning Style Paradigm. *Educational Leadership,* 48(2), 57-61

Kennedy, L. M. (1986). A Rationale. *Arithmetic Teacher,* 33(6), 6–7.

Khaliqi, David. (2016). How Common Is the Common Core? A Global Analysis of Math Teaching and Learning. *School Science and Mathematics,* 116(4), 199-211.

Kilpatrick, J., Swafford, J., & Findell, B. (Eds.). (2001). Adding it Up: Helping Children Learn Mathematics. Washington, DC: National Academies Press.

King-Sears, Peggy, Doabler, Christian T, Clarke, Ben, Fien, Hank, Baker, Scott K, Kosty, Derek B, & Cary, Mari Strand. (2015). The Science Behind Curriculum Development and Evaluation. *Learning Disability Quarterly, 38*(2), 97-111.

Koizumi, Y. (2013). Similarities and Differences in Teachers' Questioning in German and Japanese Mathematics Classrooms. *ZDM,* 45(1), 47-59.

Krajewski, K., & Schneider, W. (2009). Exploring the Impact of Phonological Awareness, Visual-spatial Working Memory, and Preschool Quantity-number Competencies on Mathematics Achievement in lementary scLhool: Findings from a 3-year Longitudinal Study. *Journal of Experimental Child Psychology,* 103, 516–531.

Kress, G., & Jewitt, C. (2008). Introduction. In C. Jewitt, & G. Kress (Eds.), Multimodal Literacy (pp. 1–18). New York: Peter Lang.

Kristian, J., Kiili, M., Devlin, K., & Multisilta, J. (2015). Editorial: Is Game-Based Math Learning Finally Coming of Age? *International Journal of Serious Games*, 2 (4).

Kung, H.-Y. (2002). Parental Involvement in the Academic Achievement of Middle School Students in Taiwan (Unpublished doctoral dissertation). University of California, Santa Barbara, California

Kung, & Lee. (2016). Multidimensionality of Parental Involvement and Children's Mathematics Achievement in Taiwan: Mediating effect of math self-efficacy. *Learning and Individual Differences*, 47, 266-273.

Ladel, S., & Kortenkamp, U. (2012). Early Maths with Multi-touch—an Activity-Theoretic Approach. In Proceedings of POEM.

Land, T., Tyminski, A., & Drake, C. (2015). Examining Pre-Service Elementary Mathematics Teachers' Reading of Educative Curriculum Materials. *Teaching and Teacher Education*, 51, 16-26.

LaVenia, M., Cohen-Vogel, L., & Lang, L. B. (2015). The Common Core State Standards Initiative: An Event History Analysis of State Adoption. *American Journal of Education*, 121(2), 145-182.

LeFevre, J.-A., Fast, L. Smith-Chant, B. L., Skwarchuk, S.-L., Bisanz, J., Kamawar, D., et al. (2010). Pathways to Mathematics: Longitudinal Predictors of Performance. *Child Development*, 81, 1753–1767.

LeFevre, J. A., Skwarchuk, S. L., Smith-Chant, B. L., Fast, L., Kamawar, D., & Bisanz, J. (2009). Home Numeracy Experiences and Children's Math Performance in the Early School Years. *Canadian Journal of Behavioral Science*, 41, 55–66

Lee, C., Li, H., & Shahrill, M. (2018). Utilizing the Think-Pair-Share Technique in the Learning of Probability. *International Journal on Emerging Mathematics Education*, 2(1), 49-64.

Leung, K., Lau, S. & Lam, W. (1988). Parenting Styles and cademic Achievement: A Cross-cultural Study. *Journal of Developmental Psychology*, 44(2), 157–172

Levine, S. C., Suriyakham, L. W., Rowe, M. L., Huttenlocher, J., & Gunderson, E. A. (2010). What ounts in the Development of Young Children's Number Knowledge? *Developmental Psychology*, 46, 1309.

Levpuscek, M. P. & Zupancic, M. (2009). Math Achievement in Early Adolescence: The Role of Parental Involvement, Teachers' Behavior and Students' Motivational Beliefs about Math. *The Journal of Early Adolescence*, 29(4), 541–570

Liggett, Robert Scott. (2017). The Impact of Use of Manipulatives on the Math Scores of Grade 2 Students. Brock Education: *A Journal of Educational Research and Practice*, 26(2), 87-101.

Lom, B. (2012). Classroom Activities: Simple Strategies to Incorporate Student-centered Activities Within Undergraduate Science Lectures. *Journal of Undergraduate Neuroscience Education*, 11(1), A64-A71.

Ma, X. & Kishor ,N.(1997). Assessing the Relationship Between Attitude Toward Mathematics and Achievement in Mathematics: A Meta-analysis. *Journal for Research in Mathematics Education*, 28(1), 27–47.

Maggio, M., & Sayler, M. (2013). Trying Out Acceleration for Mathematically Talented Fifth Graders. *Gifted Child Today, 36*(1), 20-26.

Martens, P., Martens, R., Doyle, M. H., Loomis, J., & Aghalarov, S. (2013). Learning from Picture Books: Reading and Writing Multimodally in First Grade. *Reading Teacher*, 66(4), p. 285-294.

McCarthy, D. S. (2008). Communication in Mathematics: Preparing Preservice Teachers to Include Writing in Mathematics Teaching and Learning. *School Science and Mathematics,* 108, 334–340

McLeod, J., Vasinda, S., & Dondlinger, M. J. (2012). Conceptual Visibility and Virtual Dynamics in Technology-scaffolded Learning Environments for Conceptual Knowledge of Mathematics. *Journal of Computers in Mathematics and Science Teaching*, 31(3), 283–310.

McTighe, J., & Lyman, F.T. (1988). Cueing Thinking in the Classroom: The Promise of Theory Embedded Tools. *Educational Leadership*, 457), 18-24.

Meyer, M. R. & Langral, C. W., (Eds.), A Decade of Middle School Mathematics Curriculum Implementation: Lessons Learned From How Me Project, Information Age Publishing, Charlotte (2008), pp. 183-190

Modebelu, M. N., & Ogbonna, C. C. (2014). Reform-Based-Instructional Method and Learning Styles on Students' Achievement and Retention in Mathematics: Administrative Implications. *International Journal of Education and Literacy Studies*, *2*(2), 48-52.

Moeller, K., Fischer, U., Link, T., Wasner, M., Huber, S., Cress, U., & Nuerk, H. C. (2012). Learning and Development of Embodied Numerosity. Cognitive Processing, 13(1), 271-274.

Mohd, N., Mahmood, T. F. P. T., & Ismail, M. N. (2011). Factors that Influence Students in Mathematics Achievement. *International Journal of Academic Research*, 3(3), 49–54

Monroe, E. E., & Panchyshyn, R. (1995). Vocabulary Considerations for Teaching Mathematics. *Childhood Education*, 72, 80–83.

Monroe, E. E., & Pendergrass, M. R. (1997). Effects of Mathematical Vocabulary I Instruction on Fourth Grade Students. *Reading Improvement*, 34, 120–132.

Moyer, P. S. (2001). Are We Having Fun Yet? How Teachers Use Manipulatives to Teach Mathematics. *Educational Studies in Mathematics*, 47(2), 175-197.

Moyer, P. S., Bolyard, J. J., & Spikell, M. A. (2002). What are Virtual Manipulatives? *Teaching Children Mathematics*, 8(6), 372–377.

Moyer-Packenham, P. S., Anderson, K. L., Shumway, J. F., Tucker, S. I., Westenskow, A., Boyer-Thurgood, J. M., et al. (2014). Developing Research Tools for Young Children's Interactions With Mathematics Apps on the iPad. In Proceedings of the 12th Annual Hawaii International Conference on Education (HICE) (pp. 1685–1694). Honolulu, Hawaii.

Moyer-Packenham, P. S., Shumway, J. F., Bullock, E., Tucker, S. I., Anderson-Pence, K. L., Westenskow, A., et al. (2015). Young Children's Learning Performance and Efficiency When Using Virtual Manipulative Mathematics iPad Apps. *Journal of Computers in Mathematics and Science Teaching,* 34(1), 41–69.

Moyer-Packenham, P. S., & Suh, J. M. (2012). Learning Mathematics with Technology: The Influence of Virtual Manipulatives on Different Achievement Groups. *Journal of Computers in Mathematics & Science Teaching*, 31(1), 39–59.

Moyer-Packenham, P. S., & Westenskow, A. (2013). Effects of Virtual Manipulatives on Student Achievement and Mathematics Learning. *International Journal of Virtual and Personal Learning Environments*, 4(3), 35–50.

Murat, G. (2013). The Effect of Students' Learning Styles to Their Academic Success. *Educational Research and Reviews, 8*(17), 1634-1641.

Murray, T., & Arroyo, I. (2002). Toward Measuring and Maintaining the Zone of Proximal Development in Adaptive Instructional Systems. In S. A. Cerri, G. Gouarde `res, & F. Paraguac¸u (Eds.), Intelligent Tutoring Systems (pp. 749–758). Berlin: Springer.

National Center for Education Statistics (NCES) Home Page, part of the U.S. Department of Education. (n.d.). Retrieved November 30, 2017, from http://nces.ed.gov/

National Council of Teachers of Mathematics. (2000). Principles and Standards for School Mathematics. Reston, VA: National Council of Teachers of Mathematics

National Council of Teachers of Mathematics. (2014). Principles to Actions: Ensuring Mathematical Success for All. Reston, VA: Author.

National Mathematics Advisory Panel (NMAP). (2008). Foundations for Success: Final Report of the National Math Advisory Panel. Washington, D.C.: U.S. Department of Education.

Nemirovsky, R., Kelton, M. L., & Rhodehamel, B. (2013). Playing Mathematical Instruments: Emerging Perceptuomotor Integration With an Interactive Mathematics Exhibit. *Journal for Research in Mathematics Education*, 44(2), 372–415

Okkonen, J., Sharma, S., Raisam R. & Turunen, M. (2016). Kinesthetic Elementary Mathematics - Creating Flow with Gesture Modality. *International Journal of Serious Games,* 3(2)

Ozerem, A., & Akkoyunlu, B. (2015). Learning Environments Designed According to Learning Styles and its Effects on Mathematics Achievement. *Eurasian Journal of Educational Research,* 61, 61-80. http://dx.doi.org/10.14689/ejer.2015.61.4

Özyurt, Ö., Özyurt, H., Baki, A., & Güven, B. (2013). Integration into Mathematics Classrooms of an Adaptive and Intelligent Individualized e-Learning Environment: Implementation and Evaluation of UZWEBMAT. *Computers in Human Behavior,* 29(3), 726-738.

Paek, S. (2012). The Impact of Multimodal Virtual Manipulatives on Young Children's Mathematics Learning (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Full Text. (UMI No. 3554708)

Paoletti, T., Krupnik, V., Papadopoulos, D., Olsen, J., Fukawa-Connelly, T., & Weber, K. (2018). Teacher Questioning and Invitations to Participate in Advanced Mathematics Lectures. *Educational Studies in Mathematics,* 98(1), 1-17.

Parmar, R. S., Cawley, J. F., & Frazita, R. R. (1996). Word Problem-solving by Students With and Without Mild Disabilities. *Exceptional Children,* 62, 415–429.

Powell, S. R., & Driver, M. K. (2015). The Influence of Mathematics Vocabulary Instruction Embedded Within Addition Tutoring for First-grade tudents with Mathematics Difficulty. *Learning Disability Quarterly,* 38, 221–233.

Principles and Standards for School Mathematics (2000). Reston: National Council of Teachers of School Mathematics.

Purpura, D. J., Hume, L. E., Sims, D. M., & Lonigan, C. J. (2011). Early Literacy and Early Numeracy: The Value of Including Early Literacy Skills in the Prediction of Numeracy Development. *Journal of Experimental Child Psychology,* 110, 647–658.

Quintana, C., Reiser, B. J., Davis, E. A., Krajcik, J., Fretz, E., Duncan, R. G., et al. (2004). A Scaffolding Design Framework for Software to Support Science Inquiry. *The Journal of the Learning Sciences,* 13(3), 337–386.

Raiker, A. (2002). Spoken Language and Mathematics. *Cambridge Journal of Education,* 32, 45–60.

Reid, Mary, & Reid, Steven. (2017). Learning to Be a Math Teacher: What Knowledge Is Essential? *International Electronic Journal of Elementary Education*, 9(4), 851-872.

Ren, G. (2013). Which Learning Style Is Most Effective In Learning Chinese As A Second Language? *Journal of International Education Research*, 9(1), 21.

Riccomini, P. J., Smith, G. W., Hughes, E. M., & Fries, K. M. (2015). The Language of Mathematics: The Importance of Teaching and Learning Mathematical Vocabulary. *Reading and Writing Quarterly*, 31, 235–253.

Robinson, A., Shore, B. M., & Enersen, D. L. (2007). Best Practices in Gifted Education: An Evidence-based Guide. Overcoming Math Anxiety. *Mathitudes*, 1(1), 1–4.

Roth, W. M., & Thom, J. S. (2009). Bodily Experience and Mathematical Conceptions: From Classical Views to a Phenomenological Reconceptualization. *Educational Studies in Mathematics*, 70(2), 175-189

Rowe, M.B. (1987). Wait Time: Slowing Down May be a Way of Speeding Up. *American Educator: The Professional Journal of the American Federation of Teachers,* 11(1), 38-43.

Rubenstein, R. N., & Thompson, D. R. (2002). Understanding and Supporting Children's Mathematical Vocabulary Development. *Teaching Children Mathematics*, 9, 107–112.

Sarver, D. E., Rapport, M. D., Kofler, M. J., Raiker, J. S., & Friedman, L. M. (2015). Hyperactivity in Attention-Deficit/Hyperactivity Disorder (ADHD): Impairing Deficit or Compensatory Behavior? *Journal of Abnormal Child Psychology*, 1-14.

Schenkel, B. (2009). The Impact of an Attitude Toward Mathematics on Mathematics Performance (Unpublished master's thesis), Marietta College, Marietta, OH.

Schleppegrell, M. J. (2007). The Linguistic Challenges of Mathematics Teaching and Learning: A Research Review. *Reading and Writing Quarterly*, 23, 139–159.

Schreiber, J. B. (2002). Institutional and Student Factors and Their Influence on Advanced Mathematics Achievement. *The Journal of Educational Research*, 95(5), 274–286.

Seethaler, P. M., Fuchs, L. S., Star, J. R., & Bryant, J. (2011). The Cognitive Predictors of Computational Skill with Whole Versus Rational Numbers: An Exploratory Study. *Learning and Individual Differences.* 21, 536–542.

Shivraj, Pooja. (2017). Evaluating the (Mis)Alignment of the Intended to the Assessed Curriculum for the U.S.: Implications for the Common Core State Standards for Mathematics. *International Journal of Education in Mathematics, Science and Technology, 5*(4), 333-347.

Shuell, T. J. (1986). Cognitive Conceptions of Learning. *Review of Educational Research*, 56, 411-436.

Shulman, L. S. (1987). Knowledge and Teaching: Foundations of the New Reform. *Harvard Educational Review*, 57(1), 1–22.

Siswati, B.H., & Corebima, A.D. (2017). The Effect of Education Level and Gender on Students' Metacognitive Skills in Malang, Indonesia. *Advances in Social Sciences Research Journal,* 4(4), 163-169.

Skovsmose, O. (1994). Towards a Philosophy of Critical Mathematics Education. Dordrecht, the Netherlands: Kluwer.

Skwarchuk, S. L., Sowinski, C., & LeFevre, J. A. (2014). Formal and Informal Home Learning Activities in Relation to Children's Early Numeracy and Literacy Skills: The Development of a Home Numeracy Model. *Journal of Experimental Child Psychology*, 121, 63–84.

Smith, I.M. (1964). Spatial Ability. San Diego, CA: Knapp.

Smith, Joanna, & Thier, Michael. (2017). Challenges to Common Core State Standards Implementation: Views from Six States. *NASSP Bulletin*, 101(3), 169-187.

Soni, A., & Kumari, S. (2017). The Role of Parental Math Anxiety and Math Attitude in Their Children's Math Achievement. *International Journal Of Science And Mathematics Education*, 15(2), 331-347.

Southern, W. T., & Jones, E. D. (2004). Types of Acceleration: Dimensions and Issues. In N. Colangelo, S. G. Assouline, & M. U. M. Gross (Eds.), A Nation Deceived: How Schools Hold Back America's Brightest Students (Vol. II, pp. 5-12). Iowa City, IA: The Connie Belin & Jacqueline N. Blank International Center for Gifted Education and Talent Development.

Sparks, Sarah D. (2011). "Math Anxiety" Explored in Studies. *Education Week, 30* (31), 1.

Starkey, P., & Klein, A. (2000). Fostering Parental Support for Children's Mathematical Development: An Intervention with Head Start Families. *Early Education and Development*, 11, 659–680.

Stein, M. (2009). *Implementing Standards-based Mathematics Instruction: A Casebook for Professional Development* (2nd ed. / foreword by James Hiebert. ed.). Reston, Va. : New York: National Council of Teachers of Mathematics ; Teachers College Press.

Stonewater, J. K. (2002). The Mathematics Writer's Checklist: The Development of a Preliminary Assessment Tool for Writing in Mathematics. *School Science and Mathematics,* 102, 324–334.

Swan, P. &. Marshall, L. (2010). Revisiting Mathematics Manipulative Materials. *Australian Primary Mathematics Classroom,* 15(2), 13-19.

Swars, S., Smith, S., Smith, M, Carothers, J. & Myers, K. (2018). The Preparation Experiences of Elementary Mathematics Specialists: Examining Influences on Beliefs, Content Knowledge, and Teaching Practices. *Journal of Mathematics Teacher Education*, 21(2), 123-145.

Taljaard, Johann. (2016). A Review of Multi-Sensory Technologies in a Science, Technology, Engineering, Arts and Mathematics (STEAM) Classroom. *Journal of Learning Design*, 9(2), 46-55.

Tarr, J. E., Reys, R. E., Reys, B. J., Chavez, O., Shih, J., & Osterlind, S. J. (2008). The Impact of Middle Grades Mathematics Curricula and the Classroom Learning Environment on Student Achievement. *Journal for Research in Mathematics Education*, 39(3), 247–280.

Taylor, R. D. & Wang, M. C., (2000) (Eds.), Resilience Across Contexts: Family, Work, Culture, and Community, Lawrence Erlbaum Associates, Mahwah: NJ, pp. 333-363

Thames, M., & Ball, D. L. (2010). What Math Knowledge Does Teaching Require? *Teaching Children Mathematics*, 17(4), 220-229

Toll, S. W., & Van Luit, J. E. (2014). The Developmental Relationship Between Language and Low Early Numeracy Skills Throughout Kindergarten. *Exceptional Children*, 81, 64–78

Tucker, S. I. (2015). An Exploratory Study of Attributes, Affordances, Abilities, and Distance in Children’s Use of Mathematics Virtual Manipulative iPad Apps (Doctoral dissertation).

Tucker, S. I., Moyer-Packenham, P S., Westenskow, A & Jordan, K. E. (2016). The Complexity of the Affordance-Ability Relationship When Second-Grade Children Interact with Mathematics Virtual Manipulative Apps. *Technology, Knowledge and Learning*, 21(3), 341-360.

Uribe-Flórez, L., & Wilkins, J. (2017). Manipulative Use and Elementary School Students' Mathematics Learning. *International Journal of Science and Mathematics Education*, 15(8), 1541-1557.

Van de Weijer-Bergsma, E., Kroesbergen, E., & Van Luit, J. (2015). Verbal and Visual-spatial Working Memory and Mathematical Ability in Different Domains Throughout Primary School. *Memory & Cognition*, 43(3), 367-378.

Vander Ven, S. H. G., Vander Maas, H. L. J., Straatemeier, M., & Jansen, B. R.J. (2013). Visuospatial Working Memory and Mathematical Ability at Different Ages Throughout Primary School. *Learning and Individual Differences*, 27, 182–192

Vinson, B. (2001). A Comparison of Pre-service Teachers' Mathematics Anxiety Before and After a Methods Class Emphasizing Manipulatives. *Early Childhood Education Journal*, 29(2), 8994.

Volk, Cotič, Zajc, & Istenic Starcic. (2017). Tablet-based Cross-curricular Maths vs. Traditional Maths Classroom Practice for Higher-order Learning Outcomes. *Computers & Education*, 114, 1-23.

Vukovic, R. K., & Lesaux, N. K. (2013). The Language of Mathematics: Investigating the Ways Language Counts for Children's Mathematical Development. *Journal of Experimental Child Psychology*, 115, 227–244.

Wakefield, D. V. (2000). Math as a Second Language. *The Educational Forum*, 64(3), 272–279.

Warshauer, H. K. (2015). Productive Struggle in Middle School Mathematics Classrooms. *Journal of Mathematics Teacher Education*, 18(4), 375-400.

Wayman, P. (2003). Amazing Grades! Tune-in to Your Child’s Personal Learning Style & Create Higher Grades in Just 14 Days. Retrieved 26 August 2011 from: http://www.howtolearn.com/instantamazinggrades.html

Weiss, L. H. & Schwarz, J. C. (1996). The Relationship Between Parenting Types and Older Adolescents’ Personality, Academic Achievement, Adjustment, and Substance Use. *Child Development*, 67(5), 2101– 2114.

Wong-Lo, M., & Bai, H. (2013). Recommended Practices: Cultivating a Culturally Responsive Learning Environment for Chinese Immigrants and Chinese American Students. *Preventing School Failure: Alternative Education for Children and Youth*, *57*(1), 17-21.

Wood, D., Bruner, J. S., & Ross, G. (1976). The Role of Tutoring in Problem Solving. *Journal of Child Psychology and Psychiatry*, 17(2), 89–100

Woodard, T. (2004). The Effects of Math Anxiety on Post-secondary Developmental Students as Related to Achievement, Gender, and Age. *Inquiry*, 9(1), 1–5

Wu, H. H. (2009). What’s Sophisticated About Elementary Mathematics? *American Educator*, 33(3), 4–14.

Wyman, P. (2006). Instant Learning: Where the World Comes to Learn. Retrieved April, 22, 2006. http://www.howtolearn.com/lsioptin_teacher.html

Zakaria, E. & Nordin, N. M. (2008). The Effect of Mathematics Anxiety on Matriculation Students as Related to Motivation and Achievement. *Eurasia Journal of Mathematics, Science & Technology Education*, 4(1), 27–30.

Zamarian, L., Lopez-Rolon, A., & Delazer, M. (2007). Neuropsychological Case Studies on Arithmetic Processing. In D. B. Berch & M. M. M. Mazzocco (Eds.), Why is Math so Hard for Some Children? The Nature and Origins of Mathematical Learning Difficulties and Disabilities (pp. 245–264). Baltimore, MD: Paul Brookes.

PART TWO

A Parent’s Guide To

5th Grade Math Skills Lessons and Activities

Handbook

A Parent's Guide to

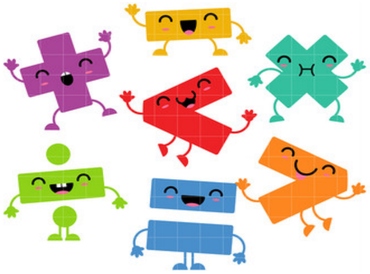
newkidscenter.com

5th Grade Math!

By

Gina Lynn Davis

Table of Contents


etsy.com

Dear Parents,

YOU can influence your student's math skills! Perhaps you do not realize it, but whenever you sort objects, read maps or schedules, compare prices, make change, or use a calculator or calendar, you are a model of mathematical behavior. When you measure, weigh, work with family finances, or figure out how much wallpaper will cover a wall, you are a living textbook!

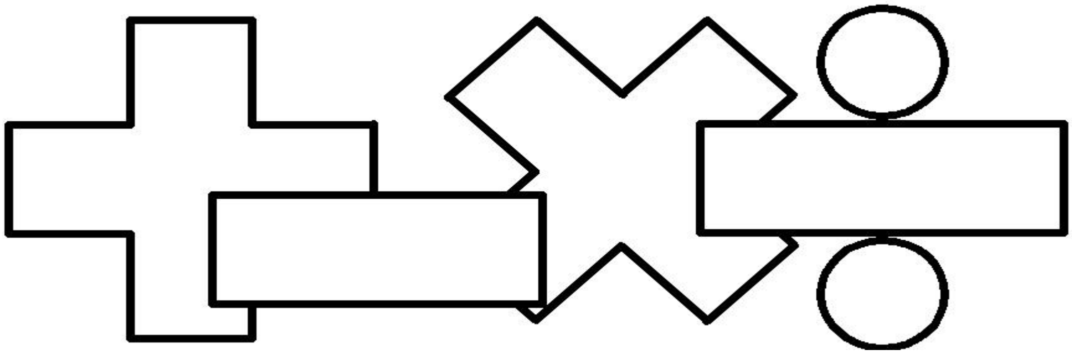
The best help you can give your student in math is to make your child aware of when and how to use math. Whenever possible, talk through activities with your child and encourage him/her to take part in them. Think out loud, make estimates, check them, correct mistakes, and try more than one way to solve a problem. When you do, you provide your child with important experiences in mathematical thinking!

parents.com

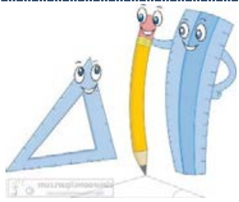
Parents can help their children succeed in mathematics by . . .

- Being positive about your own and your child's mathematics ability.
- Discussing with your child the importance of mathematics in his/her daily life and pointing out examples of how people use mathematics in daily life.
- Providing activities and objects that make mathematics interesting and fun at home.
- Encouraging your child to ask questions, solve problems, and to explain his/her solutions.
- Modeling how to solve math problems.
- Challenging your child in his/her areas of math strengths and providing support in areas of math weaknesses.

- Familiarizing yourself with books, games, resources, web sites, and television programs that encourage mathematics learning.
- Continuing to learn mathematics with your child!



lakegenevamath.com



Mathematics Tools in Your Home…

GAMES- board games, dice, cards, dominoes, bingo, checkers, chess, strategy games

CALCULATORS

CALENDARS

CAMERAS

COMPUTER

CONSTRUCTION SETS- blocks, tangrams, attribute blocks, Legos, puzzles, model kits, Etch-A-Sketch

KALEIDOSCOPES

MAPS and SCHEDULES

MATH ORIENTED BOOKS and MAGAZINES maze books, Highlights

MEASURING OBJECTS measuring cups, rulers, protractor, compass, tape measure, scales, balance, clocks, watches

NEWSPAPERS and CATALOGS

PENCILS and PAPER- Origami supplies

SMALL OBJECTS- buttons, coins, poker chips, dried beans, toothpicks, jellybeans, cookies

In this handbook, you will find instructions, lessons, examples and practice problems for fifth grade students to apply their understanding of fractions, now to the addition and subtraction of fractions with unlike denominators, the concept of fraction multiplication and division, and decimal addition and subtraction. They will analyze numeric patterns and relationships and graph ordered pairs on a coordinate plane. Your child will build on their understanding of geometry by recognizing attributes of geometrical shapes and calculating inside angle measurement and area of triangles and parallelograms.

The lessons are based on the Common Core Math Standards. Your child will:

- Write and interpret numerical expressions using parentheses, brackets, or braces, such as, “Add 8 and 7, then multiply by 2” is 2(8 + 7)
- Understand the place value system from thousandths to millions
- Fluently multiply multi-digit numbers using the standard algorithm
- Divide multi-digit numbers by two-digit divisors
- Read, write, and compare decimals to the thousandths
- Round decimals to any place
- Compute with multi-digit whole numbers and numbers with decimals to the hundredths
- Add and subtract fractions with unlike denominators
- Multiply fractions and mixed numbers

- Divide unit fractions by whole numbers and whole numbers by unit fractions
- Convert measurements and use in problem solving o 0.05 m = 5 cm or 2.5 feet = 30 inches
- Organize and explain data using a line plot
- Understand and find the volume of rectangular prisms
- Analyze number patterns
- Graph points on a coordinate graph
- Show a graph with an x and y axis with several points labeled by their coordinates
- Sort two-dimensional shapes into categories based on their properties
- Know what makes rectangles, parallelograms, and trapezoids different
- Be able to find the area of a triangle and parallelogram by knowing and understanding the formula for area of these shapes

Unit One: Operations and Algebraic Thinking

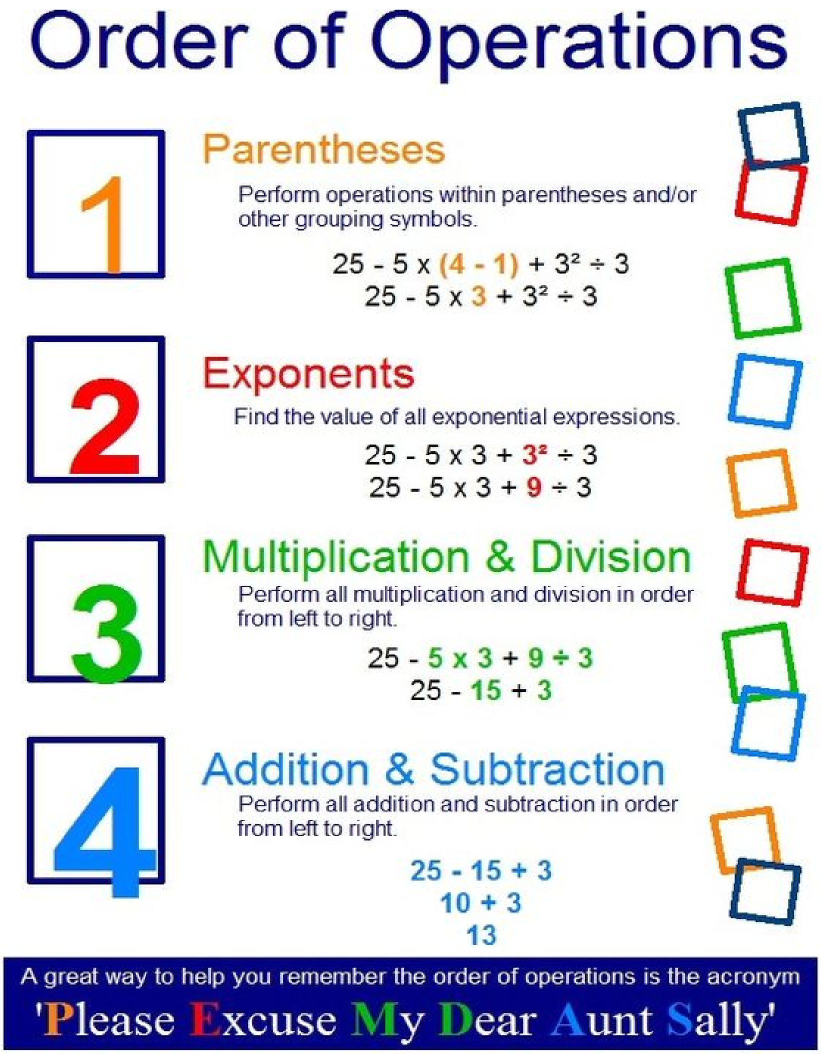
CCSS.MATH.CONTENT.5.OA.A.1

Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.

Overview: Students will be introduced to the acronym PEMDAS to simplify the order of operations. The lessons will emphasize how to solve expressions.

Purpose: The lesson is intended to introduce the order of operations and practice applying them to word problems.

Order of Operations is the standard sequence in which to perform operations in a mathematical expression.



Order of Operations

1 Parentheses

Perform operations within parentheses and/or other grouping symbols.

$25 - 5 \times (4 - 1) + 3^2 \div 3$

$25 - 5 \times 3 + 3^2 \div 3$

2 Exponents

Find the value of all exponential expressions.

$25 - 5 \times 3 + 3^2 \div 3$

$25 - 5 \times 3 + 9 \div 3$

3 Multiplication & Division

Perform all multiplication and division in order from left to right.

$25 - 5 \times 3 + 9 \div 3$

$25 - 15 + 3$

4 Addition & Subtraction

Perform all addition and subtraction in order from left to right.

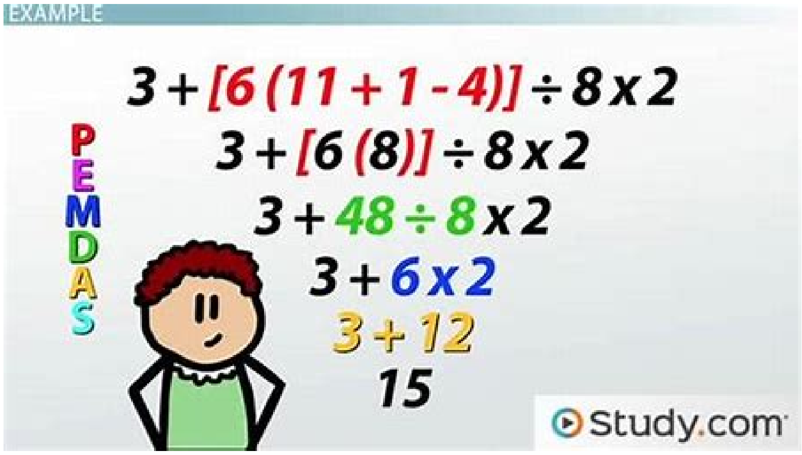
$25 - 15 + 3$

$10 + 3$

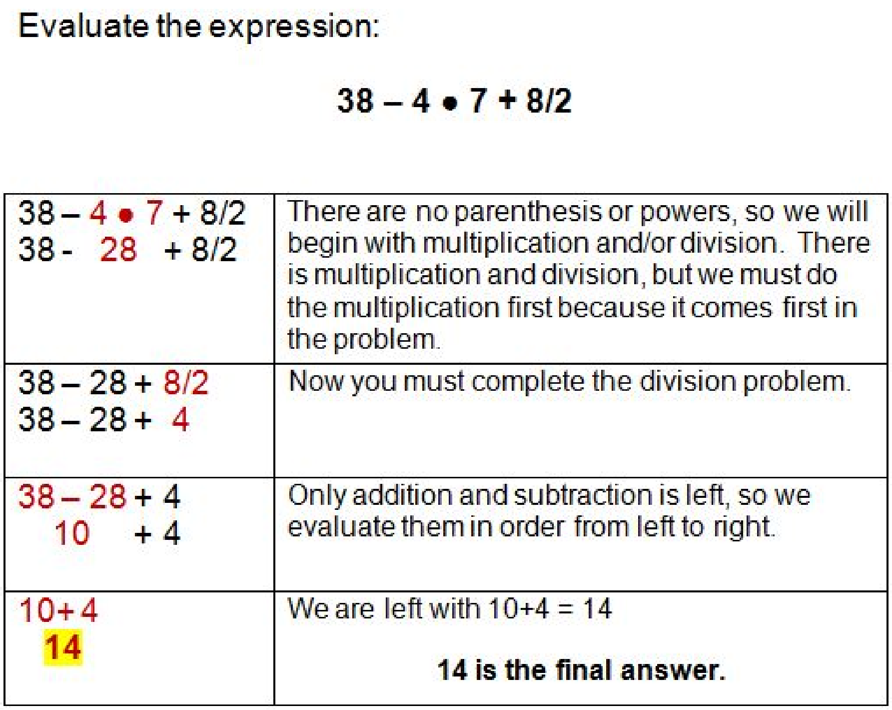
13

A great way to help you remember the order of operations is the acronym 'Please Excuse My Dear Aunt Sally'

pinterest.com



$$3 + [6\,(11 + 1 - 4)] \div 8 \times 2$$
$$3 + [6\,(8)] \div 8 \times 2$$
$$3 + 48 \div 8 \times 2$$
$$3 + 6 \times 2$$
$$3 + 12$$
$$15$$



Evaluate the expression:

38 – 4 ● 7 + 8/2

38 – 4 ● 7 + 8/2 38 - 28 + 8/2	There are no parenthesis or powers, so we will begin with multiplication and/or division. There is multiplication and division, but we must do the multiplication first because it comes first in the problem.
38 – 28 + 8/2 38 – 28 + 4	Now you must complete the division problem.
38 – 28 + 4 10 + 4	Only addition and subtraction is left, so we evaluate them in order from left to right.
10+4 14	We are left with 10+4 = 14 **14 is the final answer.**

yousearch.com

Example: $27 \div (2 + 1)^2 \text{ x } 6 - 11$

First, we must solve anything that is inside parentheses! $(2 + 1) = 3$

$27 \div (3)^2 \text{ x } 6 - 11$

Second, we must do the exponents! $(3)^2 = 9$

$27 \div 9 \text{ x } 6 - 11$

Next, we do the division! $27 \div 9 = 3$

$3 \text{ x } 6 - 11$

Next, we multiply! $3 \text{ x } 6 = 18$

$18 - 11$

Finally, we subtract! $18 - 11 =$ **7** ☺

Now you try!

Evaluating Numerical Expressions:

A. $2\times6^2 =$ _____ $2\times4+9 =$ _____ $2+3\times8 =$ _____ $2\times(8-6) =$ _____

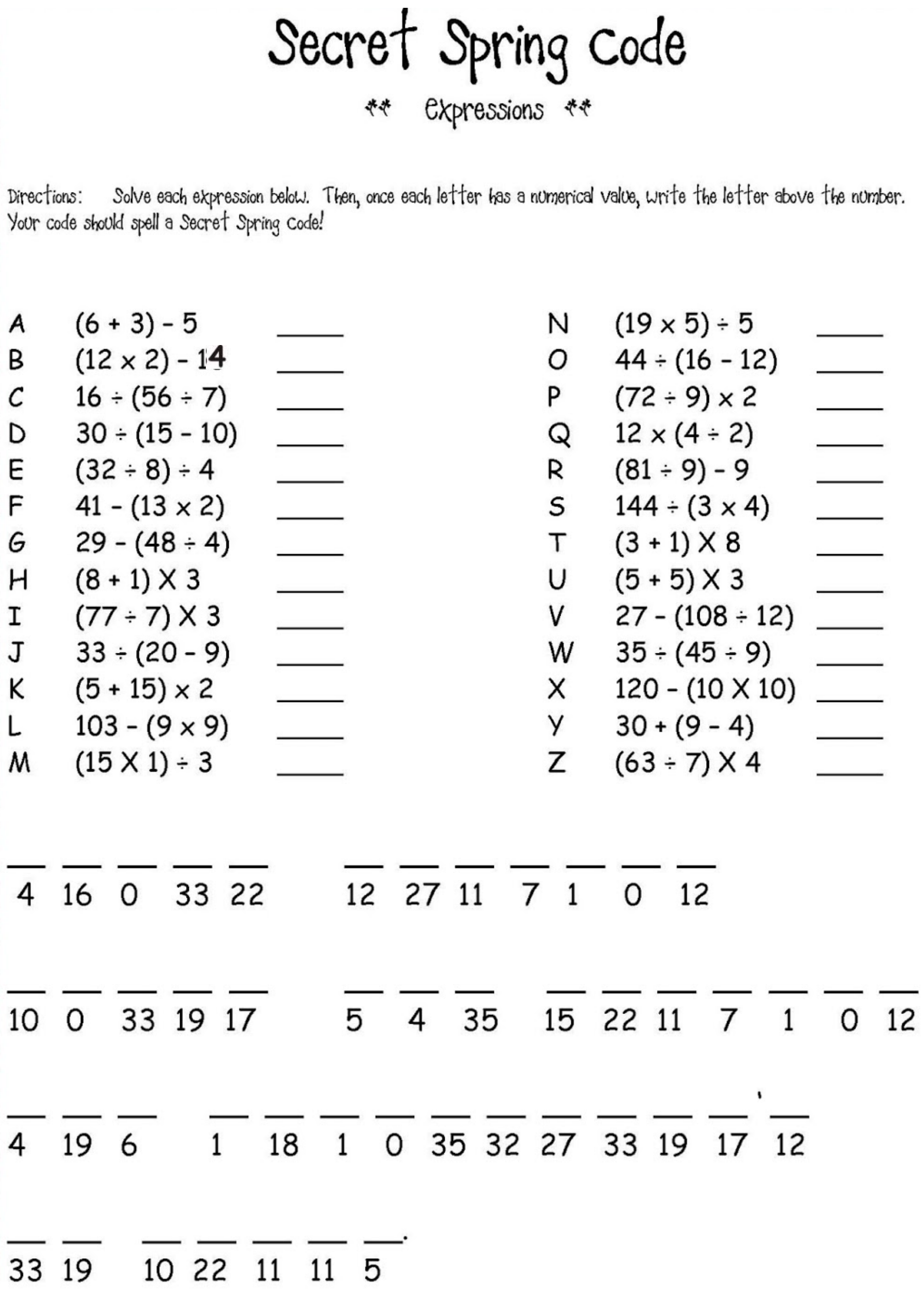
$3+9^2 =$ _____ $(9-5)\times4 =$ _____ $9+7\times5 =$ _____ $10+3^3 =$ _____

B. $10-3^3\div9 =$ _____ $72 \div (6+3) =$ _____ $7\times5 - 2^2 =$ _____

$(6+2^2) \times 10 =$ _____ $3 \times 6+ 8^2 =$ _____ $4^3-10 \div 5 =$ _____

C. $(10 + 2 - 5) \times (6^2 \div (8 - 4)) =$ _____ $10 + 8 - 6^2 \div (3^2 \times 4) =$ _____

$8 \div (10 - 9)^3 \times 7 + 4^2 =$ _____ $((10 \times (6 + 4)) \div (3^3-17)^2 =$ _____



Secret Spring Code

** Expressions **

Directions: Solve each expression below. Then, once each letter has a numerical value, write the letter above the number. Your code should spell a Secret Spring Code!

A	(6 + 3) - 5	____		N	(19 x 5) ÷ 5	____
B	(12 x 2) - 14	____		O	44 ÷ (16 - 12)	____
C	16 ÷ (56 ÷ 7)	____		P	(72 ÷ 9) x 2	____
D	30 ÷ (15 - 10)	____		Q	12 x (4 ÷ 2)	____
E	(32 ÷ 8) ÷ 4	____		R	(81 ÷ 9) - 9	____
F	41 - (13 x 2)	____		S	144 ÷ (3 x 4)	____
G	29 - (48 ÷ 4)	____		T	(3 + 1) X 8	____
H	(8 + 1) X 3	____		U	(5 + 5) X 3	____
I	(77 ÷ 7) X 3	____		V	27 - (108 ÷ 12)	____
J	33 ÷ (20 - 9)	____		W	35 ÷ (45 ÷ 9)	____
K	(5 + 15) x 2	____		X	120 - (10 X 10)	____
L	103 - (9 x 9)	____		Y	30 + (9 - 4)	____
M	(15 X 1) ÷ 3	____		Z	(63 ÷ 7) X 4	____

4 16 0 33 22   12 27 11 7 1 0 12

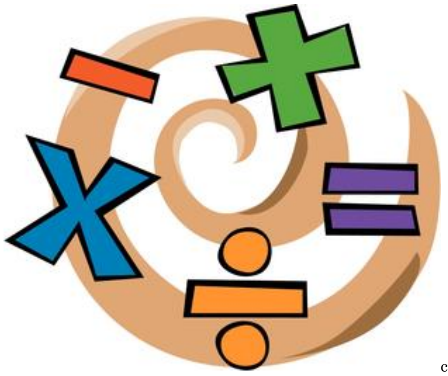
10 0 33 19 17   5 4 35   15 22 11 7 1 0 12

4 19 6   1 18 1 0 35 32 27 33 19 17 ' 12

33 19   10 22 11 11 5.

pinterest.com

chibird.com



cutebasic.blogspot.com

Parentheses, Brackets, and Braces in Expressions –

Explanation#1

Solve the bigger bracket [(6 x 3) – 3]

6 x 3 = 18

18 – 3 = 15

[(6 x 3) – 3] = **15**

Explanation #2

[(7 x 7) + 1] x (10 – 8)

7 x 7 = 49   (Solve the bigger bracket first.)

49 + 1 = 50

50 x (10 – 8) (Look at where we are now.)

10 – 8 = 2   (Solve the smaller bracket.)

10 x 2 = **100**   (multiply the numbers.)

Order of Operations Word Problems

tdittrich.blogspot.com

1. Ravi has $350. He spends $110 on food. Later he divides all the money into four parts out of which three parts were distributed to his brothers and one part he keeps for himself. Then he found $20 on the road. Write the final expression and find the money he has left?

2. Julie bought 3 notebooks for $1.20 each, two boxes of pencils for $1.50 each, and a box of pens for $1.70. She had $10.00 to spend. How much money did Sally have left? What could she do with that left-over money?

Old Mc Darrell’s Farm

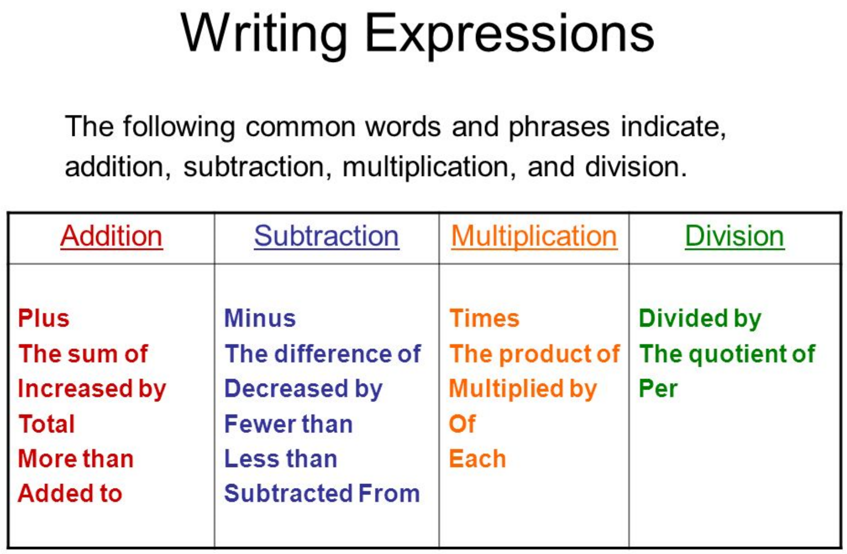
Sheep	26
Cows	4
Goats	20
Horses	5
Cats	10
Dogs	8
Chickens	12

3. Old Mc Darrell gives his neighbor half of his sheep and one horse. One of the dogs has 6 puppies and a cat has 4 kittens. Four puppies and 2 kittens are given to farm workers. Five goats are sold. How many animals are left on the farm?

4. Cows and horses cost $250 each and sheep and goats each cost $200 at the county fair. Chickens sell for $50. How much could McDonald make by selling his cows, horses, sheep, goats and chickens?

CCSS.MATH.CONTENT.5.OA.A.2

Write simple expressions that record calculations with numbers and interpret numerical expressions without evaluating them. *For example, express the calculation "add 8 and 7, then multiply by 2" as 2 × (8 + 7).*



Writing Expressions

The following common words and phrases indicate, addition, subtraction, multiplication, and division.

Addition	Subtraction	Multiplication	Division
Plus **The sum of** **Increased by** **Total** **More than** **Added to**	**Minus** **The difference of** **Decreased by** **Fewer than** **Less than** **Subtracted From**	**Times** **The product of** **Multiplied by** **Of** **Each**	**Divided by** **The quotient of** **Per**

slideplayer.com

Example: The sum of three and four, then multiplied by two:

First, the sum of three and four: 3 + 4 = 7

Then, multiplied by two: 7 x 2 = **14** ☺

It is written as: (3+4) x 2 = 14

Now you try!

Write a numerical expression to represent each description, then solve for the answer:

1.) The difference of twelve and five ____________________

2.) The product of four and eight _______________________

3.) The quotient of twenty-four and six, then multiplied by three.
____

4.) The sum of fifteen and seven divided by two. _________

5.) Three times the sum of four and one._________________

6.) Seven added to the difference of nine and five. _______

7.) Twelve times two divided by three.___________________

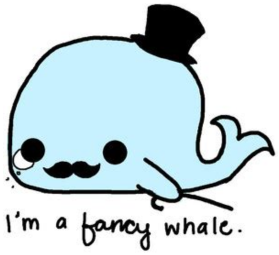
8.) The difference between fourteen and eight added to
five.____

9.) The quotient of thirty-five and five multiplied by three.
____

CCSS.MATH.CONTENT.5.OA.B.3

Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns and graph the ordered pairs on a coordinate plane. *For example, given the rule "Add 3" and the starting number 0, and given the rule "Add 6" and the starting number 0, generate terms in the resulting sequences, and observe that the terms in one sequence are twice the corresponding terms in the other sequence. Explain informally why this is so.*

Tables Rule!



Number of dogs	Legs
1	4
2	
5	20
	32
10	

Rule ______________

Teams	Students
1	5
3	
	25
7	
12	

Rule ______________

Dan's age	Sam's age
2	6
3	
4	8
	9
10	

Rule ______________

Original Price	Sale Price
$10	$8
$14	
	$16
$26	
$30	

Rule ______________

Example: Gwen earns $5 every week for feeding her cat.

How much will she earn on the 8th week?

Week	$
1	5
2	10
3	15
4	20
5	25
6	30
7	35
8	**40**
9	45
10	50

Now you try!

Penny baked cakes for all her friends' birthdays!

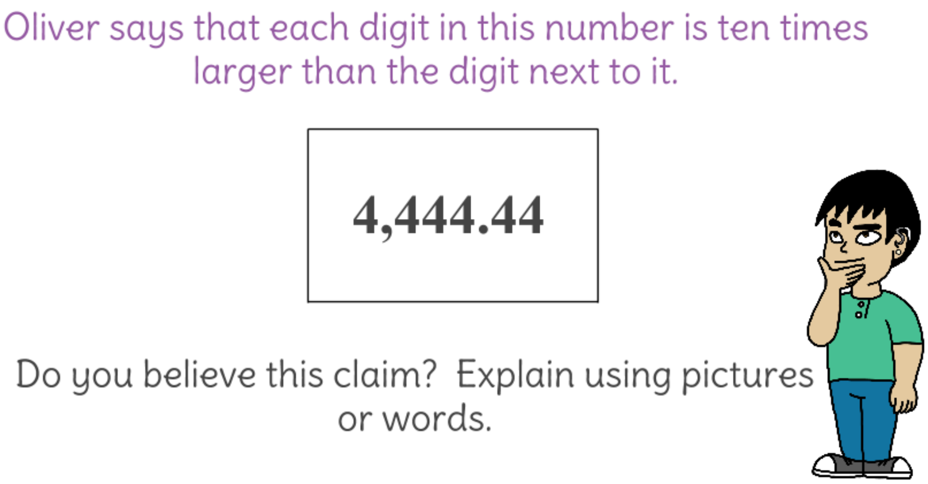
If her friends have a birthday each month, how many cakes will she have made by August?

Month	Cakes
January	1
February	2
March	3
December	12

Unit Two: Number and Operations with Base Ten

CCSS.MATH.CONTENT.5.NBT.A.1

Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left.

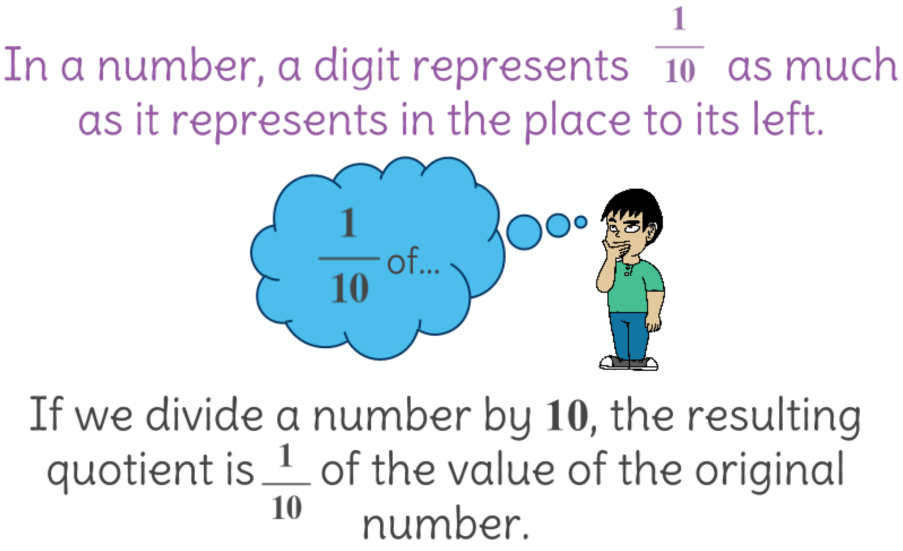


Oliver says that each digit in this number is ten times larger than the digit next to it.

4,444.44

Do you believe this claim? Explain using pictures or words.

teacherspayteachers.com



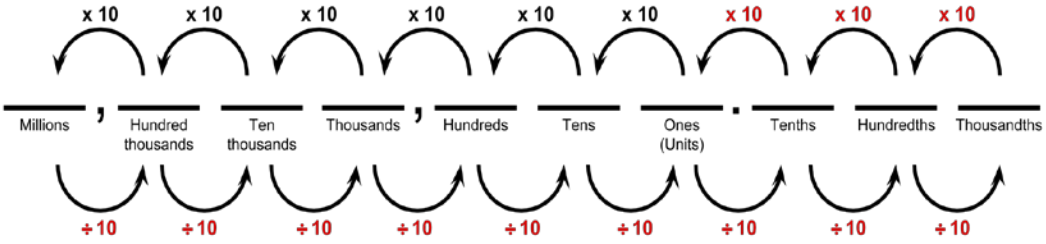
In a number, a digit represents $\frac{1}{10}$ as much as it represents in the place to its left.

If we divide a number by **10**, the resulting quotient is $\frac{1}{10}$ of the value of the original number.

As you move to the *left*, you multiply the place by 10.

As you move to the *right*, you divide the place by 10.

That will help you find the value of the number!



cpalms.org

Example:

4,536,721

6 is in the thousands place. What place is the 3 in?? Multiply the place by 10 (1000 x 10) to get ten thousands place!

Now to find the value, multiply by 3!   Its 30,000! ☺

The 7 is in the hundreds place. What place is the 2 in?? (Divide the place by 10 (100 ÷ 10) to get the tens place!

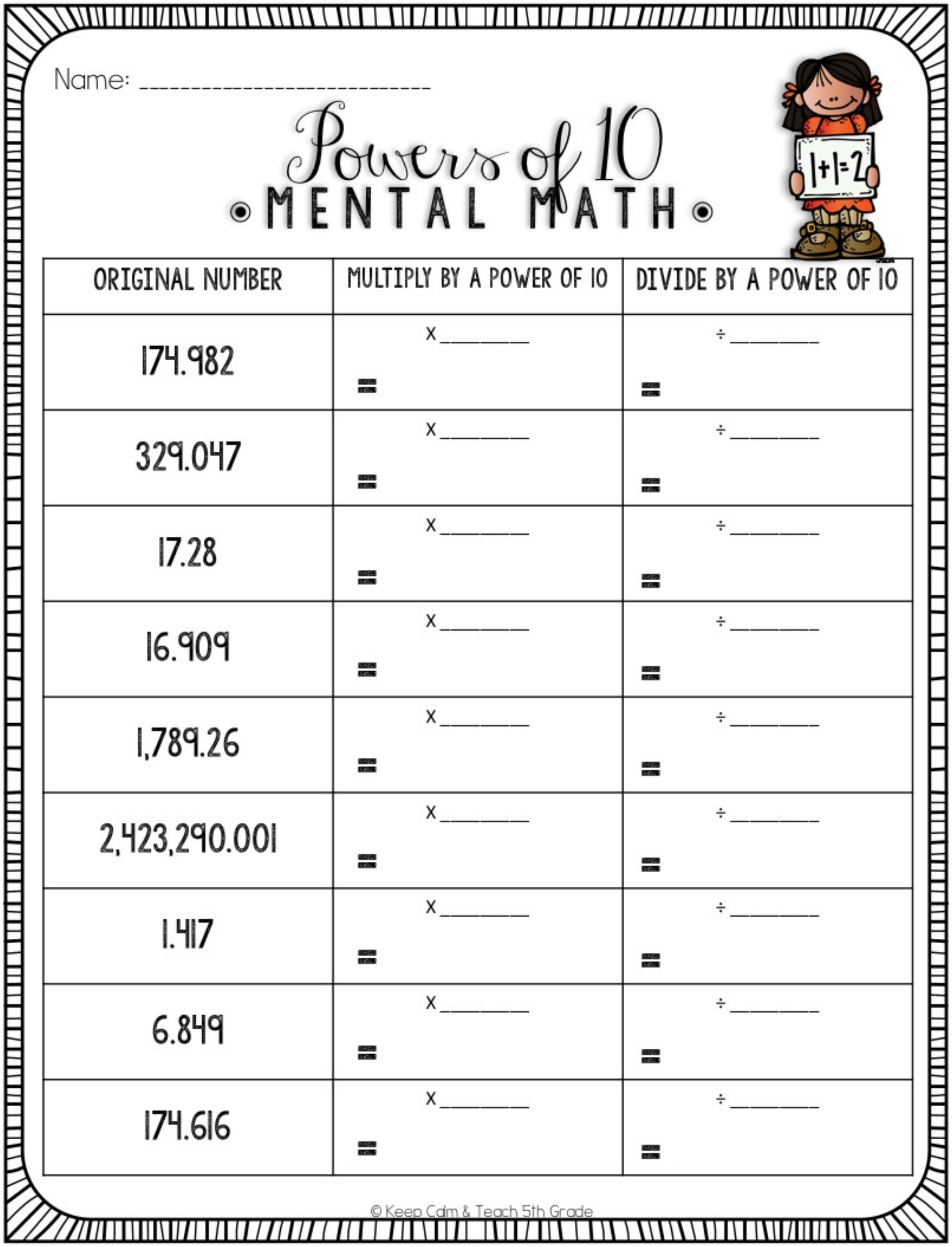
Now to find the value, multiply by 2!   Its 20! ☺

What is the value of the 5??

What is the value of the 4??

CCSS.MATH.CONTENT.5.NBT.A.2

Explain patterns in the number of zeros of the product when multiplying a number by powers of 10 and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.



Name: ______________________________

Powers of 10

MENTAL MATH

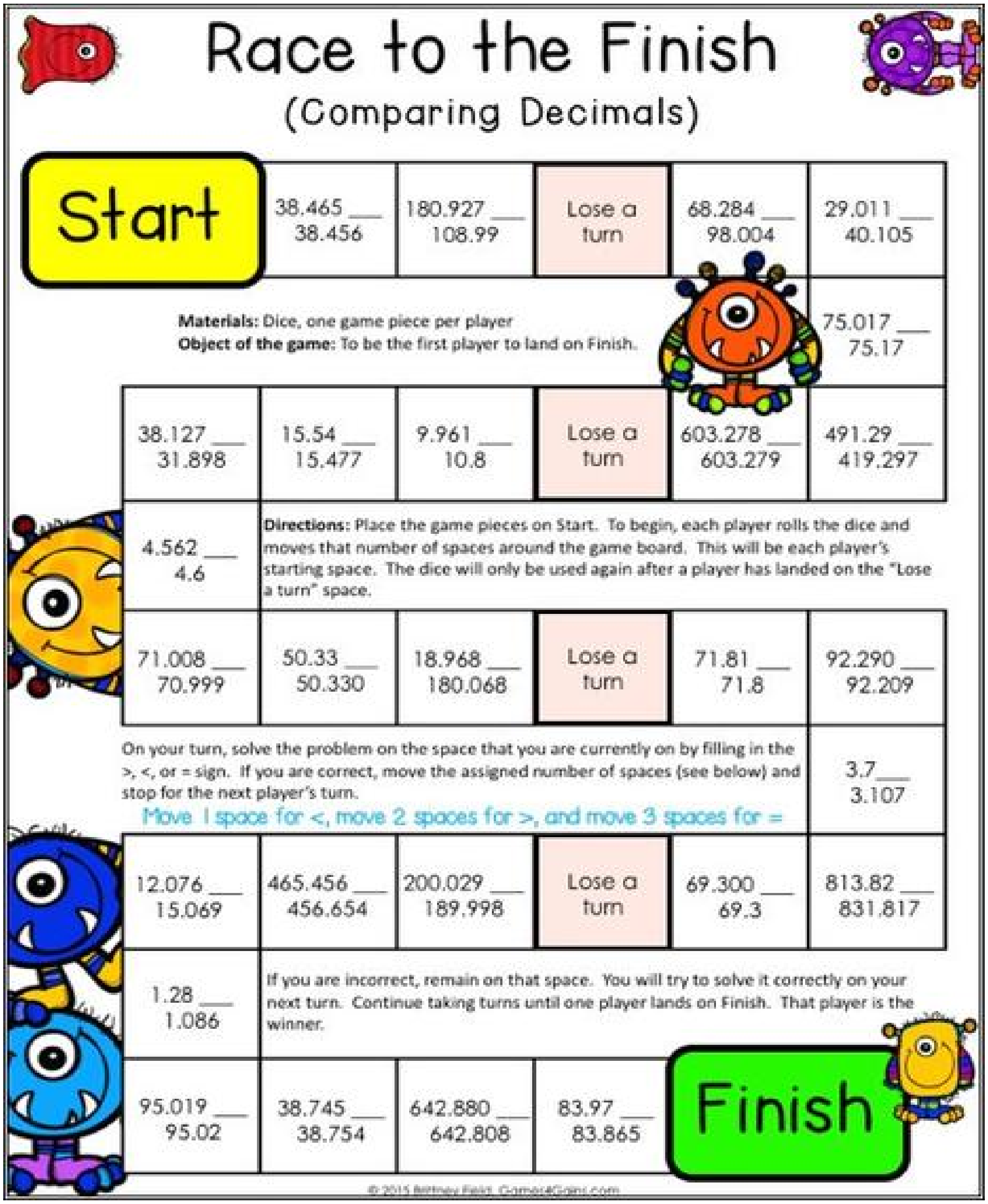
ORIGINAL NUMBER	MULTIPLY BY A POWER OF 10	DIVIDE BY A POWER OF 10
174.982	x ________ =	÷ ________ =
329.047	x ________ =	÷ ________ =
17.28	x ________ =	÷ ________ =
16.909	x ________ =	÷ ________ =
1,789.26	x ________ =	÷ ________ =
2,423,290.001	x ________ =	÷ ________ =
1.417	x ________ =	÷ ________ =
6.849	x ________ =	÷ ________ =
174.616	x ________ =	÷ ________ =

CCSS.MATH.CONTENT.5.NBT.A.3   CCSS.MATH.CONTENT.5.NBT.A.3.B

Read, write, and compare decimals to thousandths.
Compare two decimals to thousandths based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.

You will need:  and  .

Don't forget the < eats the largest number! (45.25 < 45.27)



Race to the Finish

(Comparing Decimals)

Start

38.465 ___ 38.456

180.927 ___ 108.99

Lose a turn

68.284 ___ 98.004

29.011 ___ 40.105

Materials: Dice, one game piece per player
Object of the game: To be the first player to land on Finish.

75.017 ___ 75.17

491.29 ___ 419.297

603.278 ___ 603.279

Lose a turn

9.961 ___ 10.8

15.54 ___ 15.477

38.127 ___ 31.898

4.562 ___ 4.6

Directions: Place the game pieces on Start. To begin, each player rolls the dice and moves that number of spaces around the game board. This will be each player's starting space. The dice will only be used again after a player has landed on the "Lose a turn" space.

71.008 ___ 70.999

50.33 ___ 50.330

18.968 ___ 180.068

Lose a turn

71.81 ___ 71.8

92.290 ___ 92.209

On your turn, solve the problem on the space that you are currently on by filling in the >, <, or = sign. If you are correct, move the assigned number of spaces (see below) and stop for the next player's turn.
Move 1 space for <, move 2 spaces for >, and move 3 spaces for =

3.7___ 3.107

813.82 ___ 831.817

69.300 ___ 69.3

Lose a turn

200.029 ___ 189.998

465.456 ___ 456.654

12.076 ___ 15.069

1.28 ___ 1.086

If you are incorrect, remain on that space. You will try to solve it correctly on your next turn. Continue taking turns until one player lands on Finish. That player is the winner.

95.019 ___ 95.02

38.745 ___ 38.754

642.880 ___ 642.808

83.97 ___ 83.865

Finish

CCSS.MATH.CONTENT.5.NBT.A.3.A

Read and write decimals to thousandths using base-ten numerals, number names, and expanded form.

canstockphoto.com

Standard form: Numbers written using ONLY numbers.

Example: 3,254.968

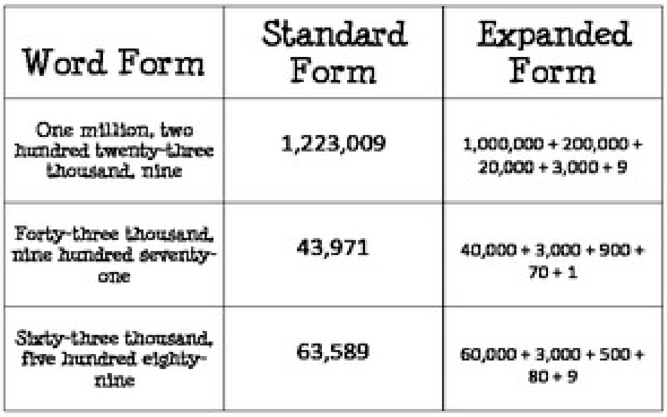
Expanded form: Numbers written by showing the value of each digit.

Example: (3 x 1000 + 2 x 100 + 5 x 10 + 4 x 1 + 9 x 1/10 + 6 x 1/100 + 8 x 1/1000)

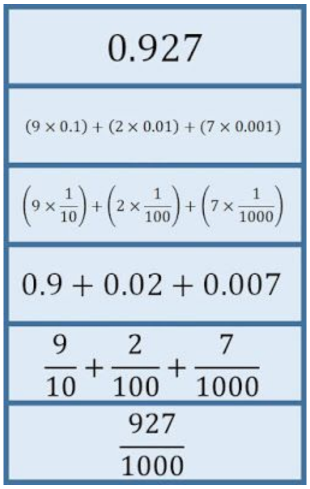
*Also 3000 + 200 + 50 + 4 + 9/10 + 6/100 + 8/1000

Word form: Numbers written using ONLY words.

Example: Three thousand, two hundred fifty-four and nine hundred and sixty-eight thousandths.



Word Form	Standard Form	Expanded Form
One million, two hundred twenty-three thousand, nine	1,223,009	1,000,000 + 200,000 + 20,000 + 3,000 + 9
Forty-three thousand, nine hundred seventy-one	43,971	40,000 + 3,000 + 900 + 70 + 1
Sixty-three thousand, five hundred eighty-nine	63,589	60,000 + 3,000 + 500 + 80 + 9



0.927

$(9 \times 0.1) + (2 \times 0.01) + (7 \times 0.001)$

$\left(9 \times \frac{1}{10}\right) + \left(2 \times \frac{1}{100}\right) + \left(7 \times \frac{1}{1000}\right)$

$0.9 + 0.02 + 0.007$

$\frac{9}{10} + \frac{2}{100} + \frac{7}{1000}$

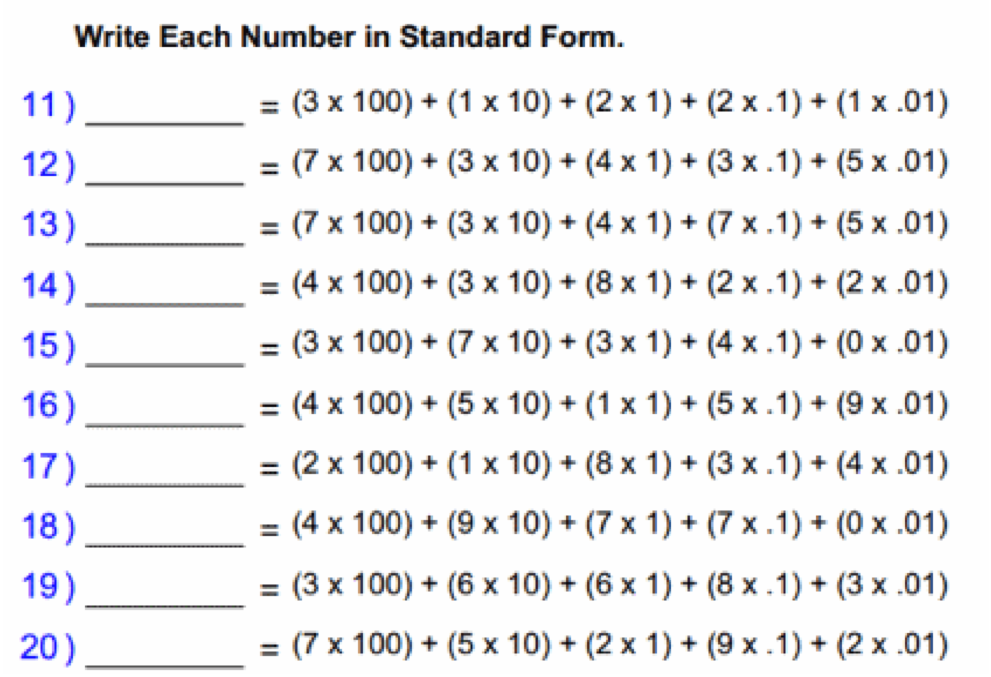
$\frac{927}{1000}$

A Matching Game!

3152Cut out the pieces and match the number or words with the correct form!

Word Form	Expanded Form	Standard Form
254	300+60+7	five hundred ninety
three hundred sixty-seven	590	200+50+4
434	two hundred fifty-four	four hundred thirty-four
500+90	400+30+4	367

pinterest.com



Write Each Number in Standard Form.

11) ________ = (3 x 100) + (1 x 10) + (2 x 1) + (2 x .1) + (1 x .01)

12) ________ = (7 x 100) + (3 x 10) + (4 x 1) + (3 x .1) + (5 x .01)

13) ________ = (7 x 100) + (3 x 10) + (4 x 1) + (7 x .1) + (5 x .01)

14) ________ = (4 x 100) + (3 x 10) + (8 x 1) + (2 x .1) + (2 x .01)

15) ________ = (3 x 100) + (7 x 10) + (3 x 1) + (4 x .1) + (0 x .01)

16) ________ = (4 x 100) + (5 x 10) + (1 x 1) + (5 x .1) + (9 x .01)

17) ________ = (2 x 100) + (1 x 10) + (8 x 1) + (3 x .1) + (4 x .01)

18) ________ = (4 x 100) + (9 x 10) + (7 x 1) + (7 x .1) + (0 x .01)

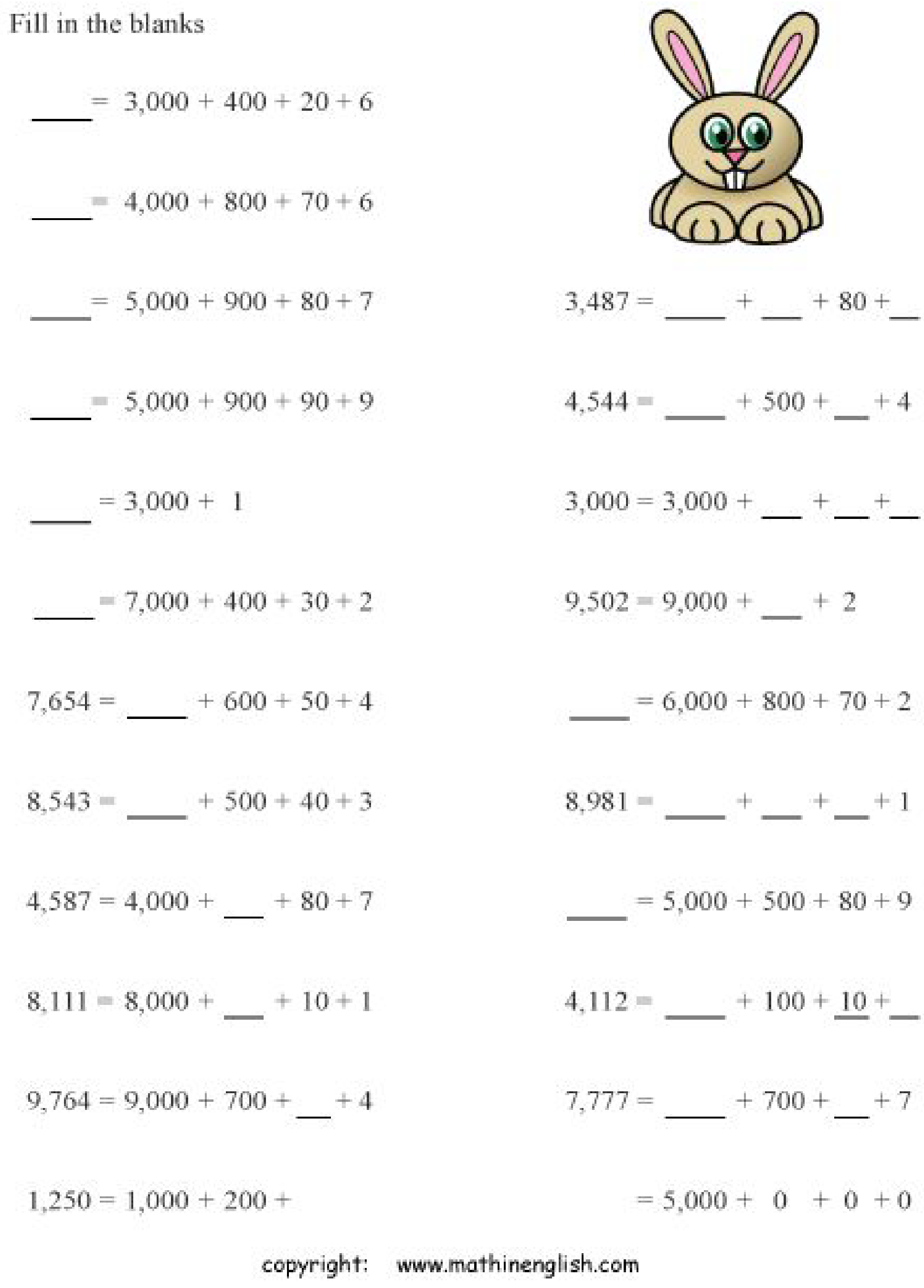
19) ________ = (3 x 100) + (6 x 10) + (6 x 1) + (8 x .1) + (3 x .01)

20) ________ = (7 x 100) + (5 x 10) + (2 x 1) + (9 x .1) + (2 x .01)

mathchimp.com

Expanded Notation

Write or fill in the missing numbers.



Fill in the blanks

____ = 3,000 + 400 + 20 + 6

____ = 4,000 + 800 + 70 + 6

____ = 5,000 + 900 + 80 + 7

____ = 5,000 + 900 + 90 + 9

____ = 3,000 + 1

____ = 7,000 + 400 + 30 + 2

7,654 = ____ + 600 + 50 + 4

8,543 = ____ + 500 + 40 + 3

4,587 = 4,000 + ___ + 80 + 7

8,111 = 8,000 + ___ + 10 + 1

9,764 = 9,000 + 700 + ___ + 4

1,250 = 1,000 + 200 +

3,487 = ____ + ___ + 80 + ___

4,544 = ____ + 500 + ___ + 4

3,000 = 3,000 + ___ + ___ + ___

9,502 = 9,000 + ___ + 2

____ = 6,000 + 800 + 70 + 2

8,981 = ____ + ___ + ___ + 1

____ = 5,000 + 500 + 80 + 9

4,112 = ____ + 100 + 10 + ___

7,777 = ____ + 700 + ___ + 7

= 5,000 + 0 + 0 + 0

Write these in word form:

1.) 45.332

2.) 23.1

3.) 4, 219

4.) 15, 774

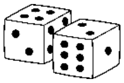
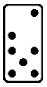
5.) 889.5

6.) 775

7.) 16

8.) 434.11

Create your own numbers!

You will need:  or 

Standard Unit and Expanded Form

**Roll the die or pick out a domino. Write the numbers in the standard form box, then finish the expanded and unit forms.

- Expanded: 47.93 = 40 + 7 + .9 + .03 OR (4 x 10) + (7 x 1) + (9 x 0.1) + (3 x 0.01)
- Unit: 47.93 = 4 tens, 7 ones, 9 tenths, 3 hundredths

Standard Form	Expanded Form	Unit Form
___ ___ ___ . ___ ___		
___ ___ . ___ ___ ___		
___ ___ . ___		
___ ___ ___ . ___		
___ ___ . ___ ___		

keepcalmandteachfifthgrade.blogspot.com

Rounding Decimals

CCSS.MATH.CONTENT.5.NBT.A.4

Use place value understanding to round decimals to any place. Perform operations with multi-digit whole numbers and with decimals to hundredths.

Find you place, then look next door,

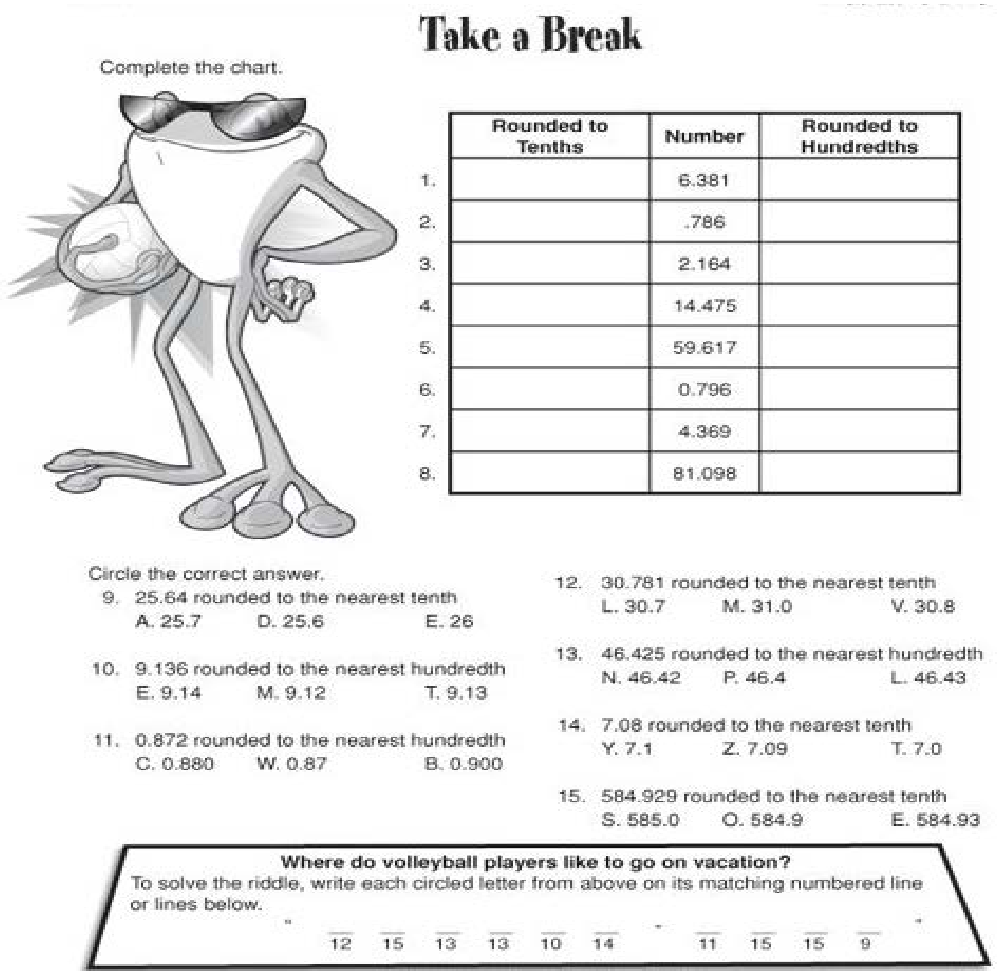
if 5 or greater, just add one more!

All the digits in front remain the same…all the digits behind, well, zero is now their name!

Example: Round to the nearest tenths.

38.47 38.47 (five or greater, add one more!)

= 38.50



Take a Break

Complete the chart.

	Rounded to Tenths	Number	Rounded to Hundredths
1.		6.381	
2.		.786	
3.		2.164	
4.		14.475	
5.		59.617	
6.		0.796	
7.		4.369	
8.		81.098	

Circle the correct answer.

9. 25.64 rounded to the nearest tenth
A. 25.7 D. 25.6 E. 26

10. 9.136 rounded to the nearest hundredth
E. 9.14 M. 9.12 T. 9.13

11. 0.872 rounded to the nearest hundredth
C. 0.880 W. 0.87 B. 0.900

12. 30.781 rounded to the nearest tenth
L. 30.7 M. 31.0 V. 30.8

13. 46.425 rounded to the nearest hundredth
N. 46.42 P. 46.4 L. 46.43

14. 7.08 rounded to the nearest tenth
Y. 7.1 Z. 7.09 T. 7.0

15. 584.929 rounded to the nearest tenth
S. 585.0 O. 584.9 E. 584.93

Where do volleyball players like to go on vacation?

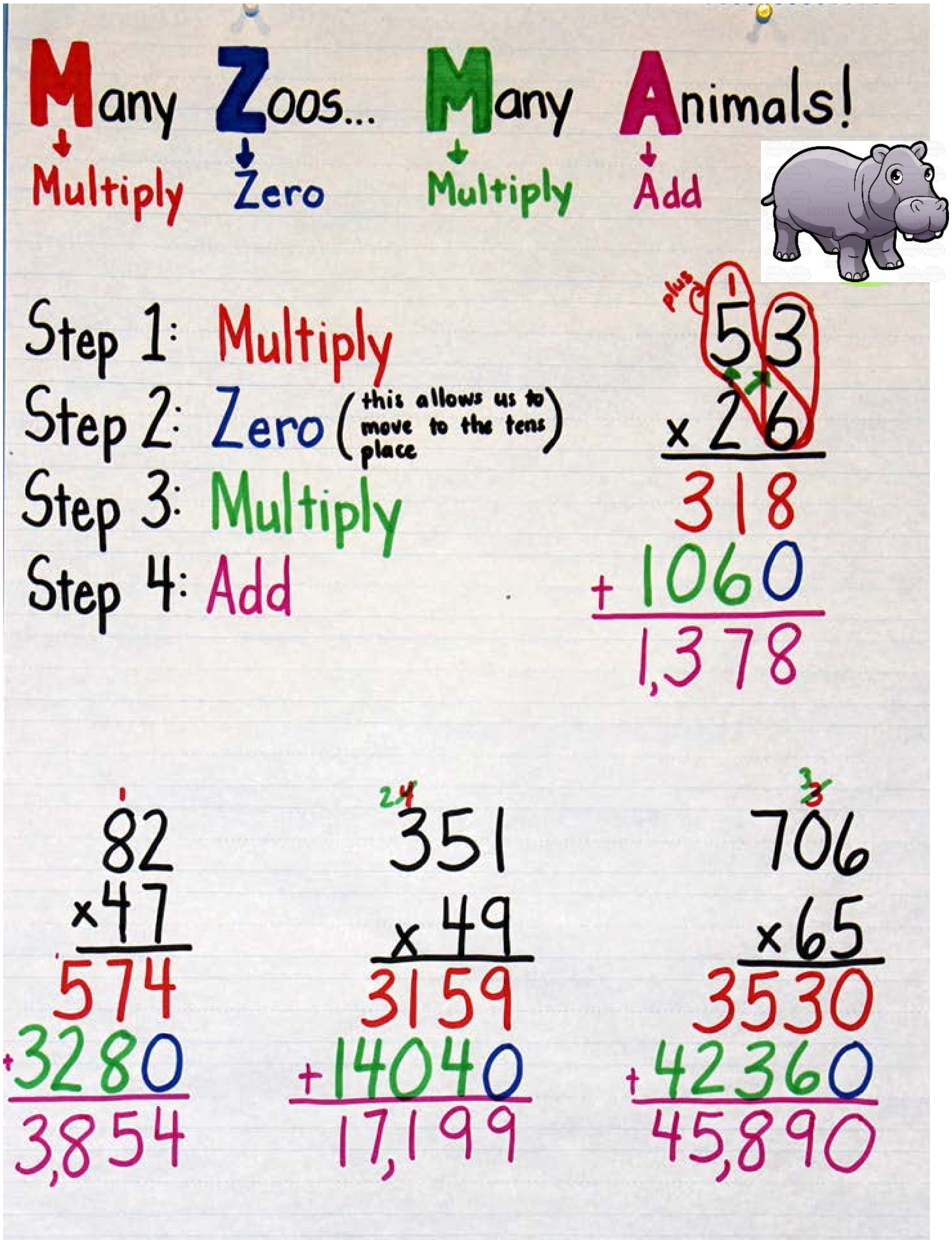
To solve the riddle, write each circled letter from above on its matching numbered line or lines below.

" ___ ___ ___ ___ ___ ___ - ___ ___ ___ ___ ."
12 15 13 13 10 14 11 15 15 9

ideastocker.com

CCSS.MATH.CONTENT.5.NBT.B.5

Fluently multiply multi-digit whole numbers using the standard algorithm.



Many Zoos... Many Animals!

Multiply Zero Multiply Add

Step 1: Multiply

Step 2: Zero (this allows us to move to the tens place)

Step 3: Multiply

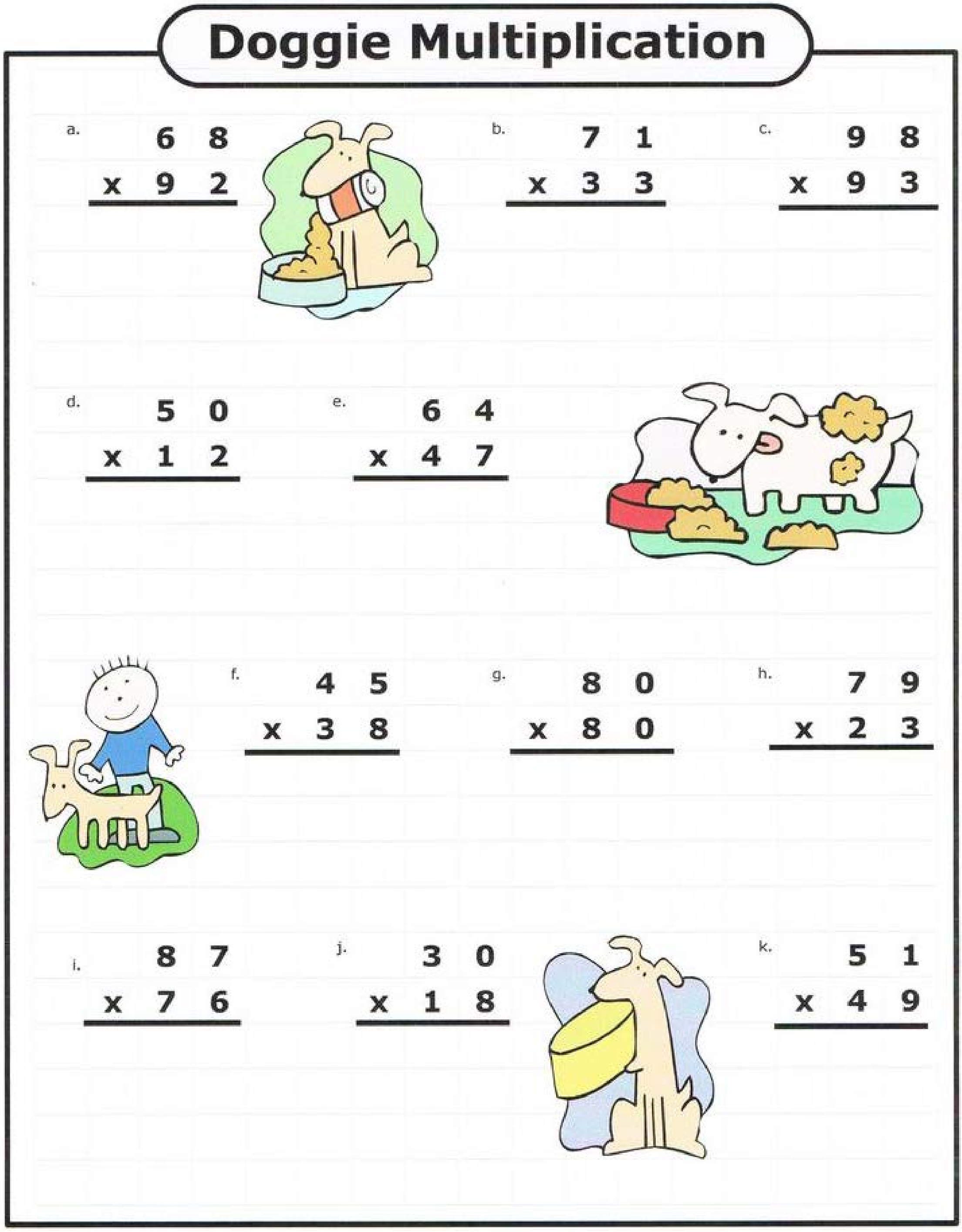
Step 4: Add

$$\begin{array}{r} \overset{1}{5}3 \\ \times\ 26 \\ \hline 318 \\ +\ 1060 \\ \hline 1{,}378 \end{array}$$

$$\begin{array}{r} \overset{1}{8}2 \\ \times 47 \\ \hline 574 \\ +3280 \\ \hline 3{,}854 \end{array} \qquad \begin{array}{r} {}^{2\,4}351 \\ \times\ 49 \\ \hline 3159 \\ +14040 \\ \hline 17{,}199 \end{array} \qquad \begin{array}{r} \overset{3}{7}06 \\ \times 65 \\ \hline 3530 \\ +42360 \\ \hline 45{,}890 \end{array}$$

crafting-connections.blogspot.com

Multiply these numbers to keep the doggies happy!



Doggie Multiplication

a.
6 8
x 9 2

b.
7 1
x 3 3

c.
9 8
x 9 3

d.
5 0
x 1 2

e.
6 4
x 4 7

f.
4 5
x 3 8

g.
8 0
x 8 0

h.
7 9
x 2 3

i.
8 7
x 7 6

j.
3 0
x 1 8

k.
5 1
x 4 9

gigidiaries.com

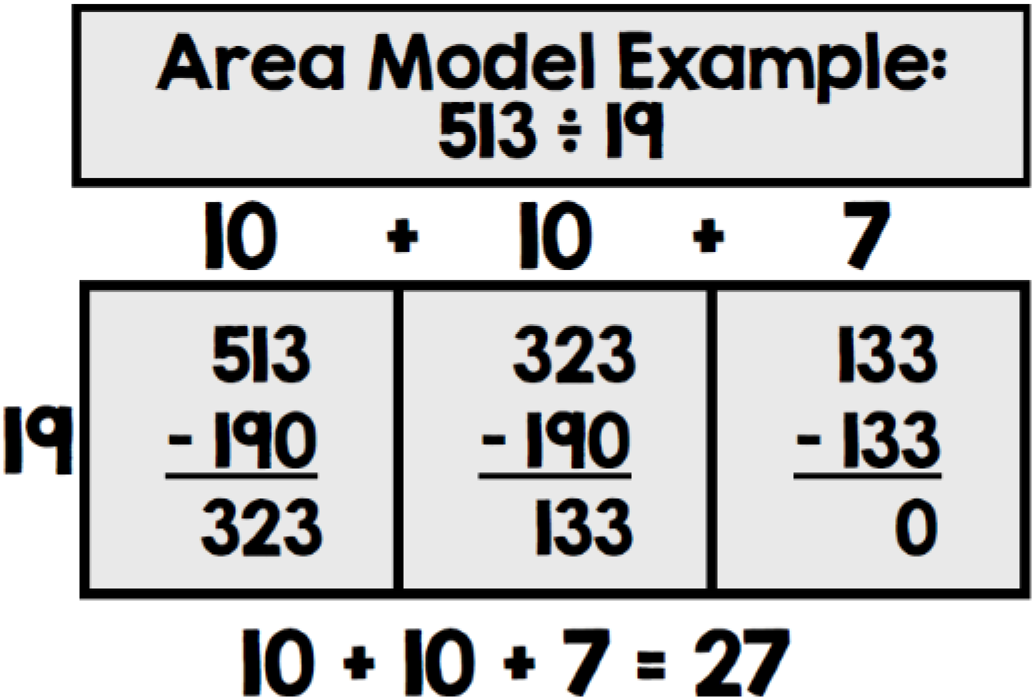
CCSS.MATH.CONTENT.5.NBT.B.6

Find whole-number quotients of whole numbers with up to four-digit dividends and two-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.

(The dividend is the number being divided, the divisor is the number by which the dividend is divided, and the quotient is the result of the division. With **a** ÷ **b** = **c**,   **a** is the dividend, **b** is the divisor and **c** is the quotient.)

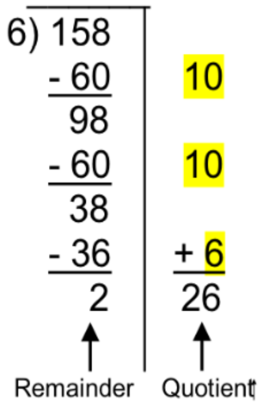
Area Model of Division:

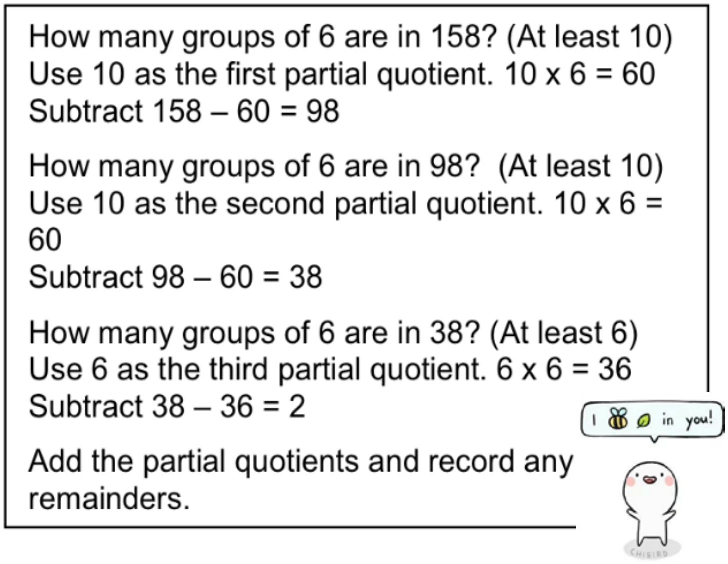
1.) Multiply the divisor by 10 or 100.
2.) Subtract that number from the dividend.
3.) Multiply the divisor by 10 or 100.
4.) Subtract again from the remaining number.
5.) Divide the divisor into the remaining number.
6.) Add all the numbers together.



investorsgrouphamilton.com

Another example:




How many groups of 6 are in 158? (At least 10)
Use 10 as the first partial quotient. 10 x 6 = 60
Subtract 158 – 60 = 98

How many groups of 6 are in 98? (At least 10)
Use 10 as the second partial quotient. 10 x 6 = 60
Subtract 98 – 60 = 38

How many groups of 6 are in 38? (At least 6)
Use 6 as the third partial quotient. 6 x 6 = 36
Subtract 38 – 36 = 2

Add the partial quotients and record any remainders.

weebly.com

Example:

576 ÷ 18

	10 +	10 +	10 +	2 = **32**
18	576 -180 396	396 -180 216	216 -180 36	36 -36 0

chibird

Now you try!

2,376 ÷ 33 =

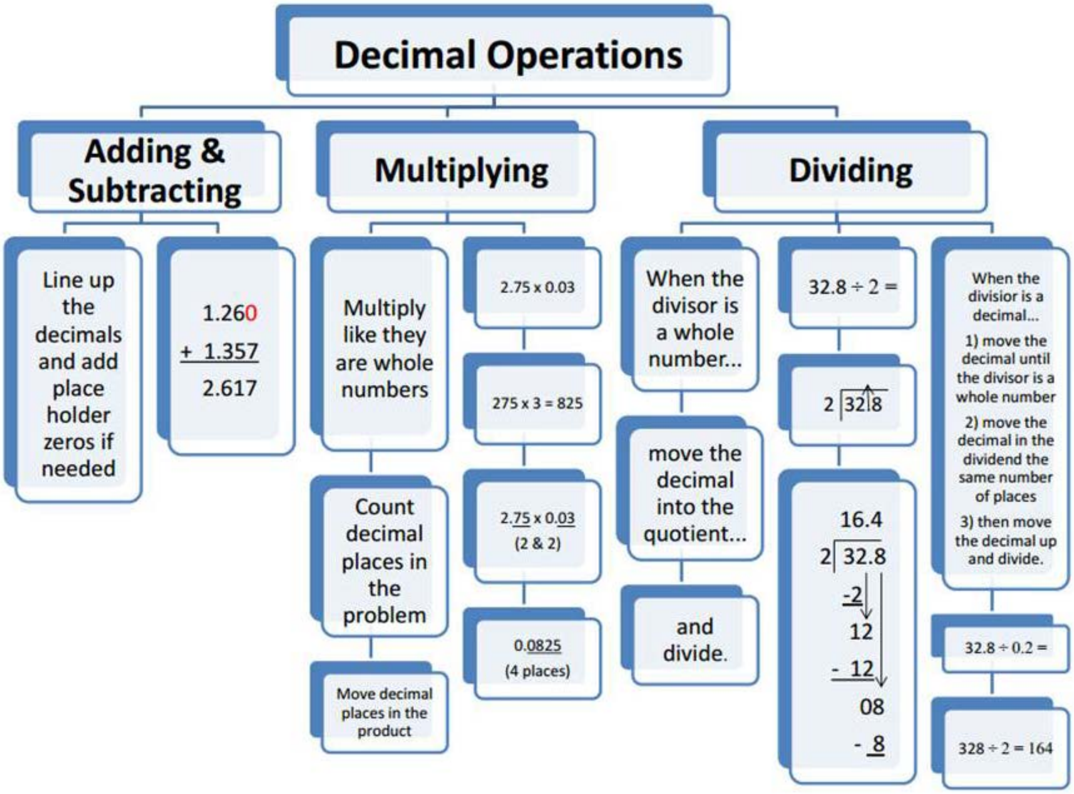
1,430 ÷ 22 =

492 ÷ 12 =

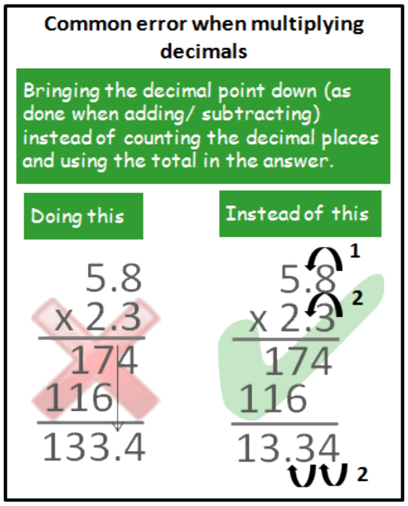
5,272 ÷ 8 =

CCSS.MATH.CONTENT.5.NBT.B.7

Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.



teacherspayteachers.com


Common error when multiplying decimals

Bringing the decimal point down (as done when adding/ subtracting) instead of counting the decimal places and using the total in the answer.

bubbazartwork.com

Rules of Decimals:

Addition

- Line up the decimals
- Fill in empty spots with "0"
- Add
- Bring the decimal point straight down!

143.60
+23.89
167.49

Subtraction

- Line up the decimals
- Fill in empty spots with "0"
- Subtract (don't forget to borrow)
- Bring the decimal point straight down!

532.40
- 73.21
459.19

Multiplication

- Number with the most digits goes on top
- You do not need to line up the decimals
- Multiply (don't forget to add a "0" in the next line)
- Count how many numbers are behind the decimal point in your problem. That's how many you need behind the decimal point in your answer.

34.52
x 1.7
58.684

Division

- You cannot divide by a decimal.
- Move the decimal to the right in your divisor to get a whole number.
- Move the decimal the same number of times in the dividend.
- Move the decimal straight up to your answer!

452.3
12 / 5427.6

Shop ‘Til You Solve!

You are starting your holiday shopping early! You look at your local Target or Rite-Aid ad (or any store flyer you find) that you get in the mail or newspaper. Complete the questions below using the flyers.

Item:	Price:
1.)	
2.)	
3.)	
4.)	
5.)	
6.)	
Total	$

Wait! You only have $25.00 to spend! Did you spend too much? What could you subtract?

Item:	Price:
7.)	
8.)	
9.)	
10.)	
11.)	
12.)	
Total	$

You have a coupon for $5.00 off of your final price. Now how much is your new total?

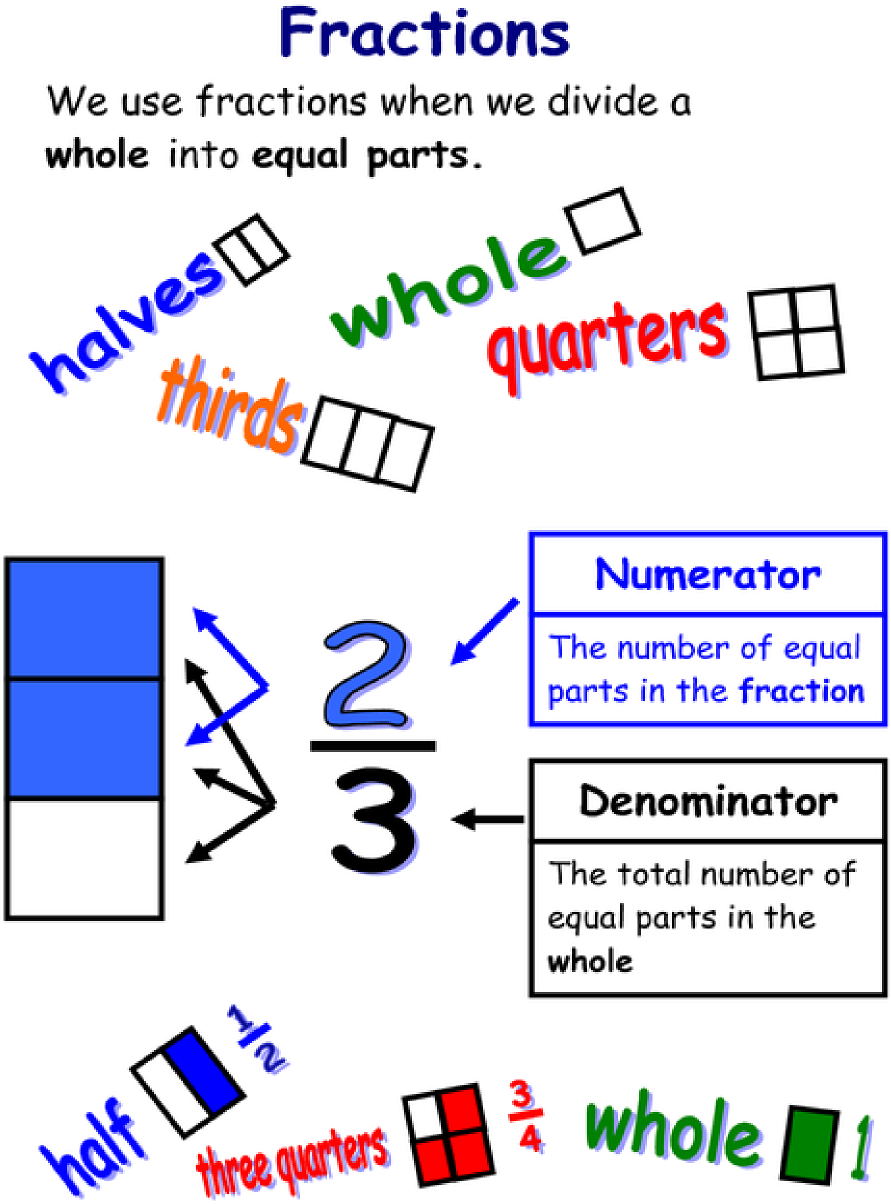
If you by four of item #3, what is your price for all of them?

If you spent $4.89 on three notebooks, how much was each one?

Unit Three: Numbers and Operations- Fractions

CCSS.MATH.CONTENT.5.NF.A.1

Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators. *For example, 2/3 + 5/4 = 8/12 + 15/12 = 23/12. (In general, a/b + c/d = (ad + bc)/bd.)*



teacherspayteachers.com

Adding fractions with unlike denominators

When adding two or more fractions with unlike denominators, the first thing you need to do is, make their denominators same. To make the denominators same you should know how to find least common multiple (*lcm)* of the denominators or it is also called the ***least common denominator (lcd)***.

Once ***lcd*** is known, change both the denominator same as lcd and ***add*** the ***numerators*** to get the ***new numerator***. The ***denominator*** stays the ***same*** as ***lcd***.

Example 3: **Add the following fractions.**

$$\frac{2}{3} + \frac{1}{4}$$

Solution: Rewrite both the fractions

$$\frac{2}{3} + \frac{1}{4}$$

Find the lcm (also called lcd) of denominators 3 and 4.

3 | 3 , 6 , 9 , 12 , 15

4 | 4 , 8 , 12

Lcd of 3 and 4 = 12

Now change both the fractions into equivalent fractions having denominators as 12 (same as lcd). For this, multiply numerator and denominator of first fraction by 4 and multiply numerator and denominator of second fraction by 3 as shown below:

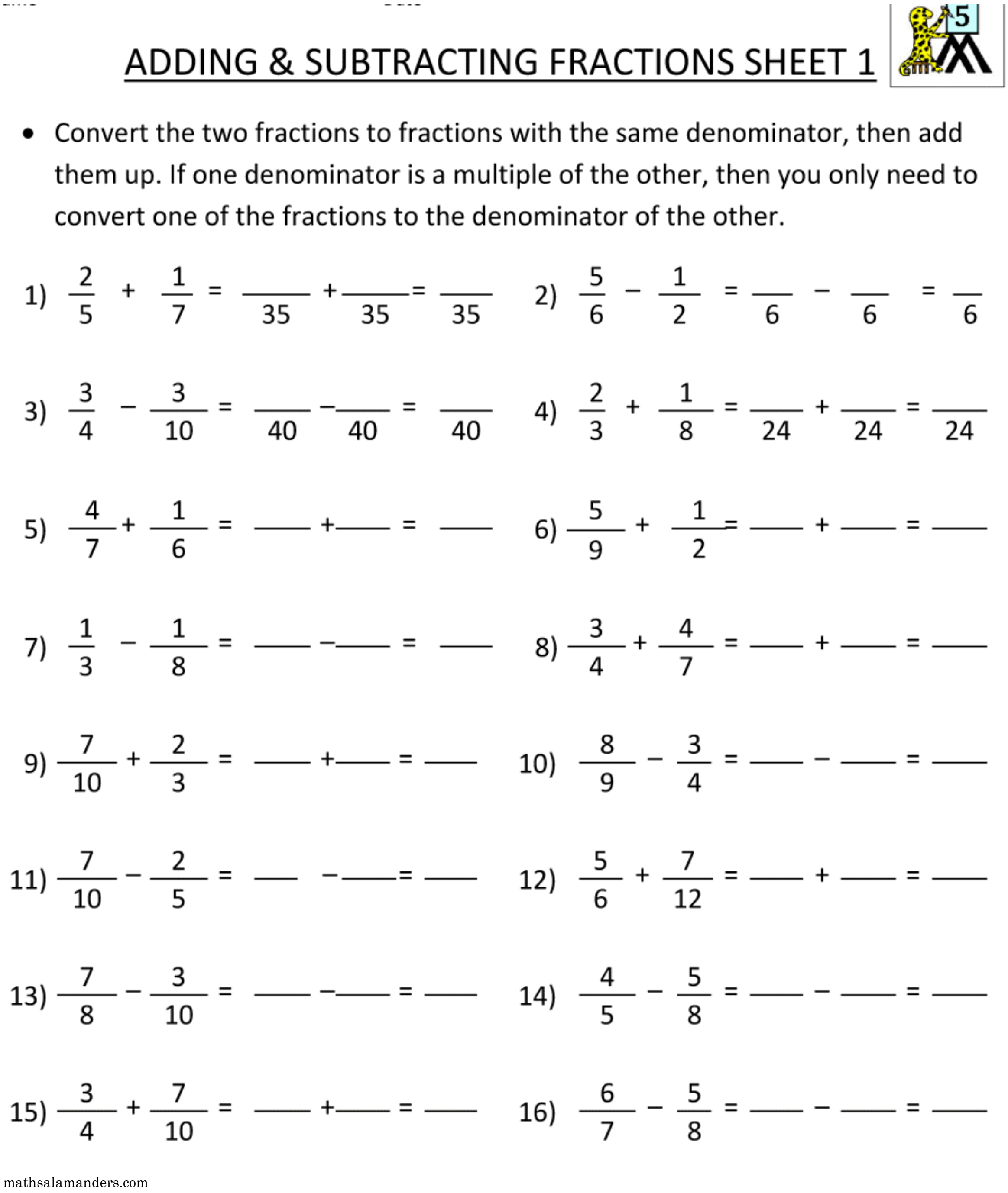
$$= \frac{2\times4}{3\times4} + \frac{1\times3}{4\times3}$$

$$= \frac{8}{12} + \frac{3}{12}$$

These fractions are new equivalent fractions to the original fractions with same denominators. Now add the numerators to get the new numerator . The denominator stays the same as lcd which is 12.

$$= \frac{11}{12}$$

Now you try!



ADDING & SUBTRACTING FRACTIONS SHEET 1

- Convert the two fractions to fractions with the same denominator, then add them up. If one denominator is a multiple of the other, then you only need to convert one of the fractions to the denominator of the other.

1) $\frac{2}{5} + \frac{1}{7} = \frac{\underline{\quad}}{35} + \frac{\underline{\quad}}{35} = \frac{\underline{\quad}}{35}$

2) $\frac{5}{6} - \frac{1}{2} = \frac{\underline{\quad}}{6} - \frac{\underline{\quad}}{6} = \frac{\underline{\quad}}{6}$

3) $\frac{3}{4} - \frac{3}{10} = \frac{\underline{\quad}}{40} - \frac{\underline{\quad}}{40} = \frac{\underline{\quad}}{40}$

4) $\frac{2}{3} + \frac{1}{8} = \frac{\underline{\quad}}{24} + \frac{\underline{\quad}}{24} = \frac{\underline{\quad}}{24}$

5) $\frac{4}{7} + \frac{1}{6} = \underline{\quad\quad} + \underline{\quad\quad} = \underline{\quad\quad}$

6) $\frac{5}{9} + \frac{1}{2} = \underline{\quad\quad} + \underline{\quad\quad} = \underline{\quad\quad}$

7) $\frac{1}{3} - \frac{1}{8} = \underline{\quad\quad} - \underline{\quad\quad} = \underline{\quad\quad}$

8) $\frac{3}{4} + \frac{4}{7} = \underline{\quad\quad} + \underline{\quad\quad} = \underline{\quad\quad}$

9) $\frac{7}{10} + \frac{2}{3} = \underline{\quad\quad} + \underline{\quad\quad} = \underline{\quad\quad}$

10) $\frac{8}{9} - \frac{3}{4} = \underline{\quad\quad} - \underline{\quad\quad} = \underline{\quad\quad}$

11) $\frac{7}{10} - \frac{2}{5} = \underline{\quad\quad} - \underline{\quad\quad} = \underline{\quad\quad}$

12) $\frac{5}{6} + \frac{7}{12} = \underline{\quad\quad} + \underline{\quad\quad} = \underline{\quad\quad}$

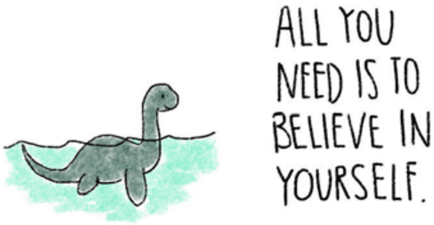
13) $\frac{7}{8} - \frac{3}{10} = \underline{\quad\quad} - \underline{\quad\quad} = \underline{\quad\quad}$

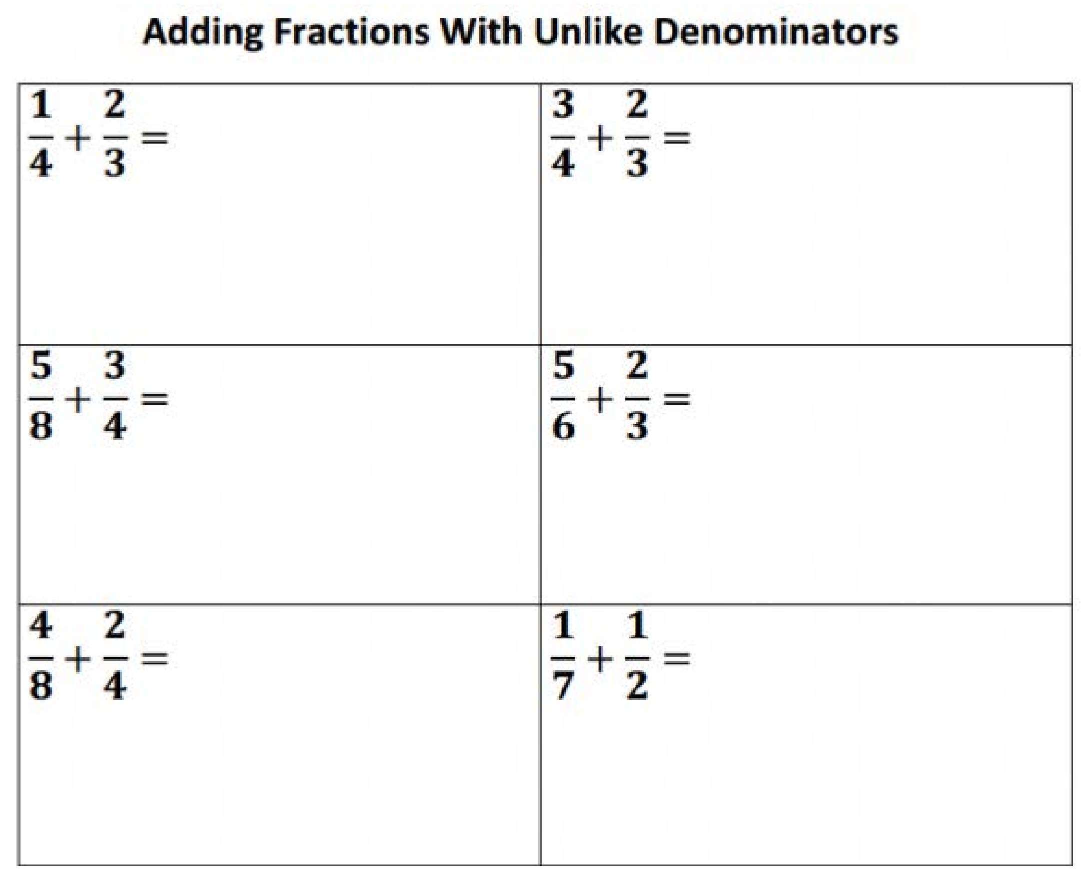
14) $\frac{4}{5} - \frac{5}{8} = \underline{\quad\quad} - \underline{\quad\quad} = \underline{\quad\quad}$

15) $\frac{3}{4} + \frac{7}{10} = \underline{\quad\quad} + \underline{\quad\quad} = \underline{\quad\quad}$

16) $\frac{6}{7} - \frac{5}{8} = \underline{\quad\quad} - \underline{\quad\quad} = \underline{\quad\quad}$

mathsalamanders.com

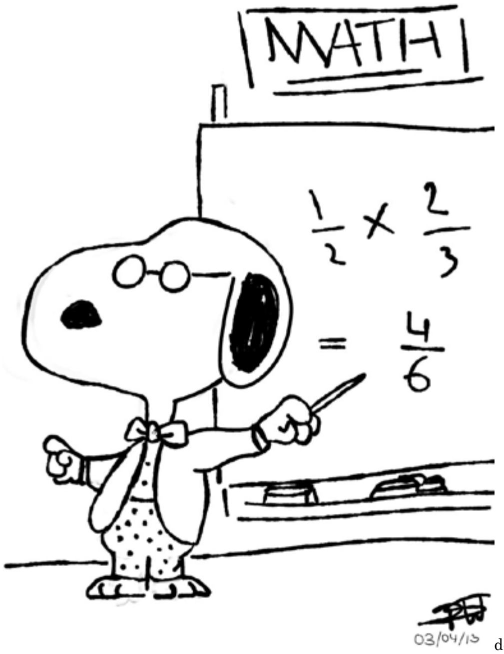




Adding Fractions With Unlike Denominators

$\frac{1}{4}+\frac{2}{3}=$	$\frac{3}{4}+\frac{2}{3}=$
$\frac{5}{8}+\frac{3}{4}=$	$\frac{5}{6}+\frac{2}{3}=$
$\frac{4}{8}+\frac{2}{4}=$	$\frac{1}{7}+\frac{1}{2}=$

pinterest.com

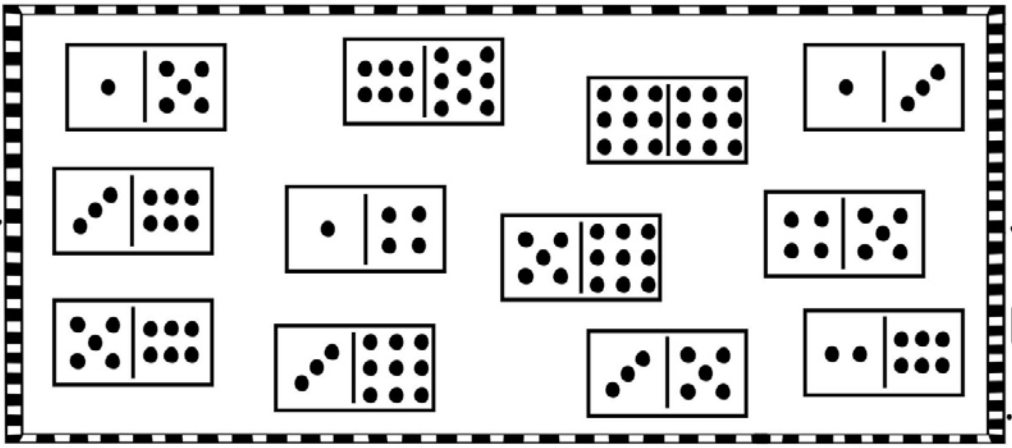


deviantart.com

Domino Decisions

Name:

Pick two of the dominos below. Write each domino as a proper fraction in the boxes. Then, add the two boxes. Each domino may only be chosen once.



1. $\frac{\square}{\square} + \frac{\square}{\square} = \frac{\square}{\square}$

2. $\frac{\square}{\square} + \frac{\square}{\square} = \frac{\square}{\square}$

3. $\frac{\square}{\square} + \frac{\square}{\square} = \frac{\square}{\square}$

4. $\frac{\square}{\square} + \frac{\square}{\square} = \frac{\square}{\square}$

5. $\frac{\square}{\square} + \frac{\square}{\square} = \frac{\square}{\square}$

6. $\frac{\square}{\square} + \frac{\square}{\square} = \frac{\square}{\square}$

7. $\frac{\square}{\square} + \frac{\square}{\square} = \frac{\square}{\square}$

8. $\frac{\square}{\square} + \frac{\square}{\square} = \frac{\square}{\square}$

pinterest.com

Just a reminder…

Mixed Numbers and Improper Fractions

Make Mixed Numbers MAD…

by changing them into improper fractions!

$7\frac{1}{4}$

$7 \times 4 = 28$ **MULTIPLY** the whole number by the denominator!

$28 + 1 = 29$ **ADD** the product and the numerator! The sum in the new numerator!

equivalent improper fraction → $\frac{29}{4}$ **DENOMINATOR** stays the same!

Make Improper Fractions GLAD…

by changing them into mixed numbers!

$\frac{29}{4}$

GO DIVIDE the numerator by the denominator!

$29 \div 4 = 7_{R}1$

LEAVE the quotient whole number as the mixed number whole number!

$7\frac{1}{4}$

equivalent mixed number

ALWAYS put the remainder as the numerator!

DENOMINATOR stays the same!

pinterest.com

Color Me Cupcake!

Solve the problems. Then follow the chart to color the cupcakes.
(The sum of each problem will be greater than one whole. The fraction will be improper. Change the improper fraction into a mixed number and simplify into lowest terms.)

① $\frac{6}{7} + \frac{8}{21}$ ______

② $\frac{7}{8} + \frac{5}{6}$ ______

③ $\frac{2}{3} + \frac{14}{24}$ ______

④ $\frac{7}{8} + \frac{5}{16}$ ______

⑤ $\frac{11}{12} + \frac{8}{9}$ ______

⑥ $\frac{9}{20} + \frac{6}{8}$ ______

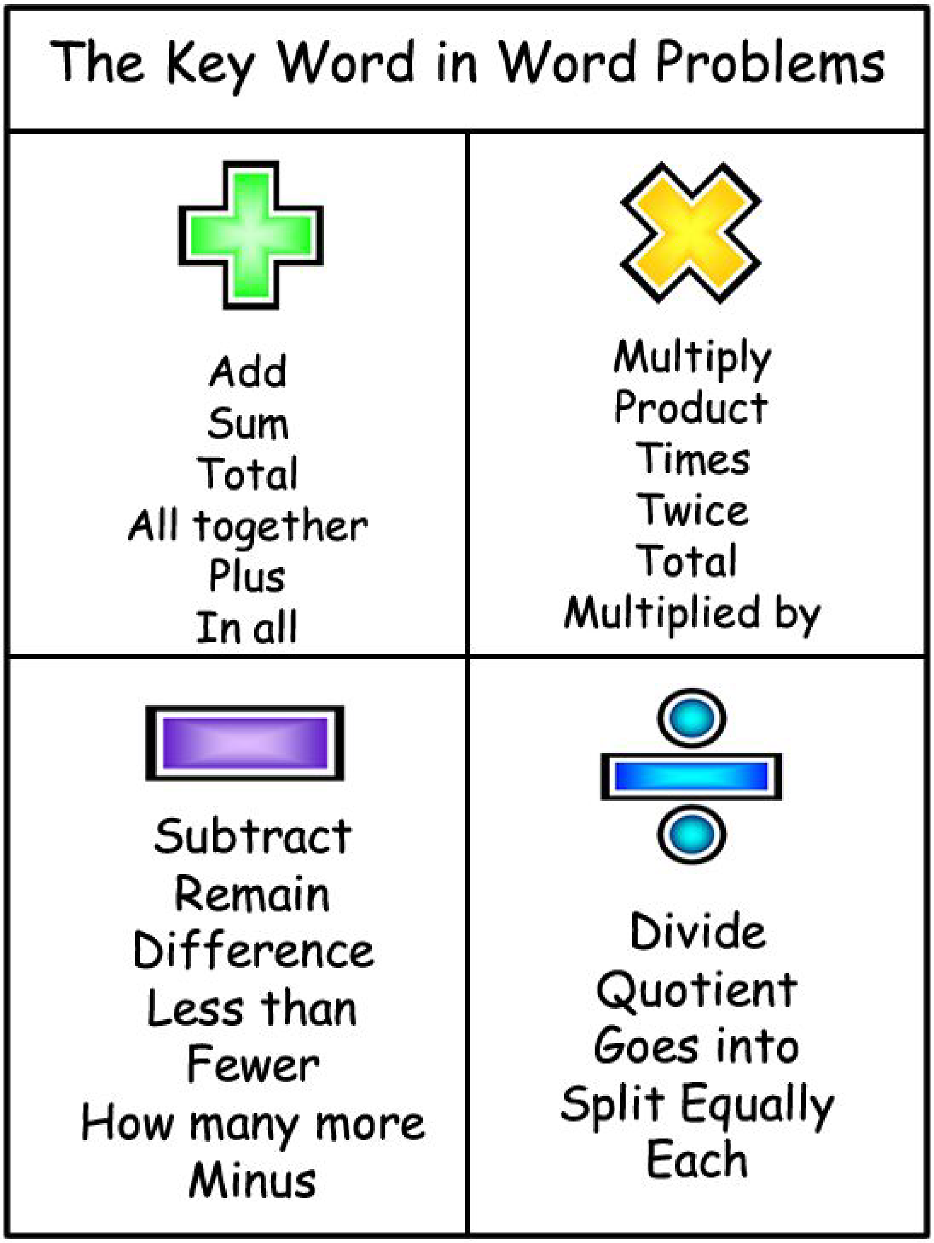
⑦ $\frac{3}{5} + \frac{11}{15}$ ______

⑧ $\frac{5}{8} + \frac{15}{16}$ ______

1 1/3 = red	1 17/24 = orange	1 9/16 = yellow	1 3 /16 = green
1 29/36 = blue	1 5/21 = purple	1 1/5 = pink	1 1/4 = brown

CCSS.MATH.CONTENT.5.NF.A.2

Solve word problems involving addition and subtraction of fractions referring to the same whole, including cases of unlike denominators, e.g., by using visual fraction models or equations to represent the problem. Use benchmark fractions and number sense of fractions to estimate mentally and assess the reasonableness of answers. *For example, recognize an incorrect result 2/5 + 1/2 = 3/7, by observing that 3/7 < 1/2.*

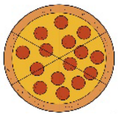


The Key Word in Word Problems

+ Add Sum Total All together Plus In all	× Multiply Product Times Twice Total Multiplied by
− Subtract Remain Difference Less than Fewer How many more Minus	÷ Divide Quotient Goes into Split Equally Each

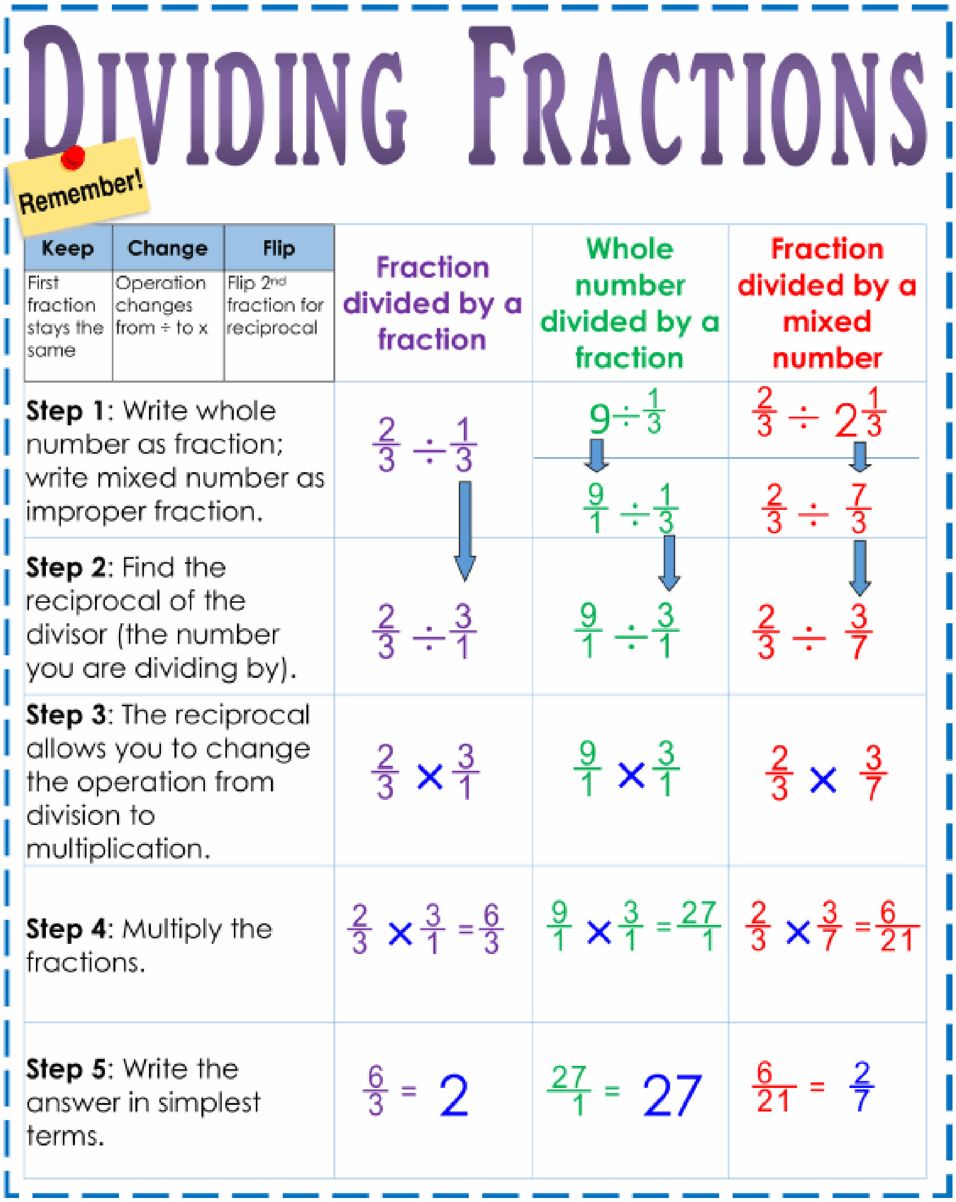
weebly.com

Now you try!

Amy's aunt had 8 slices of pizza. Her brother ate 2 1/3 slices. How much was left? 	Luke made cookies that needed five-sixths of a cup. Ryann made cookies that needed 1/3 of a cup less. How much did Ryann need? 
There are 8 meatballs in the pan. Noah ate 3 1/4 of them. How many did he eat? 	Patrick's mom made 1/3 of a pound of fudge. His sister made another one-fourth of a pound. How much did they make all together? 
Maureen had 10 cupcakes. She ate 1 ½ of them. How many are left? 	Diego ran 1 1/4 miles. He ran another 2 2/5 miles. How many miles did he run altogether? 

CCSS.Math.Content.5.NF.B.3

Interpret a fraction as division of the numerator by the denominator ($a/b = a \div b$). Solve word problems involving division of whole numbers leading to answers in the form of fractions or mixed numbers, e.g., by using visual fraction models or equations to represent the problem. *For example, interpret 3/4 as the result of dividing 3 by 4, noting that 3/4 multiplied by 4 equals 3, and that when 3 wholes are shared equally among 4 people each person has a share of size 3/4. If 9 people want to share a 50-pound sack of rice equally by weight, how many pounds of rice should each person get? Between what two whole numbers does your answer lie?*



DIVIDING FRACTIONS

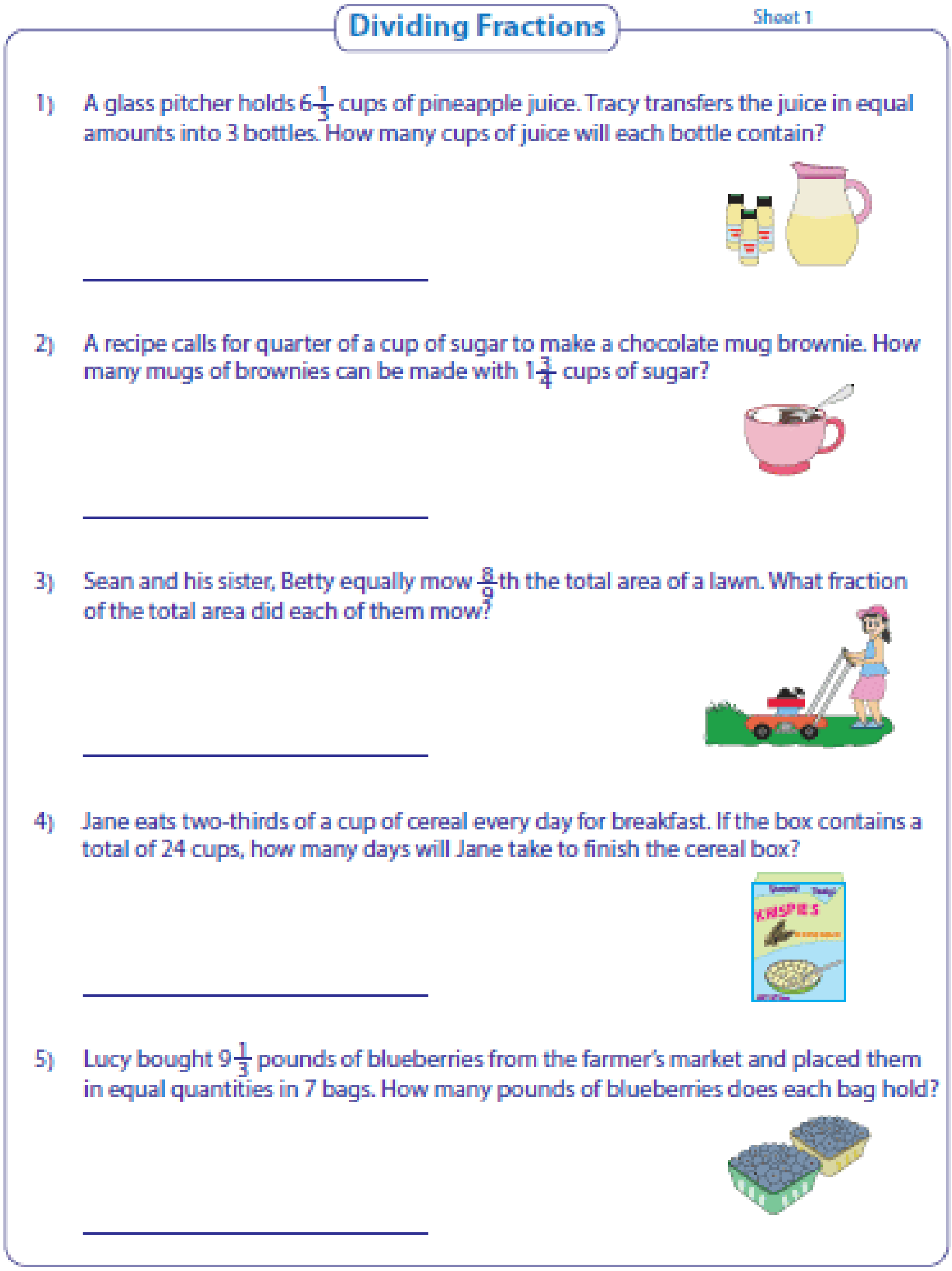
Remember!

Keep	Change	Flip
First fraction stays the same	Operation changes from ÷ to x	Flip 2nd fraction for reciprocal

	Fraction divided by a fraction	Whole number divided by a fraction	Fraction divided by a mixed number
Step 1: Write whole number as fraction; write mixed number as improper fraction.	$\frac{2}{3} \div \frac{1}{3}$	$9 \div \frac{1}{3}$ $\frac{9}{1} \div \frac{1}{3}$	$\frac{2}{3} \div 2\frac{1}{3}$ $\frac{2}{3} \div \frac{7}{3}$
Step 2: Find the reciprocal of the divisor (the number you are dividing by).	$\frac{2}{3} \div \frac{3}{1}$	$\frac{9}{1} \div \frac{3}{1}$	$\frac{2}{3} \div \frac{3}{7}$
Step 3: The reciprocal allows you to change the operation from division to multiplication.	$\frac{2}{3} \times \frac{3}{1}$	$\frac{9}{1} \times \frac{3}{1}$	$\frac{2}{3} \times \frac{3}{7}$
Step 4: Multiply the fractions.	$\frac{2}{3} \times \frac{3}{1} = \frac{6}{3}$	$\frac{9}{1} \times \frac{3}{1} = \frac{27}{1}$	$\frac{2}{3} \times \frac{3}{7} = \frac{6}{21}$
Step 5: Write the answer in simplest terms.	$\frac{6}{3} = 2$	$\frac{27}{1} = 27$	$\frac{6}{21} = \frac{2}{7}$

classroomcaboodle.com

Now you try!



Dividing Fractions

Sheet 1

1) A glass pitcher holds $6\frac{1}{3}$ cups of pineapple juice. Tracy transfers the juice in equal amounts into 3 bottles. How many cups of juice will each bottle contain?

____

2) A recipe calls for quarter of a cup of sugar to make a chocolate mug brownie. How many mugs of brownies can be made with $1\frac{3}{4}$ cups of sugar?

____

3) Sean and his sister, Betty equally mow $\frac{8}{9}$th the total area of a lawn. What fraction of the total area did each of them mow?

____

4) Jane eats two-thirds of a cup of cereal every day for breakfast. If the box contains a total of 24 cups, how many days will Jane take to finish the cereal box?

____

5) Lucy bought $9\frac{1}{3}$ pounds of blueberries from the farmer's market and placed them in equal quantities in 7 bags. How many pounds of blueberries does each bag hold?

____

mathworksheets4kids.com

CCSS.Math.Content.5.NF.B.4

Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction.

Multiply.

$$\frac{2}{3} \cdot 5$$

Step 1: Rewrite the whole number (5) as a fraction, but writing a 1 in the denominator.

$$\frac{2}{3} \cdot \frac{5}{1}$$

5 and 5/1 are equivalent because 5/1 = 5.

Step 2: Multiply the numerator and denominators.

$$\frac{2}{3} \cdot \frac{5}{1} = \frac{10}{3}$$

Step 3: Simplify if possible.

$\frac{10}{3}$ cannot be simplified.

Step 4: You may be able to leave your answer as an improper fraction or you may need to rewrite it as a mixed number.

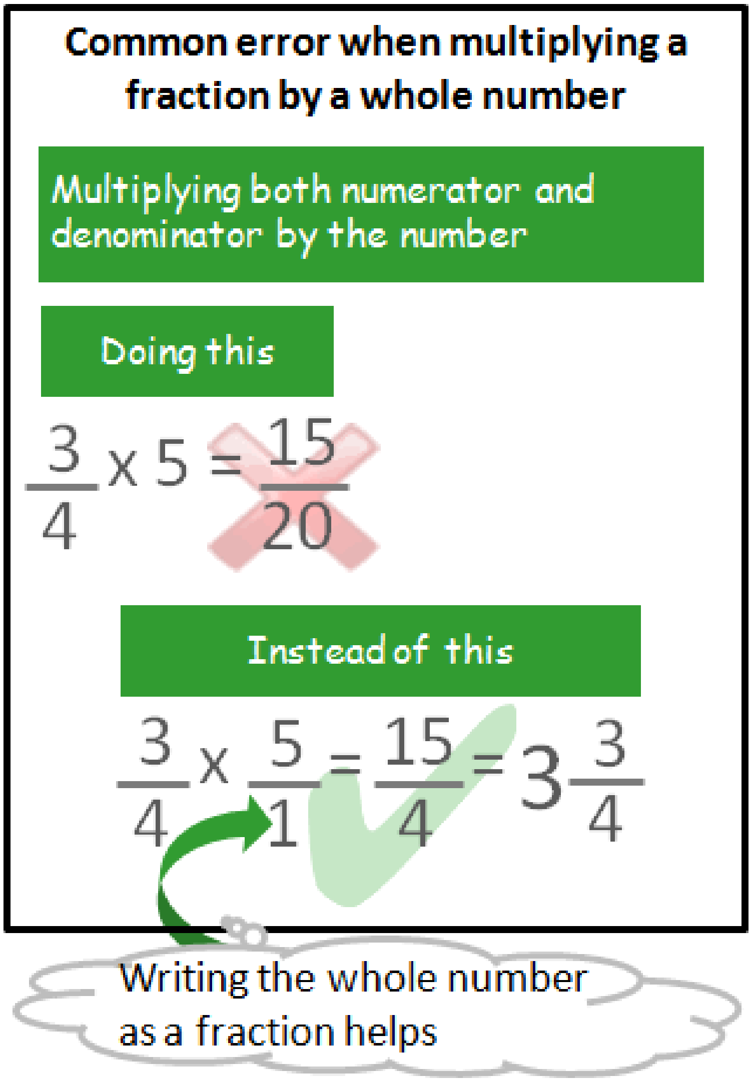
To write as a mixed number:

$$\frac{10}{3} = 3\frac{1}{3}$$

Think: 10/3 = 3 with 1 as a remainder.
(3 · 3 = 9) then (10-9=1)

tes.com

Don’t forget, the whole number has a denominator of 1!



Common error when multiplying a fraction by a whole number

Multiplying both numerator and denominator by the number

Doing this

$$\frac{3}{4} \text{ x } 5 = \frac{15}{20}$$

Instead of this

$$\frac{3}{4} \text{ x } \frac{5}{1} = \frac{15}{4} = 3\frac{3}{4}$$

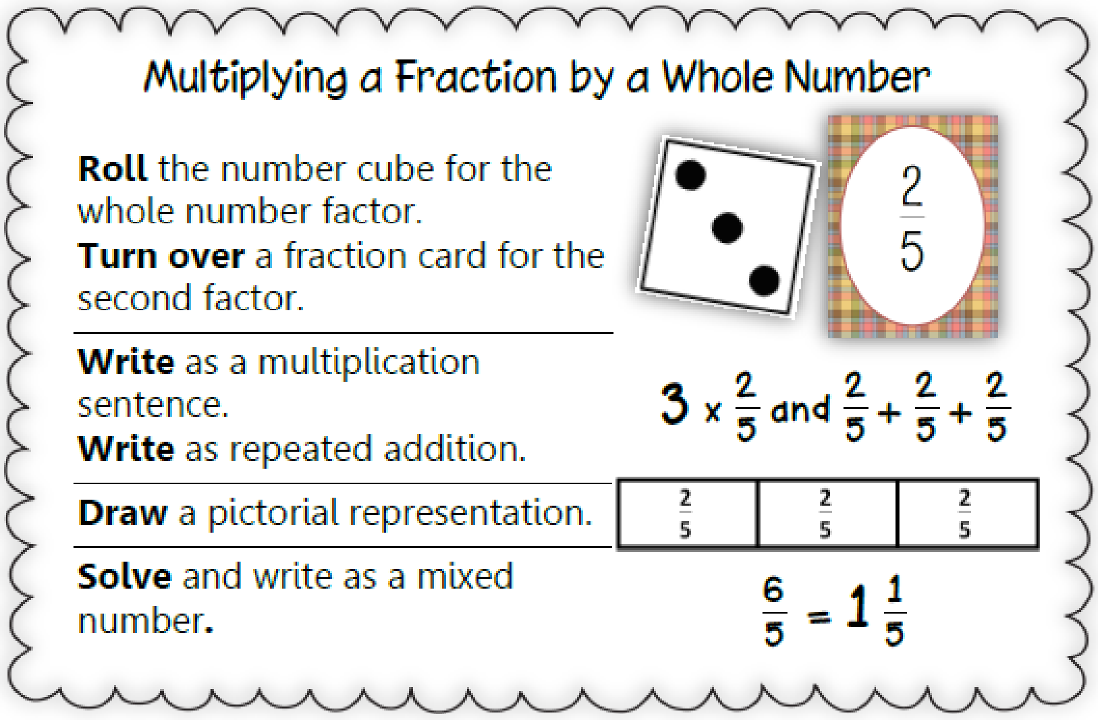
Writing the whole number as a fraction helps

bubbazartwork.com

Now you try!

Jack’s mom spent $60 dollars at the mall. ¾ of that money was spent on shoes. How much was spent on shoes? 	Dan needed 1 1/3 cups of butter for one batch of his sugar cookie recipe. He made 8 batches. How much butter did he use? 
Joe ate half a pizza. The next day, he ate 1/2 of what was left. How much was left? 	Mia and Grace went blueberry picking. Mia picked 6/7 of a pound and Grace picked half as many as Mia? How much of a pound did Grace pick? 

More fun with dice!



Multiplying a Fraction by a Whole Number

Roll the number cube for the whole number factor.
Turn over a fraction card for the second factor.

Write as a multiplication sentence.
Write as repeated addition.

$3 \times \frac{2}{5}$ and $\frac{2}{5} + \frac{2}{5} + \frac{2}{5}$

Draw a pictorial representation.

$\frac{2}{5}$	$\frac{2}{5}$	$\frac{2}{5}$

Solve and write as a mixed number.

$\frac{6}{5} = 1\frac{1}{5}$

mathcoachscorner.com

(Cut out these fraction cards and place them face down.)

$\frac{1}{2}$	$\frac{1}{4}$	$\frac{2}{4}$
$\frac{2}{6}$	$\frac{3}{6}$	$\frac{4}{6}$
$\frac{3}{5}$	$\frac{2}{5}$	$\frac{1}{2}$

wordpress.com

mariafresa.net

Strawberry Fractions

Emy is selling her strawberries at her fruit stand in the local farmers market. She starts the day with 10 ½ baskets of strawberries.

Prices
$3.00 for a basket of strawberries
$2.00 for ½ a basket of strawberries
$1.25 for ¼ a basket of strawberries
$.75 for 1/8 of a basket of strawberries

1.) Renae needs 2/7 of what Emy has for her bakery. How much does Renae need? ____

2.) How much did Renae spend? ___________________________

3.) Tyler and Raelynn buy 1/5 of what Emy has left. How much did they buy?

____

4.) How much did they spend? ____________________________

5.) Aaron and Austin bought 1/3 of what Emy had left. How much did they buy? ____

How much did they spend? ______________________________

6.) Bryan wants to buy ¼ of what Emy has left. How much did he buy?

____

How much did Bryan spend? _____________________________

7.) How many baskets does Emy have left? ____________________

8.) How much money did Emy make today? ____________________

Because you did such a great job…here is a recipe for

Strawberry Shortsnakes!

justapinch.com

How to make a STRAWBERRY SHORTSNAKE

Serves:
4

Cook:
10 Min

SHORTCAKE MIX

2 cups of all-purpose flour
2 Tbsp of confectioners' sugar
4 tsp of baking powder
¾ tsp of salt
1 stick of butter
1 cup of milk

STRAWBERRY FILLING

1 basket of strawberries
4 Tbsp of confectioners' sugar

WHIPPED TOPPING

1 cup of whipping cream
2 Tbsp confectioners' sugar
8 mini chocolate chips

GARNISHES

4 whole strawberries
1 green fruit roll-up

(Please ask your parent to help you make this!)

1. Heat the oven to 400 degrees. Sift together the flour, sugar, baking powder and salt into a large mixing bowl. Cut in the butter into small pieces or use a vegetable grater to grate the stick into the mixing bowl and blend the butter into the dry ingredients with their fingertips. Once the dough is crumbly, slowly stir in the milk.
2. Turn out the dough onto a floured working surface and gently roll or pat the dough into a 1-inch-thick rectangle (it should measure about 6 x 8 inches). For the best results, handle the dough as little as possible.
3. Slice the rectangle into four 1-1/2- x 8-inch strips. Place the strips on an ungreased baking sheet, then mold and curve them into S shapes that resemble snakes. Bake for 10 to 12 minutes until the bottoms are golden brown. Transfer the baked shortsnakes to a wire rack (a parent's job) and let cool. Carefully slice the cooled shortsnakes in half lengthwise or split them with a fork and then set aside.
4. Combine the whipping cream and confectioners' sugar in a chilled bowl and beat with an electric or hand mixer until stiff peaks form.
5. Just before serving, arrange berries on the bottom half of each shortsnake, then cover with the shortsnake top. Spread on whipped cream and add a layer of sliced strawberry "scales."
6. For the snakes' heads, cut mouth openings in the tips of the whole berries and place one at the end of each shortsnake. Press a pair of mini chocolate chip or M&M's eyes into the sides of each head and add a forked tongue cut from green fruit leather.

What would you do to the recipe if you wanted to make it for only **two** people??

____

____

____

____

____

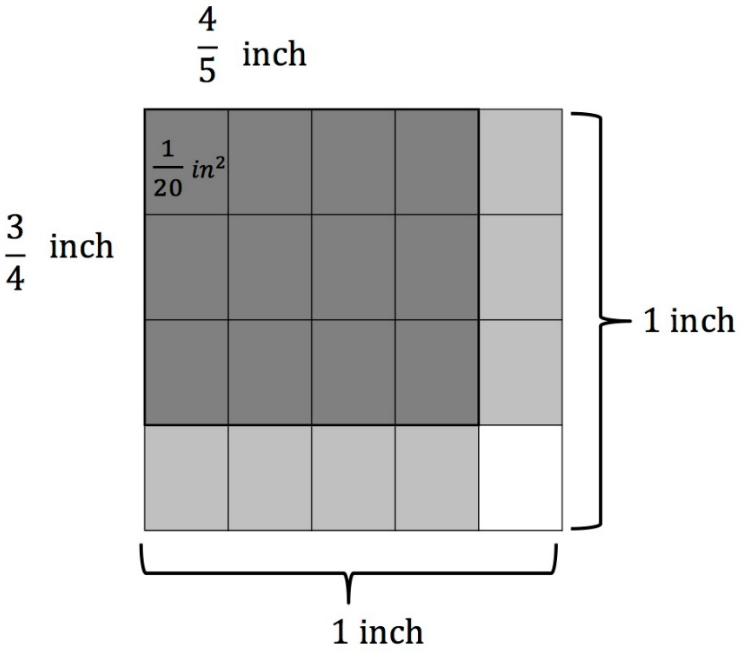
____

____

____

CCSS.MATH.CONTENT.5.NF.B.4.B

Find the area of a rectangle with fractional side lengths by tiling it with unit squares of the appropriate unit fraction side lengths and show that the area is the same as would be found by multiplying the side lengths. Multiply fractional side lengths to find areas of rectangles and represent fraction products as rectangular areas.



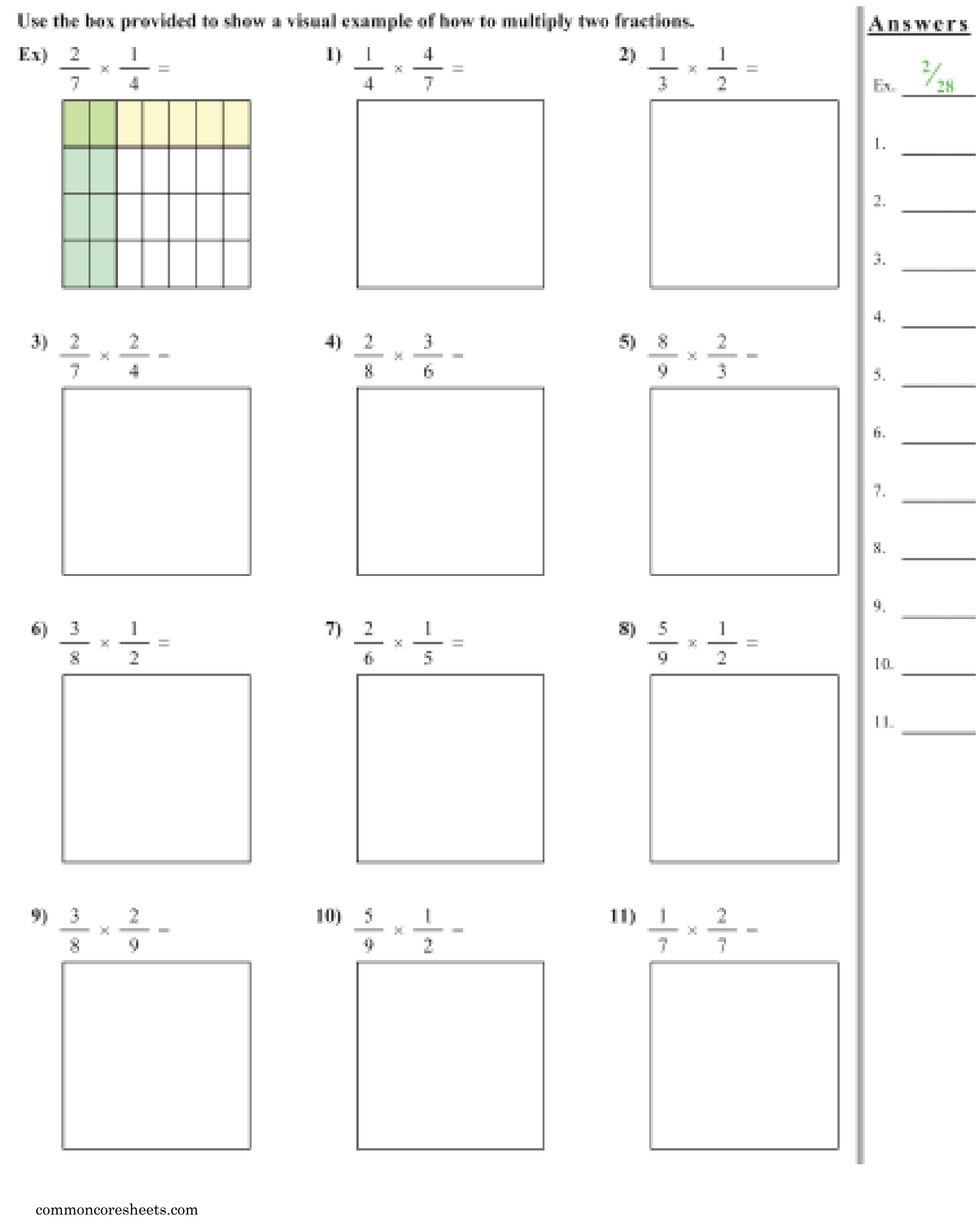
There are twelve smaller rectangles each with an area of $\frac{1}{20}$ square inch. Therefore, the area of the $\frac{4}{5}$ inch by $\frac{3}{4}$ inch rectangle is $\frac{12}{20}$ square inch.

cpalms.org

What is 2/5 times 1/4? ____

What is 3/5 times 3/4? ____

Now you try!



Use the box provided to show a visual example of how to multiply two fractions.

Ex) $\frac{2}{7} \times \frac{1}{4} =$

1) $\frac{1}{4} \times \frac{4}{7} =$

2) $\frac{1}{3} \times \frac{1}{2} =$

3) $\frac{2}{7} \times \frac{2}{4} =$

4) $\frac{2}{8} \times \frac{3}{6} =$

5) $\frac{8}{9} \times \frac{2}{3} =$

6) $\frac{3}{8} \times \frac{1}{2} =$

7) $\frac{2}{6} \times \frac{1}{5} =$

8) $\frac{5}{9} \times \frac{1}{2} =$

9) $\frac{3}{8} \times \frac{2}{9} =$

10) $\frac{5}{9} \times \frac{1}{2} =$

11) $\frac{1}{7} \times \frac{2}{7} =$

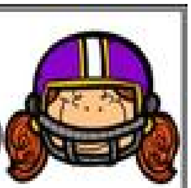
Answers

Ex. $^{2}/_{28}$
1. ______
2. ______
3. ______
4. ______
5. ______
6. ______
7. ______
8. ______
9. ______
10. ______
11. ______

commoncoresheets.com

Bump!

(Fraction Multiplication with Picture Models)



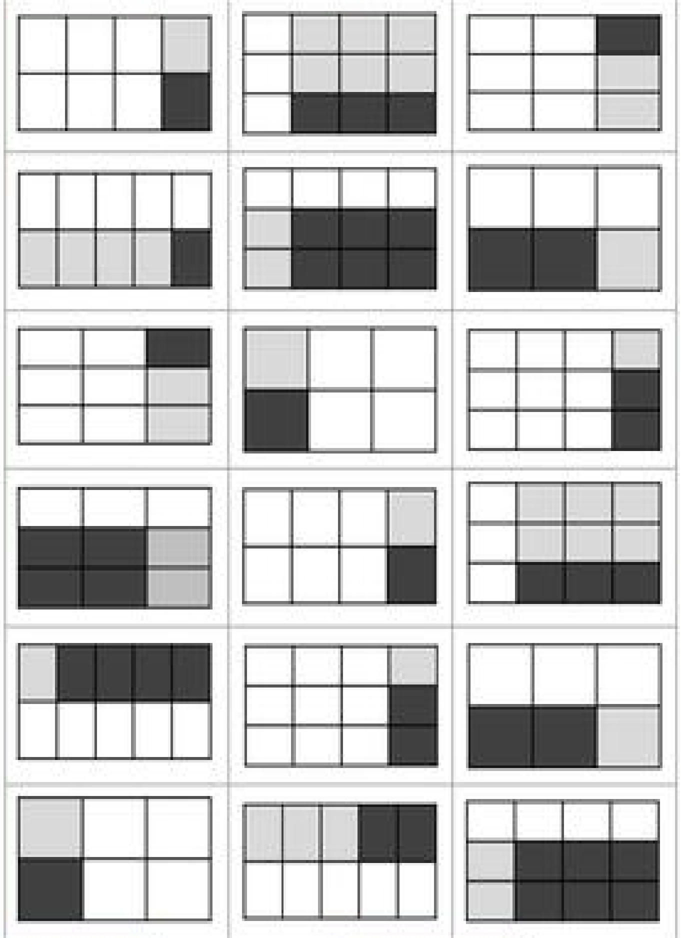
Materials: Dice, one game piece per player, and 8 counters per player (one color per player)

Object of the game: To get all of your counters onto the game board

Directions: Begin on Start. On your turn, roll the dice and move your piece around the game board. Read the fraction problem that you landed on. Find a fraction model that shows that problem in the center of the game board. You must state what the answer is. Do the following if you are correct:

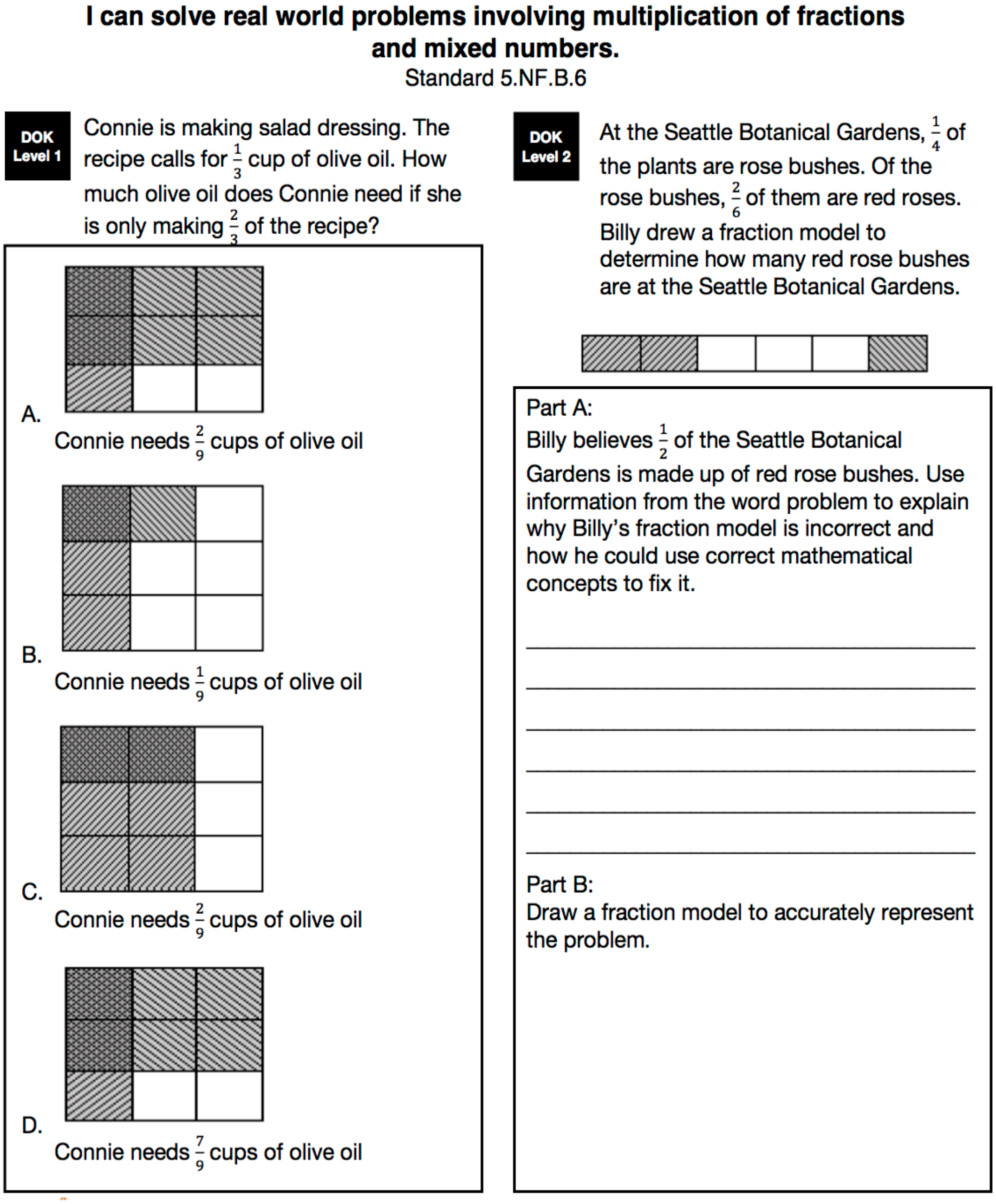
- If that space is empty, place one counter on it.
- If that space has one of the other player's counters on it, remove the other player's counter and replace it with one of your own.
- If that space already has one of your own counters on it, place a second counter on top of it. You've now locked in that space and cannot get bumped off!
- If that space is already locked in by the other player, you cannot place any of your counters on it.

Continue taking turns and moving around the board until one player places all of his/her counters onto the center board. Note that players will continue moving around and around the game board until this happens.

<table>
<tr><td>Start
$\frac{2}{3}$ x $\frac{1}{4}$</td><td>$\frac{1}{2}$ x $\frac{1}{4}$</td><td>$\frac{1}{2}$ x $\frac{1}{3}$</td><td>$\frac{2}{5}$ x $\frac{1}{2}$</td><td>$\frac{2}{3}$ x $\frac{2}{3}$</td><td>$\frac{1}{5}$ x $\frac{1}{2}$</td></tr>
<tr><td>$\frac{4}{5}$ x $\frac{1}{2}$</td><td colspan="4" rowspan="6"></td><td>$\frac{3}{4}$ x $\frac{2}{3}$</td></tr>
<tr><td>$\frac{1}{3}$ x $\frac{1}{3}$</td><td>$\frac{2}{3}$ x $\frac{1}{2}$</td></tr>
<tr><td>$\frac{1}{3}$ x $\frac{3}{4}$</td><td>$\frac{1}{3}$ x $\frac{3}{4}$</td></tr>
<tr><td>$\frac{2}{3}$ x $\frac{1}{2}$</td><td>$\frac{1}{3}$ x $\frac{1}{3}$</td></tr>
<tr><td>$\frac{3}{4}$ x $\frac{2}{3}$</td><td>$\frac{4}{5}$ x $\frac{1}{2}$</td></tr>
<tr><td>$\frac{1}{5}$ x $\frac{1}{2}$</td><td>$\frac{2}{3}$ x $\frac{2}{3}$</td><td>$\frac{2}{5}$ x $\frac{1}{2}$</td><td>$\frac{1}{2}$ x $\frac{1}{3}$</td><td>$\frac{1}{2}$ x $\frac{1}{4}$</td><td>$\frac{2}{3}$ x $\frac{1}{4}$</td></tr>
</table>

CCSS.MATH.CONTENT.5.NF.B.6

Solve real world problems involving multiplication of fractions and mixed numbers, e.g., by using visual fraction models or equations to represent the problem.



I can solve real world problems involving multiplication of fractions and mixed numbers.
Standard 5.NF.B.6

DOK Level 1

Connie is making salad dressing. The recipe calls for $\frac{1}{3}$ cup of olive oil. How much olive oil does Connie need if she is only making $\frac{2}{3}$ of the recipe?

A. Connie needs $\frac{2}{9}$ cups of olive oil

B. Connie needs $\frac{1}{9}$ cups of olive oil

C. Connie needs $\frac{2}{9}$ cups of olive oil

D. Connie needs $\frac{7}{9}$ cups of olive oil

DOK Level 2

At the Seattle Botanical Gardens, $\frac{1}{4}$ of the plants are rose bushes. Of the rose bushes, $\frac{2}{6}$ of them are red roses. Billy drew a fraction model to determine how many red rose bushes are at the Seattle Botanical Gardens.

Part A:
Billy believes $\frac{1}{2}$ of the Seattle Botanical Gardens is made up of red rose bushes. Use information from the word problem to explain why Billy's fraction model is incorrect and how he could use correct mathematical concepts to fix it.

____

____

____

____

____

____

Part B:
Draw a fraction model to accurately represent the problem.

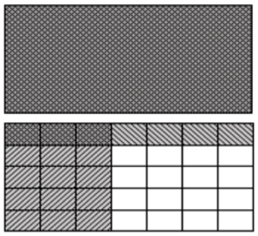
goalbookapp.com

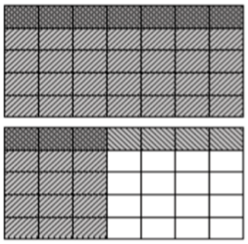
I can solve real world problems involving multiplication of fractions and mixed numbers.

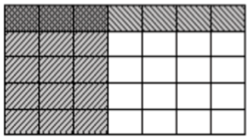
Standard 5.NF.B.6

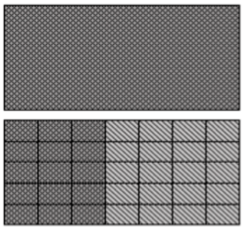
DOK Level 1

Joseph is feeding the pigs on his family's farm. Joseph is supposed to give $1\frac{3}{7}$ bins of feed to the pigs. However, Joseph only gives the pigs $\frac{1}{4}$ of their usual portion. How much feed did Joseph give to the pigs? Circle the best answer.

A.

, $1\frac{3}{28}$

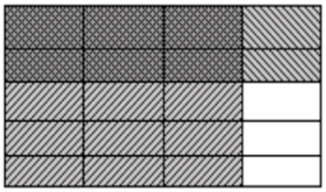
B.

, $\frac{10}{28}$

C.

, $\frac{3}{28}$

D.

, $\frac{3}{7}$

DOK Level 2

Victoria buys $2\frac{3}{4}$ rolls of fabric to make a dress. But she only needs $\frac{2}{5}$ of the fabric. Victoria draws a fraction model to figure out how much fabric she needs for her evening dress.



Part A: Victoria believes she will need $\frac{6}{20}$ of a roll of fabric for her redesigned evening dress. Explain why Victoria's fraction model is incorrect using the information in the word problem and mathematical concepts.

____

____

____

____

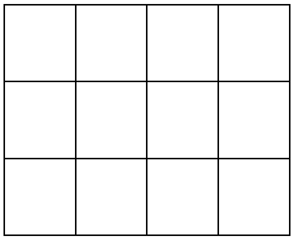
Part B: Draw a fraction model to accurately represent the problem.

CCSS.MATH.CONTENT.5.NF.B.7.C

Solve real world problems involving division of unit fractions by non-zero whole numbers and division of whole numbers by unit fractions, e.g., by using visual fraction models and equations to represent the problem. *For example, how much chocolate will each person get if 3 people share 1/2 lb of chocolate equally? How many 1/3-cup servings are in 2 cups of raisins?*

Rosa had 1/4 of her birthday cake left. She, her mom and her brother decided to split it evenly. How much of the cake did each person get?

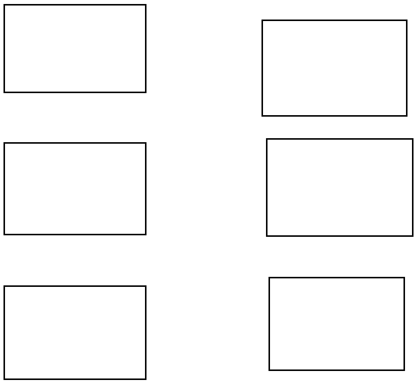
Shade in the model:



Write and solve the problem:

Jenna had six pies. She gave each of her friends 1/3 of each pie. How many friends could she share her pies with?

Divide the model into equal pieces:



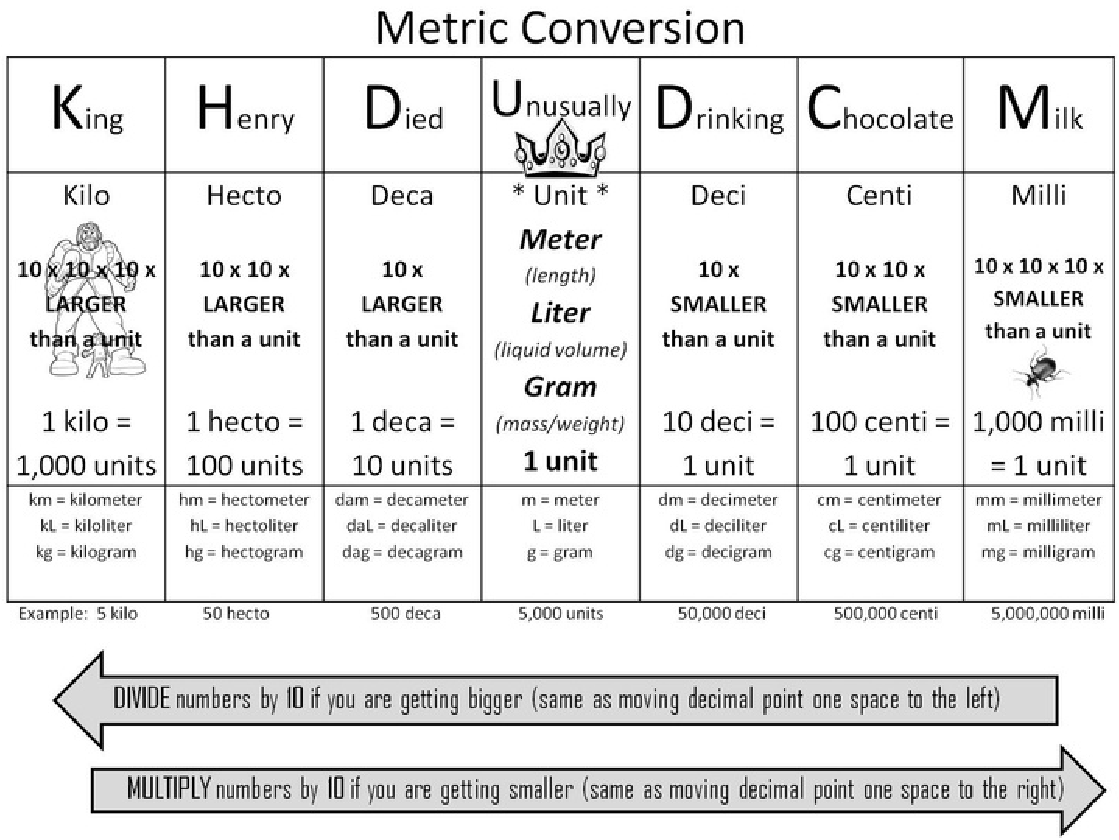
Write and solve the problem:

Unit Four: Measurement and Data

Convert like measurement units within a given measurement system.

CCSS.MATH.CONTENT.5.MD.A.1

Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.



Metric Conversion

King	Henry	Died	Unusually	Drinking	Chocolate	Milk
Kilo **10 x 10 x 10 x LARGER than a unit** 1 kilo = 1,000 units	Hecto **10 x 10 x LARGER than a unit** 1 hecto = 100 units	Deca **10 x LARGER than a unit** 1 deca = 10 units	* Unit * ***Meter*** *(length)* ***Liter*** *(liquid volume)* ***Gram*** *(mass/weight)* **1 unit**	Deci **10 x SMALLER than a unit** 10 deci = 1 unit	Centi **10 x 10 x SMALLER than a unit** 100 centi = 1 unit	Milli **10 x 10 x 10 x SMALLER than a unit** 1,000 milli = 1 unit
km = kilometer kL = kiloliter kg = kilogram	hm = hectometer hL = hectoliter hg = hectogram	dam = decameter daL = decaliter dag = decagram	m = meter L = liter g = gram	dm = decimeter dL = deciliter dg = decigram	cm = centimeter cL = centiliter cg = centigram	mm = millimeter mL = milliliter mg = milligram
Example: 5 kilo	50 hecto	500 deca	5,000 units	50,000 deci	500,000 centi	5,000,000 milli

DIVIDE numbers by 10 if you are getting bigger (same as moving decimal point one space to the left)

MULTIPLY numbers by 10 if you are getting smaller (same as moving decimal point one space to the right)

pinterest.com

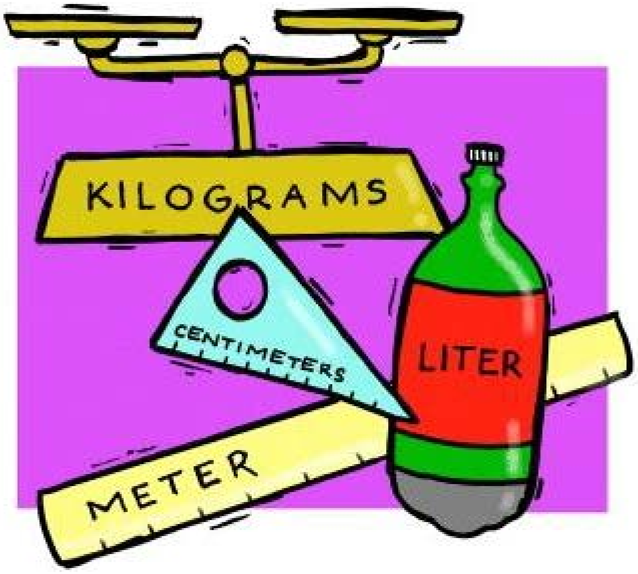
chibird.com

Customary Units

Length	Weight	Capacity
12 inches = 1 foot 3 feet = 1 yard 1,760 yards = 1 mile 5,280 feet = 1 mile	16 ounces = 1 pound 2000 pounds = 1 ton	1 cup = 8 fluid ounces 1 pint = 2 cups 1 quart = 2 pints 1 gallon = 4 quarts

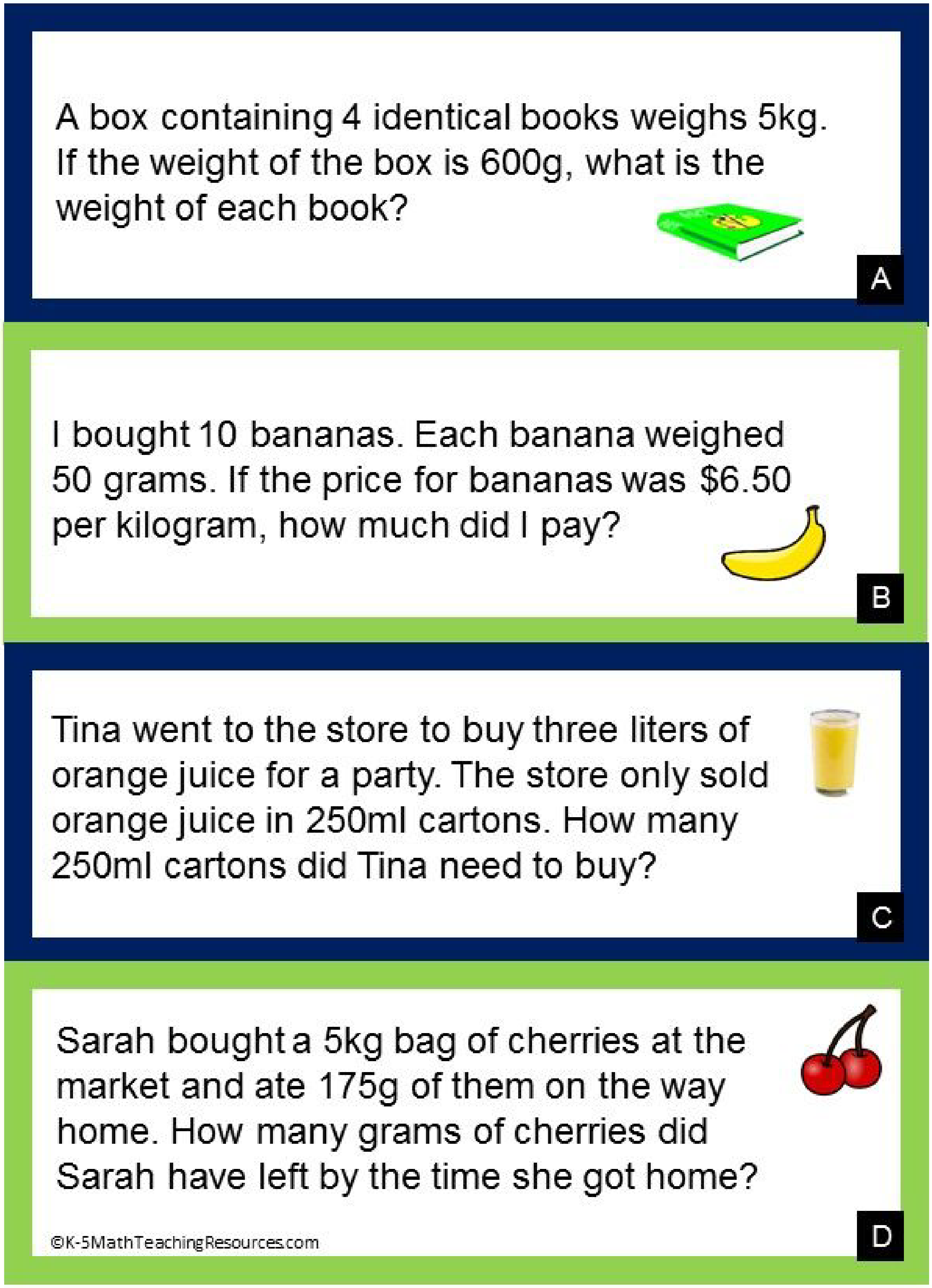
Metric Units

Length	Weight	Capacity
10 millimeters = 1 centimeter 1000 millimeters = 1 meter 100 centimeters = 1 meter 1000 meters = 1 kilometer	1000 milligrams = 1 gram 1000 grams = 1 kilogram	1000mL = 1 liter



clipart.com

Now you try!



A box containing 4 identical books weighs 5kg. If the weight of the box is 600g, what is the weight of each book?

A

I bought 10 bananas. Each banana weighed 50 grams. If the price for bananas was $6.50 per kilogram, how much did I pay?

B

Tina went to the store to buy three liters of orange juice for a party. The store only sold orange juice in 250ml cartons. How many 250ml cartons did Tina need to buy?

C

Sarah bought a 5kg bag of cherries at the market and ate 175g of them on the way home. How many grams of cherries did Sarah have left by the time she got home?

©K-5MathTeachingResources.com

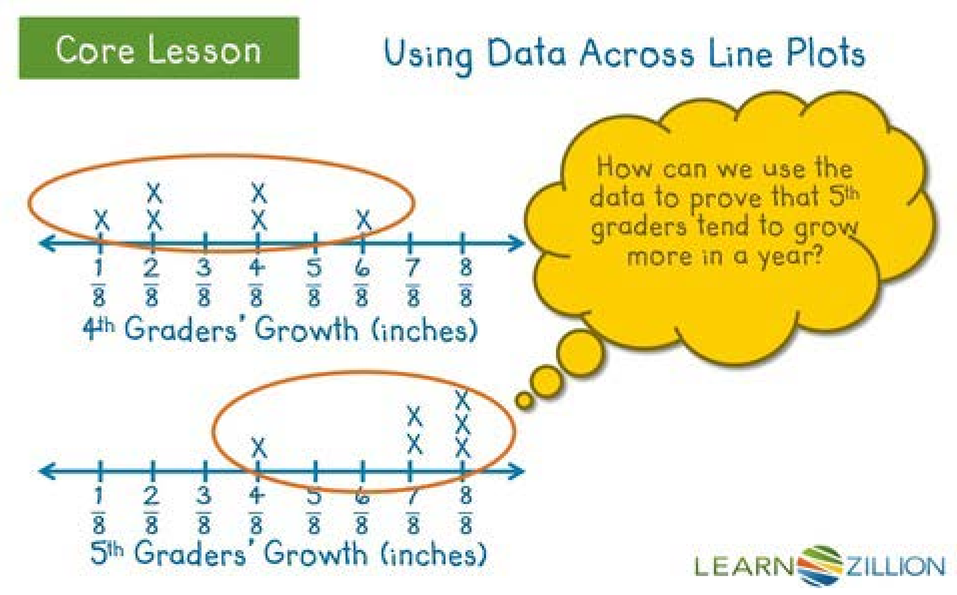
D

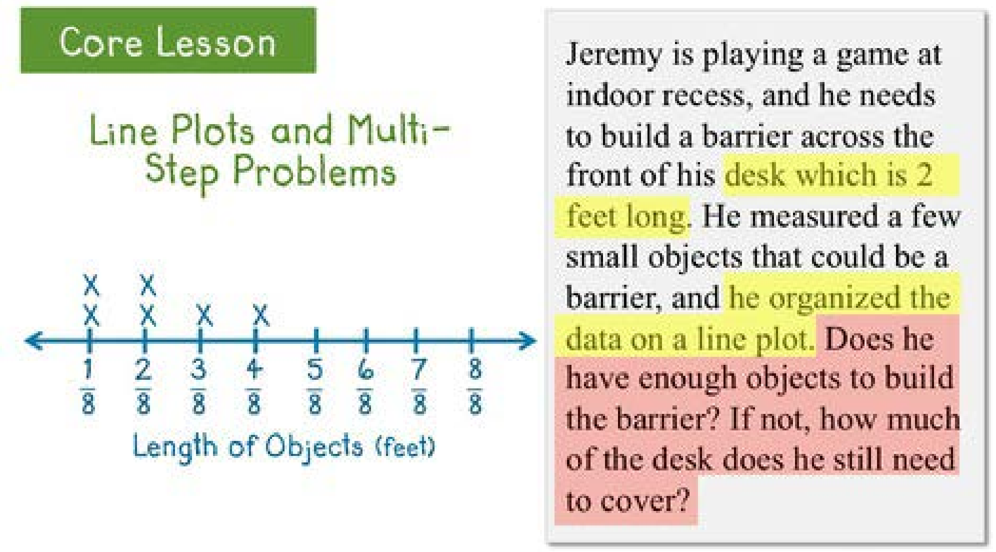
pinterest.com

Represent and interpret data.

CCSS.MATH.CONTENT.5.MD.B.2

Make a line plot to display a data set of measurements in fractions of a unit (1/2, 1/4, 1/8). Use operations on fractions for this grade to solve problems involving information presented in line plots. *For example, given different measurements of liquid in identical beakers, find the amount of liquid each beaker would contain if the total amount in all the beakers were redistributed equally*.



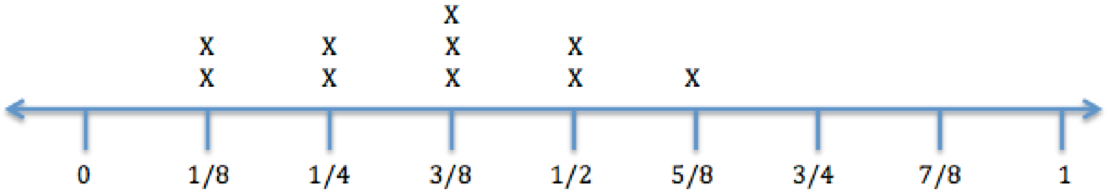


Jeremy is playing a game at indoor recess, and he needs to build a barrier across the front of his desk which is 2 feet long. He measured a few small objects that could be a barrier, and he organized the data on a line plot. Does he have enough objects to build the barrier? If not, how much of the desk does he still need to cover?

learnzillion.com

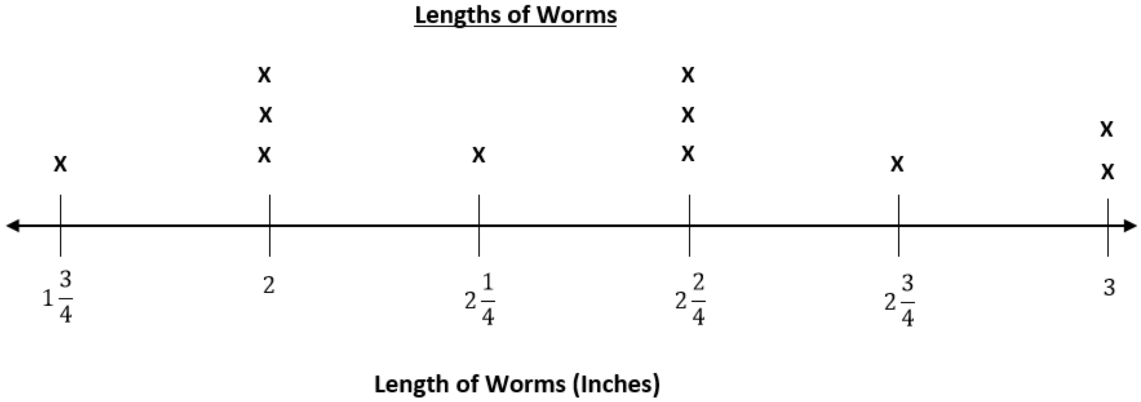
Now you try!

1.) Dahlia and her 9 classmates are having some apple juice. The each get a fraction of a cup. How many cups do they have all together?



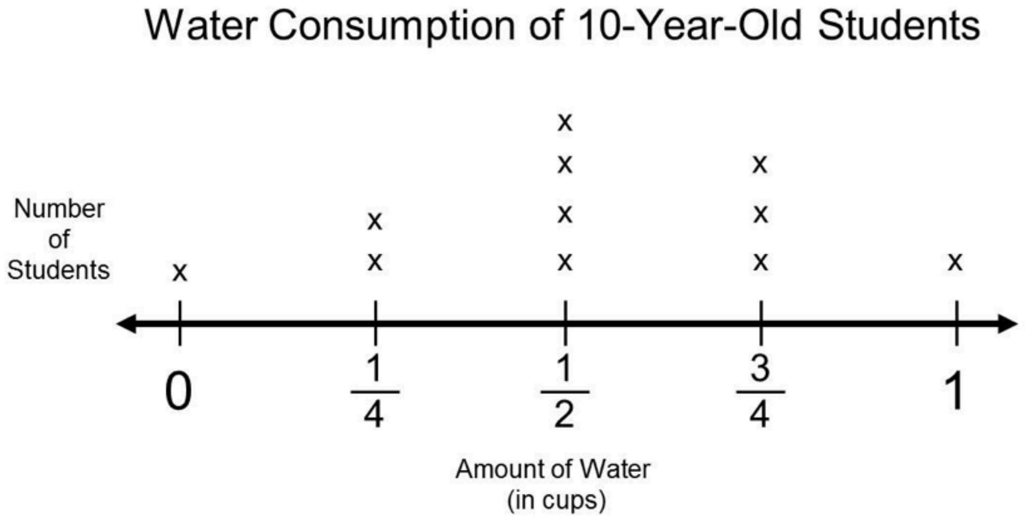
opened.com

2.) Greg and his friends found some worms. What is the total length in worms that they have?



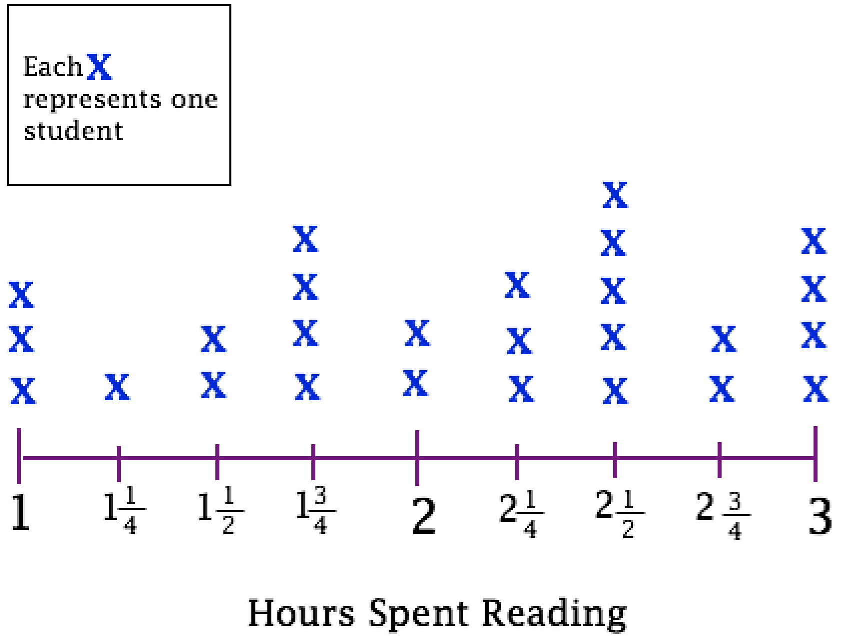
lumoslearning.com

The average 10-year-old should drink 8 cups of water per day.
We polled a certain number of students to see how much water they had consumed by the time they arrived at school and put the results in the line plot below.



weebly.com

3.) How much water did the students drink in all?



accuteach.com

4.) How many hours did the students spend all together reading over the weekend?

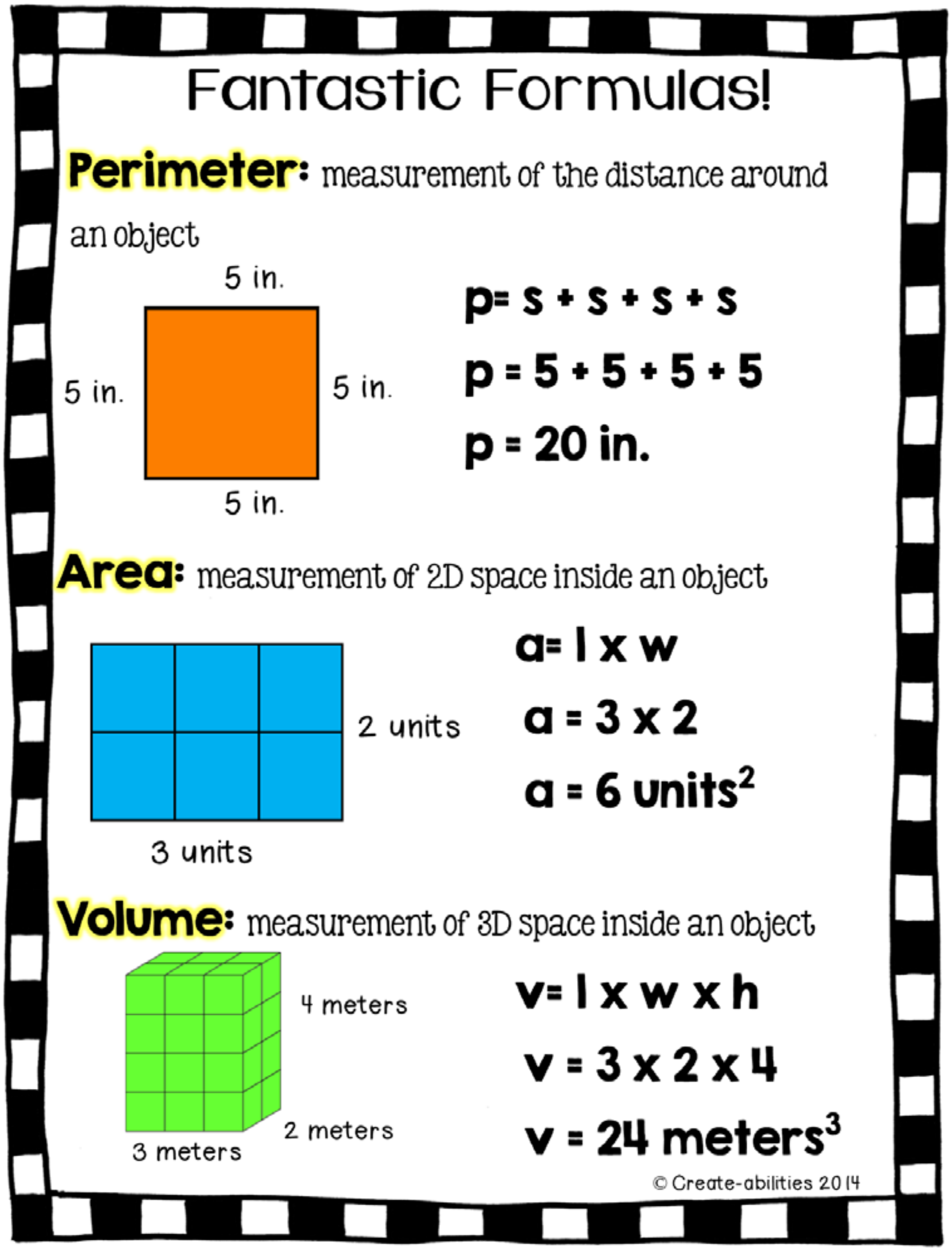
Geometric Measurement: Understand concepts of volume.

CCSS.MATH.CONTENT.5.MD.C.3 A & B

Recognize volume as an attribute of solid figures and understand concepts of volume measurement.

A cube with side length 1 unit, called a "unit cube," is said to have "one cubic unit" of volume, and can be used to measure volume.

A solid figure which can be packed without gaps or overlaps using *n* unit cubes is said to have a volume of *n* cubic units.



Fantastic Formulas!

Perimeter: measurement of the distance around an object

$p = s + s + s + s$

$p = 5 + 5 + 5 + 5$

$p = 20$ in.

Area: measurement of 2D space inside an object

$a = l \times w$

$a = 3 \times 2$

$a = 6 \text{ units}^2$

Volume: measurement of 3D space inside an object

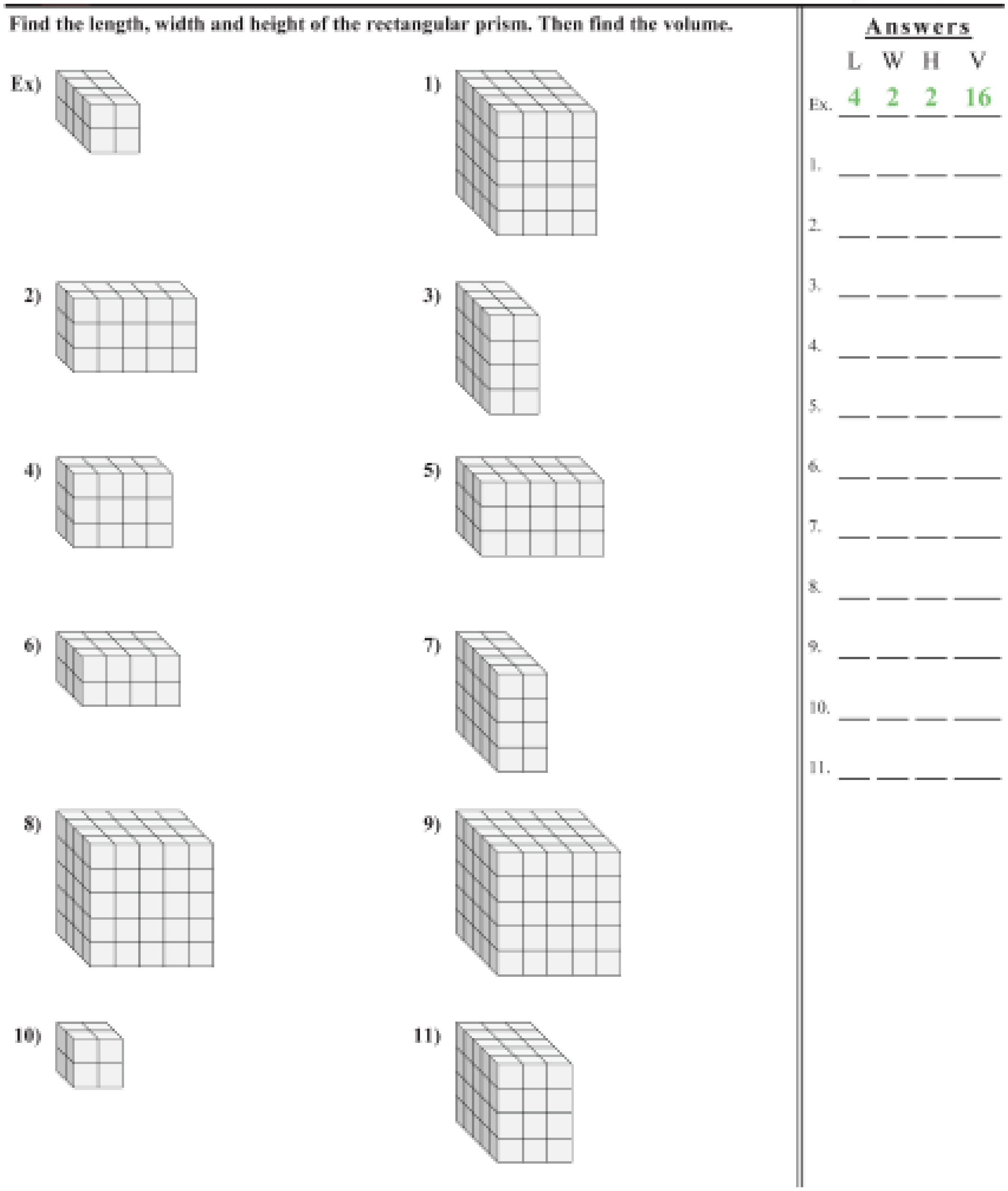
$v = l \times w \times h$

$v = 3 \times 2 \times 4$

$v = 24 \text{ meters}^3$

pinterest.com

Now you try!



Find the length, width and height of the rectangular prism. Then find the volume.

Ex)

1)

2)

3)

4)

5)

6)

7)

8)

9)

10)

11)

Answers

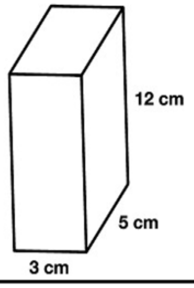
	L	W	H	V
Ex.	4	2	2	16
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				

commoncoresheets.com6,1

CCSS.MATH.CONTENT.5.MD.C.4

Measure volumes by counting unit cubes, using cubic cm, cubic in, cubic ft, and improvised units.

Volume



To find the volume of a rectangular prism, multiply the length by the width by the height.

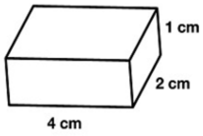
Volume = l x w x h

Volume = 3cm x 5cm x 12 cm

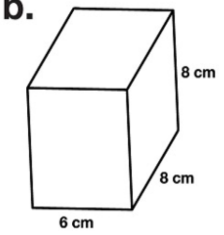
Volume = 180 cm^3

Calculate the volume of each rectangular prism.

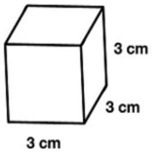
a.



b.



c.

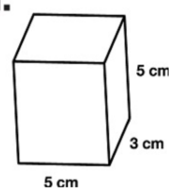


Volume = ________________

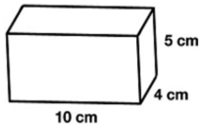
Volume = ________________

Volume = ________________

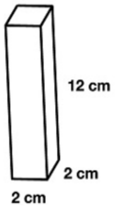
d.



e.



f.

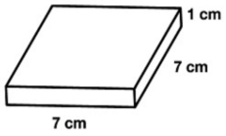


Volume = ________________

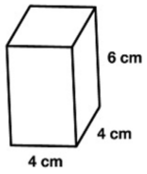
Volume = ________________

Volume = ________________

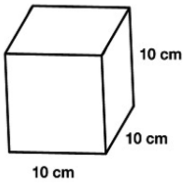
g.



h.



i.



Volume = ________________

Volume = ________________

Volume = ________________

pinterest.com

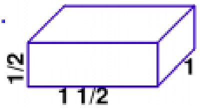
Find the volume of these figures…

1a.

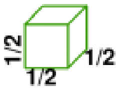
1. How many unit fraction cubes fit into the solid above?

2. Find the volume of the solid.

1b.

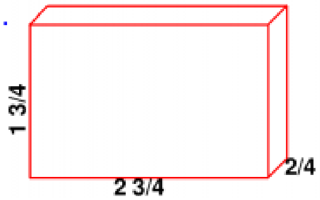


1. How many unit fraction cubes fit into the solid above?



2. Find the volume of the solid.

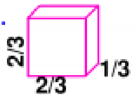
2a.



1. How many unit fraction cubes fit into the solid above?

2. Find the volume of the solid.

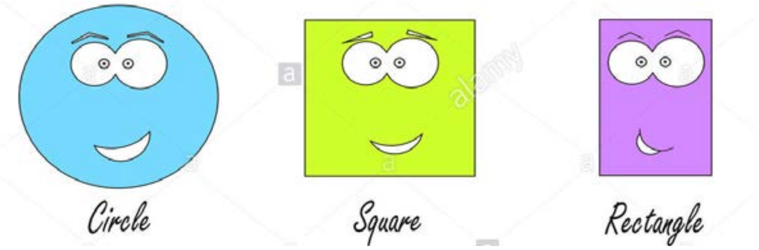
2b.



1. How many unit fraction cubes fit into the solid above?

2. Find the volume of the solid.

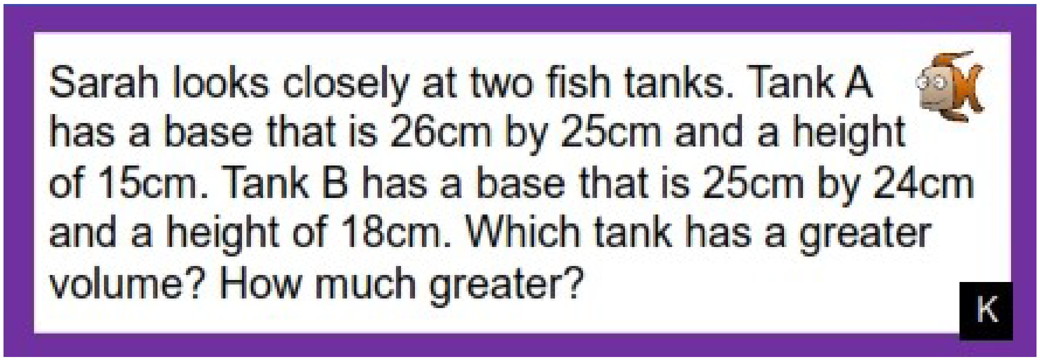
homeschoolmath.com



CCSS.MATH.CONTENT.5.MD.C.5

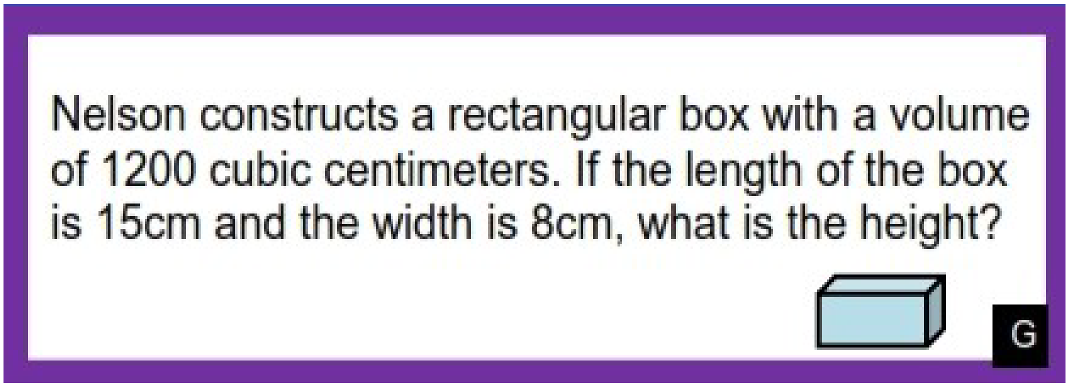
Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume.

Now you try!



Sarah looks closely at two fish tanks. Tank A has a base that is 26cm by 25cm and a height of 15cm. Tank B has a base that is 25cm by 24cm and a height of 18cm. Which tank has a greater volume? How much greater?

K

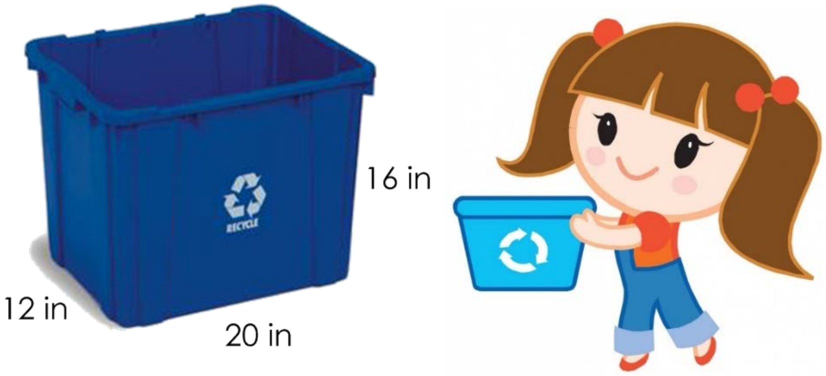


Nelson constructs a rectangular box with a volume of 1200 cubic centimeters. If the length of the box is 15cm and the width is 8cm, what is the height?

G

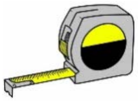
pinterest.com

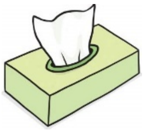
Recycling The town of Riverview provides a rectangular recycling bin for newspapers to each household. What is the greatest volume of newspapers the recycling bin can hold?



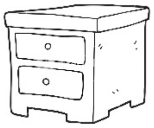
misskahrimanis.blogspot.com

Find the volume of these items in your  !

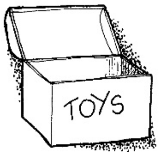
(Use inches and/or centimeters. You'll need a  or  .)



Tissue box ____________________________



Nightstand or a drawer ____________________



Toy box ______________________________

Washing machine ______________________

Your bed _____________________________

CCSS.MATH.CONTENT.5.MD.C.5.A, B & C

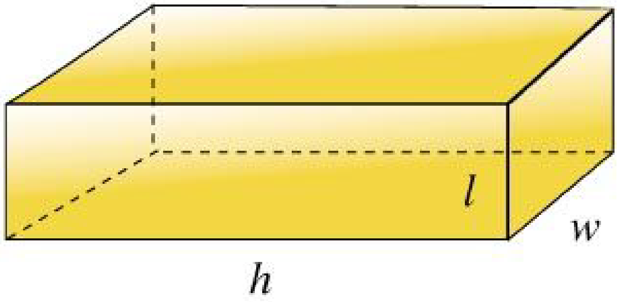
Find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent threefold whole-number products as volumes, e.g., to represent the associative property of multiplication.

Apply the formulas $V = l \times w \times h$ and $V = b \times h$ for rectangular prisms to find volumes of right rectangular prisms with whole-number edge lengths in the context of solving real world and mathematical problems.

Recognize volume as additive. Find volumes of solid figures composed of two non-overlapping right rectangular prisms by adding the volumes of the non-overlapping parts, applying this technique to solve real world problems.

Finding the volume of a rectangular prism by multiplying the length times the width times the height…is the same as finding the area of the base and then multiplying by the height.

RECTANGULAR PRISM

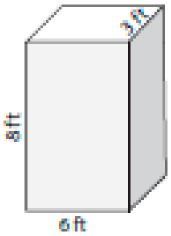


$$V = lwh \text{ or } V = Bh$$

pinterest.com

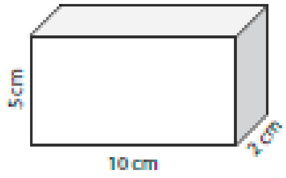
Find the volume of each rectangular prism.

1)



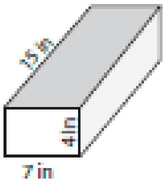
Volume = ______

2)



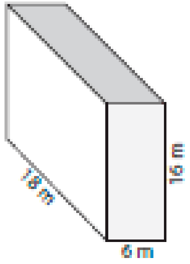
Volume = ______

3)



Volume = ______

4)

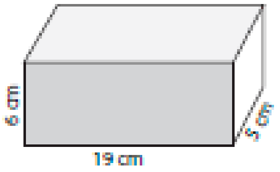


Volume = ______

5)

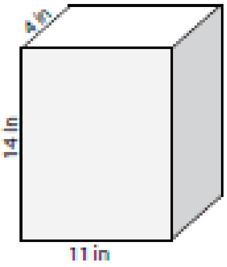
Volume = ______

6)



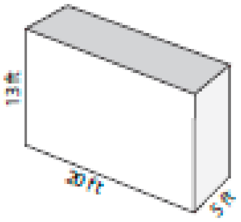
Volume = ______

7)



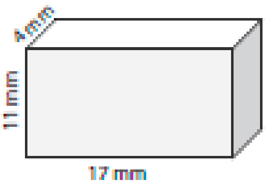
Volume = ______

8)



Volume = ______

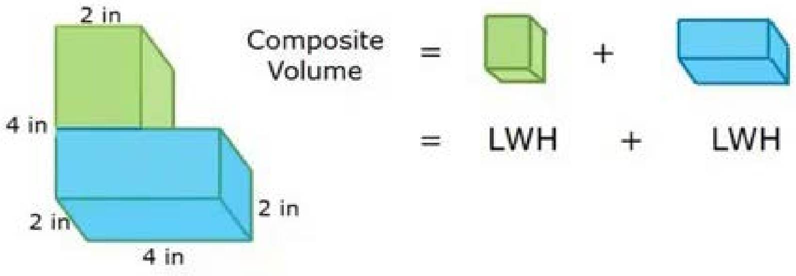
9)



Volume = ______

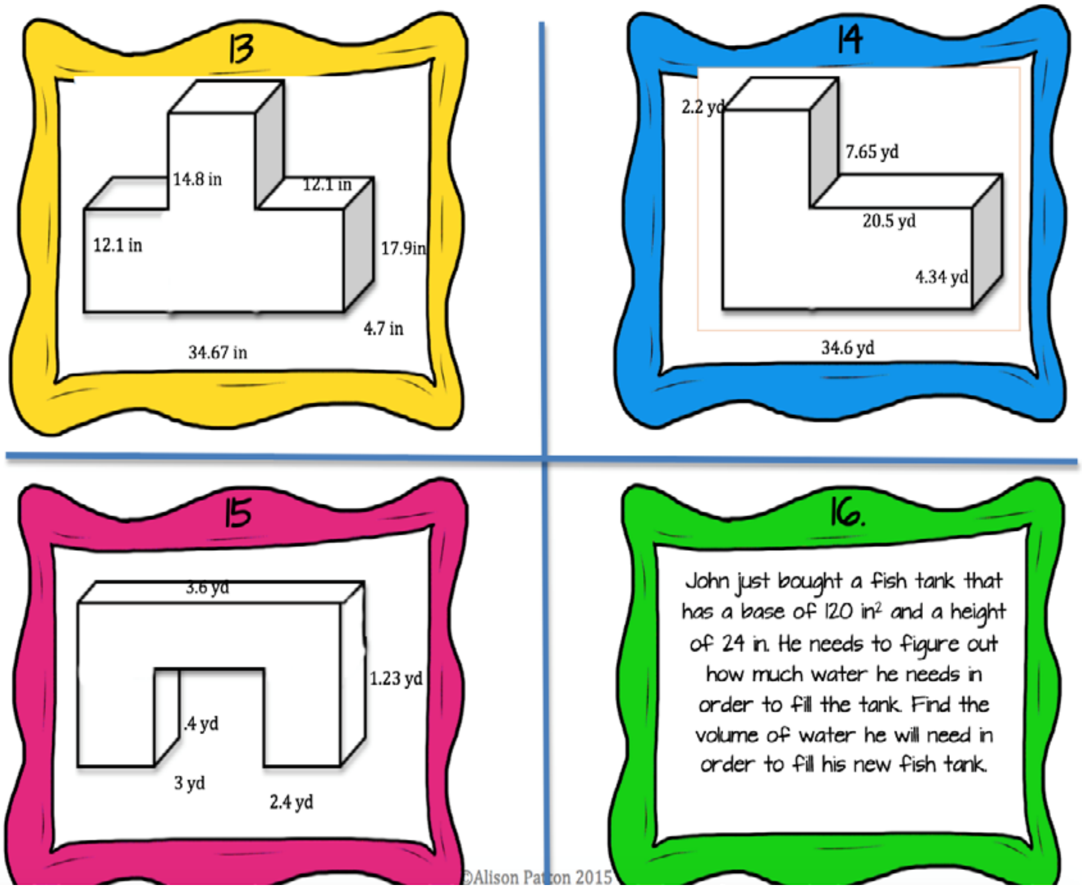
mathworksheets4kids.com

Challenge!



learnzillion.com

Find the volume of these composite figures.



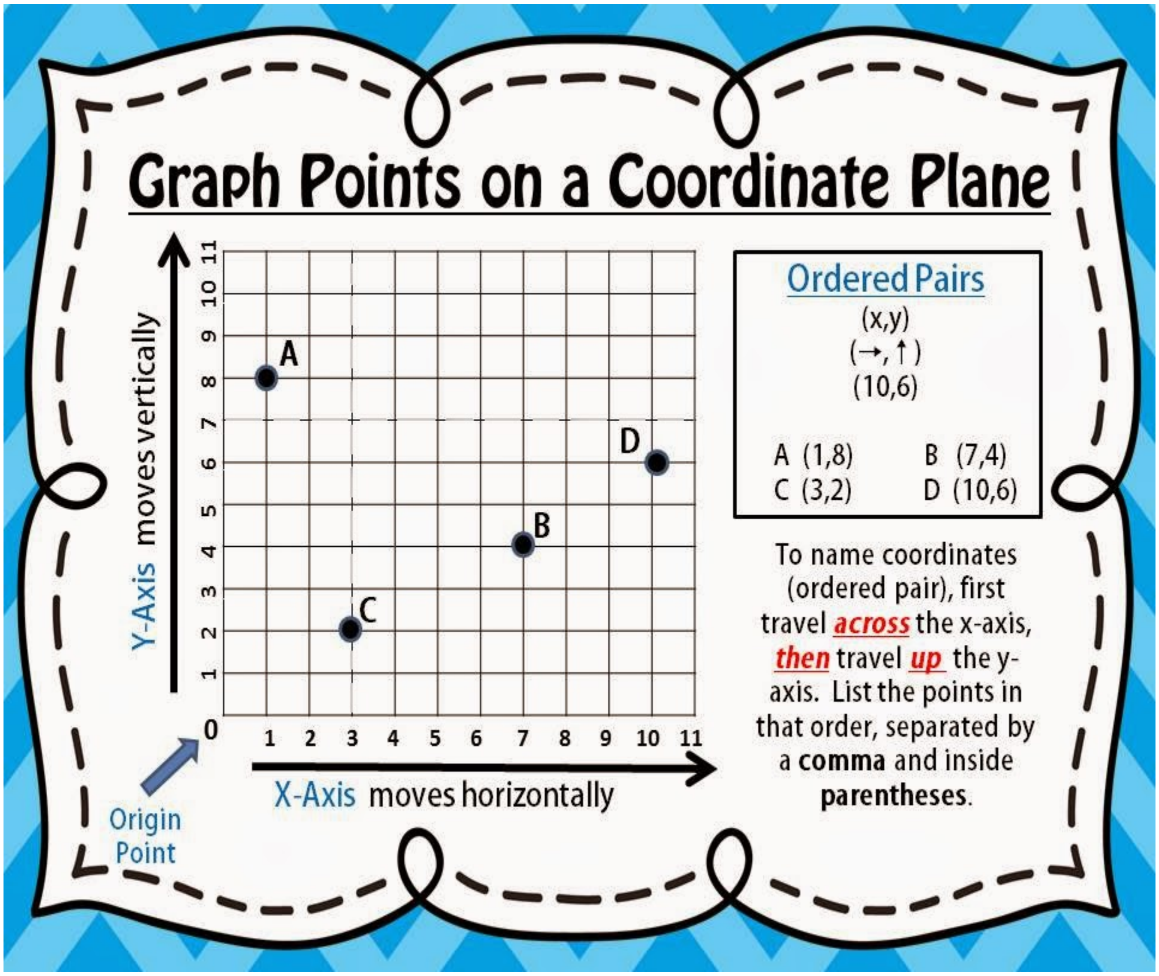
John just bought a fish tank that has a base of 120 in^2 and a height of 24 in. He needs to figure out how much water he needs in order to fill the tank. Find the volume of water he will need in order to fill his new fish tank.

pinterest.com

Unit Five: Geometry

CCSS.MATH.CONTENT.5.G.A.1

Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., x-axis and x-coordinate, y-axis and y-coordinate).

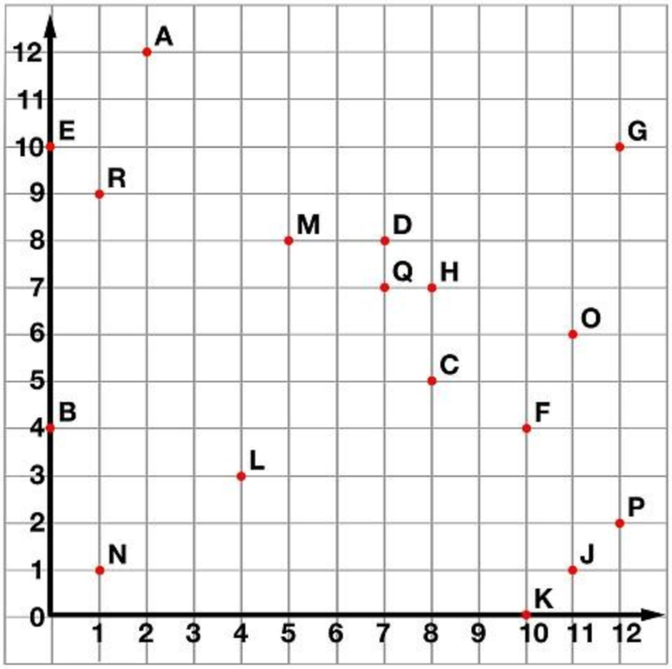


To name coordinates (ordered pair), first travel ***across*** the x-axis, ***then*** travel ***up*** the y-axis. List the points in that order, separated by a **comma** and inside **parentheses**.

appletasticlearning.com

What are the ordered pairs?

Ordered Pairs



Tell what point is located at each ordered pair.

1. **(5,8)** _______

2. **(12,2)** _______

3. **(8,7)** _______

4. **(12,10)** _______

5. **(7,7)** _______

6. **(0,10)** _______

Write the ordered pair for each given point.

7. **N** ______________

8. **L** ______________

9. **J** ______________

10. **A** ______________

11. **B** ______________

12. **E** ______________

Plot the following points on the coordinate grid.

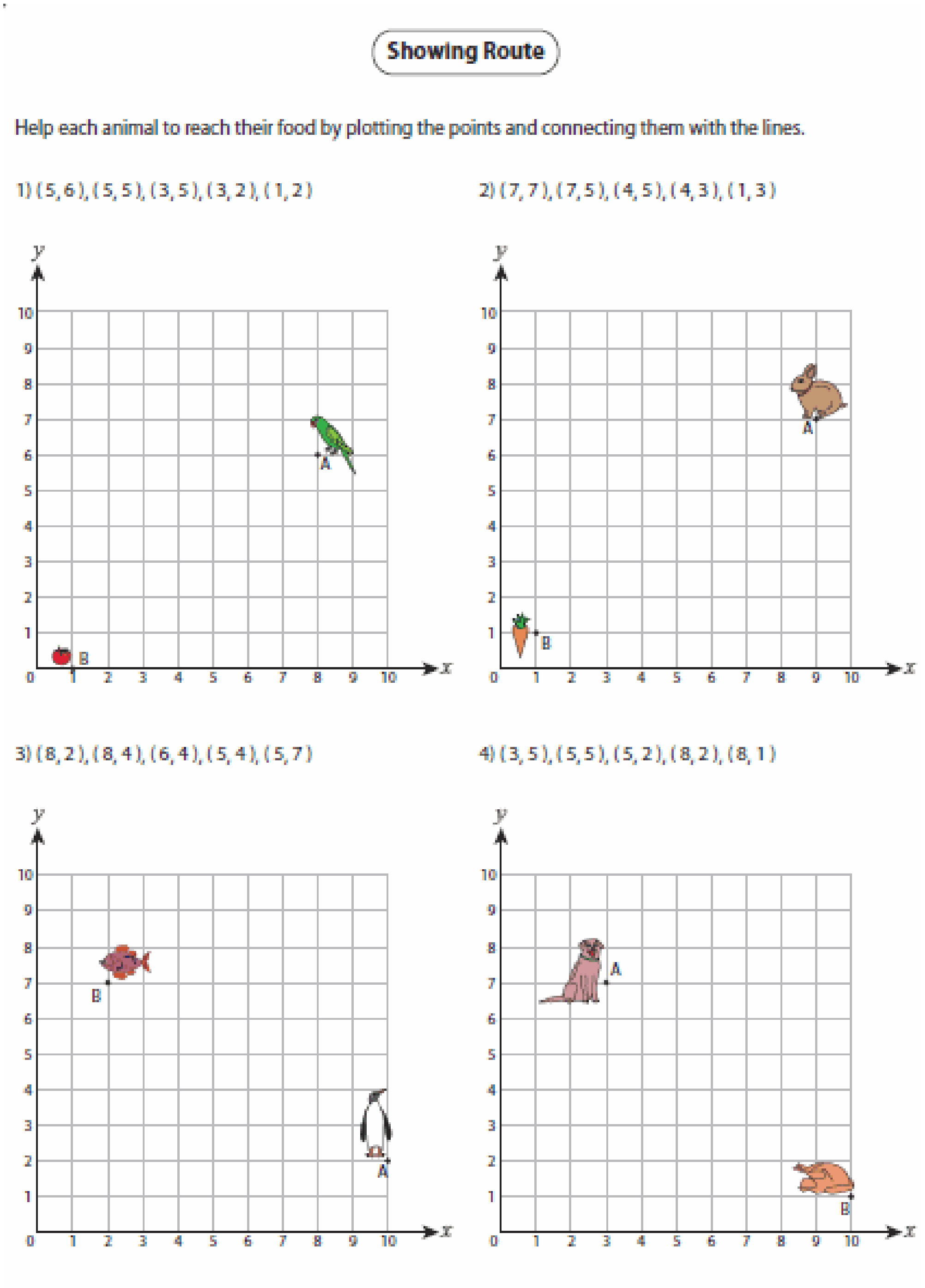
13. **S (6,11)**

14. **T (3,5)**

15. **U (9,12)**

superteacherworksheets.com

Help the animals get their food!



Showing Route

Help each animal to reach their food by plotting the points and connecting them with the lines.

1) (5, 6), (5, 5), (3, 5), (3, 2), (1, 2)

2) (7, 7), (7, 5), (4, 5), (4, 3), (1, 3)

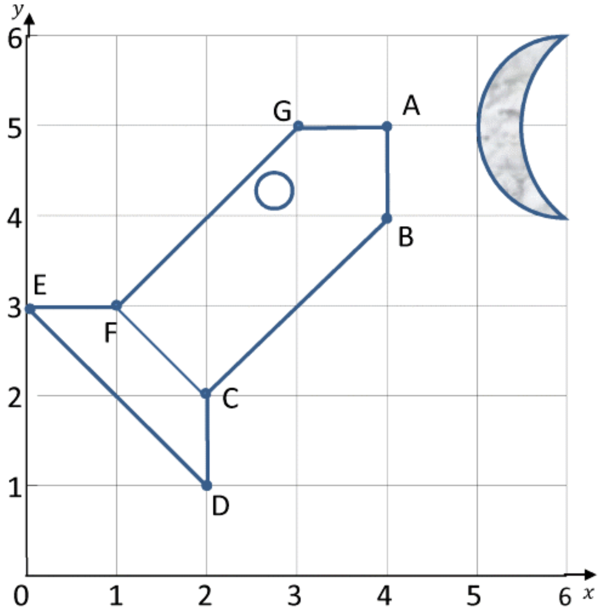
3) (8, 2), (8, 4), (6, 4), (5, 4), (5, 7)

4) (3, 5), (5, 5), (5, 2), (8, 2), (8, 1)

mathworksheets4kids.com

Graph the picture!

PLOT THE COORDINATES SHEET 3



1) Write down the coordinates of this rocket.

A (____, ____)

B (____, ____)

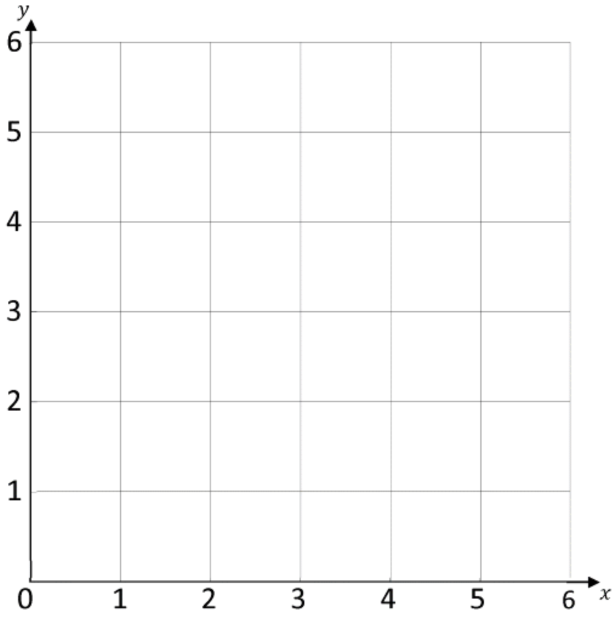
C (____, ____)

D (____, ____)

E (____, ____)

F (____, ____)

G (____, ____)



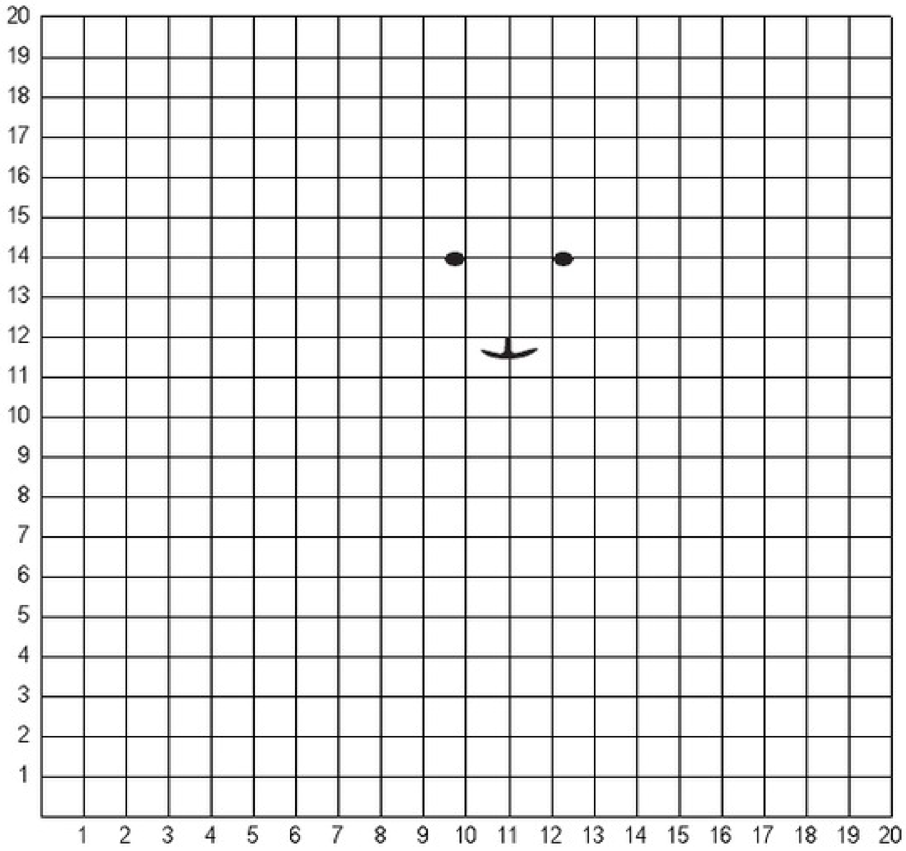
2) Draw your own rocket in the grid below and write down the coordinates.

mathsalamanders.com

What could it be???

(Don't forget to stop at the end of each line, and start again at the beginning of the next one!)

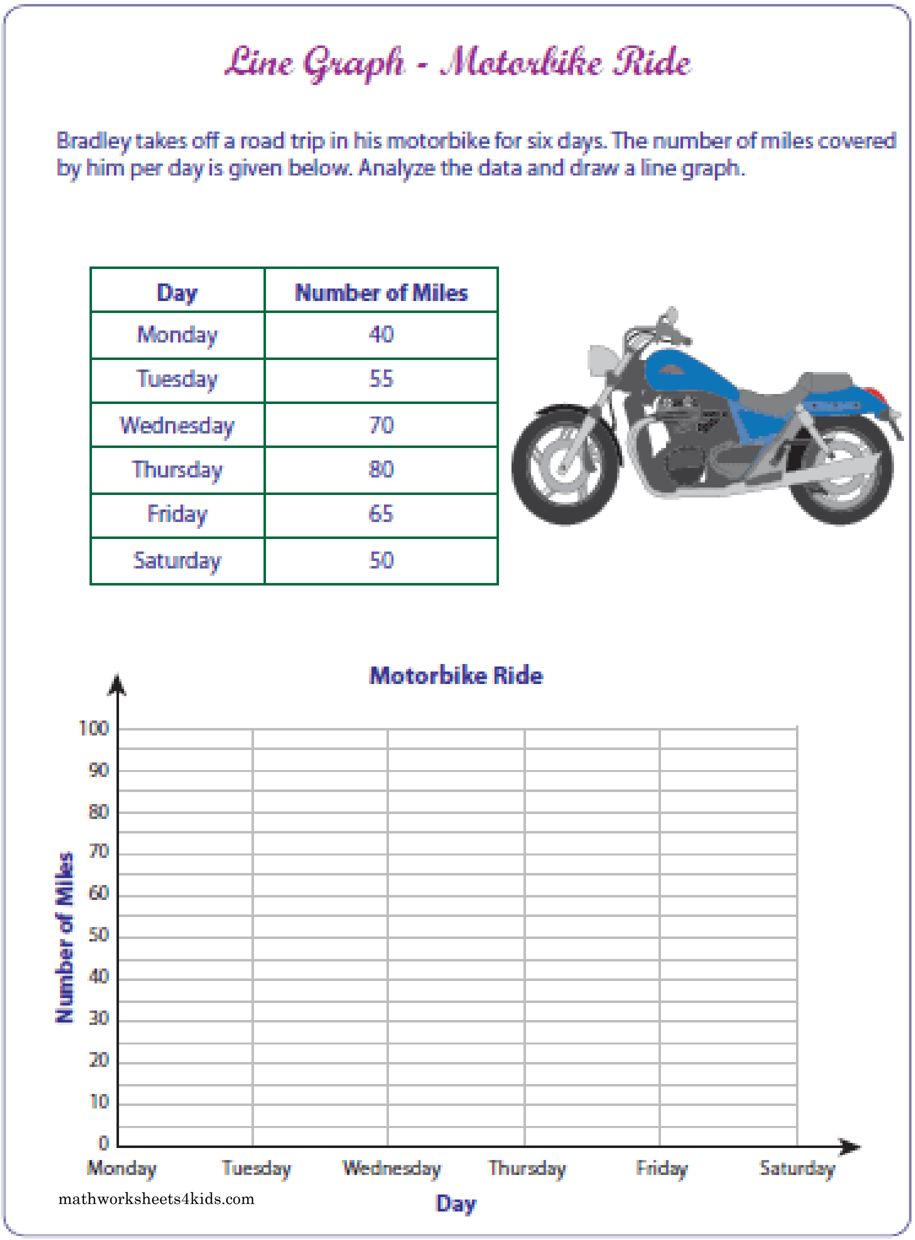
There is a picture hidden in this grid. Connect the points with lines to reveal it.



Line 1: (10,1), (9,2) **Line 2:** (9,1), (8,2) **Line 3:** (6,12), (9,13), (6,14) **Line 4:** (16,12), (13,13), (16,14) **Line 5:** (16,1), (15,2) **Line 6:** (6,4), (5,3), (3,3), (1,4), (0,7), (0,9), (1,11), (3,12), (5,12), (6,11), (4,11), (3,11), (2,10), (1,8), (2,5), (3,4), (4,4), (6,6)
Line 7: (12,2), (14,1), (16,1), (16,2), (14,3), (15,5), (14,7), (15,9), (17,10), (19,13), (18,14), (17,13), (16,11), (14,10), (13,11), (14,13), (14,18), (12,16), (10,16), (8,18), (8,13), (9,11), (7,10), (6,9), (6,4), (8,1), (10,1), (10,2), (8,3), (10,4), (11,5), (11,6), (10,7) **Line 8:** (15,1), (14,2) **Line 9:** (10,13), (11,12), (12,13) **Line 10:** (13,13), (16,13) **Line 11:** (9,13), (6,13) **Line 12:** (10,2), (12,2), (13,3), (14,5) **Line 13:** (8,8), (8,5), (7,4), (6,5)

CCSS.MATH.CONTENT.5.G.A.2

Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane and interpret coordinate values of points in the context of the situation.



Line Graph - Motorbike Ride

Bradley takes off a road trip in his motorbike for six days. The number of miles covered by him per day is given below. Analyze the data and draw a line graph.

Day	Number of Miles
Monday	40
Tuesday	55
Wednesday	70
Thursday	80
Friday	65
Saturday	50

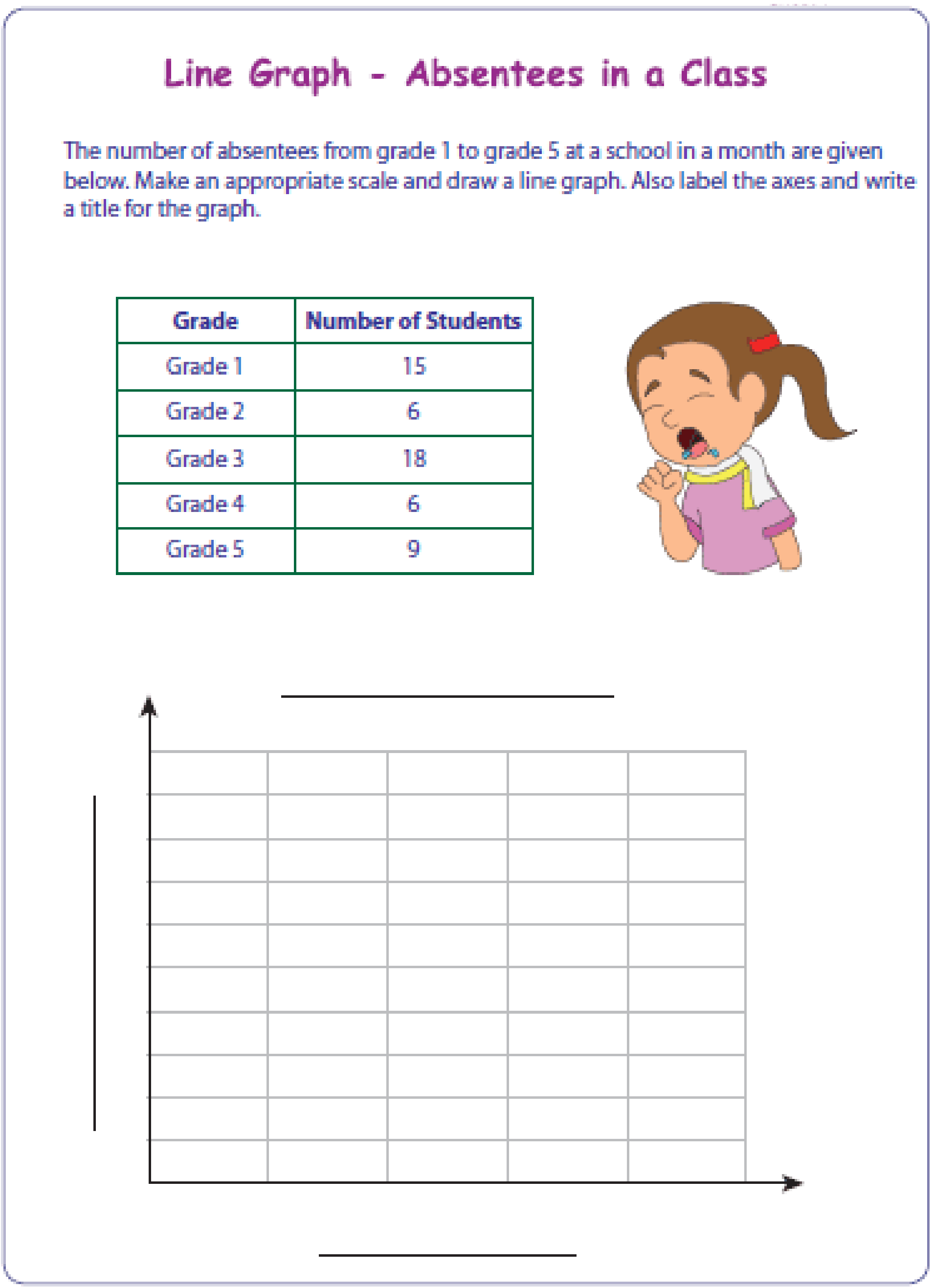
mathworksheets4kids.com

mathworksheets4kids.com

Which two consecutive days has the greatest difference?

____

Too many sick kids!



Line Graph - Absentees in a Class

The number of absentees from grade 1 to grade 5 at a school in a month are given below. Make an appropriate scale and draw a line graph. Also label the axes and write a title for the graph.

Grade	Number of Students
Grade 1	15
Grade 2	6
Grade 3	18
Grade 4	6
Grade 5	9

mathworksheets4kids.com

1.) What is the difference between the highest and lowest number of absent students? ________________________________

2.) After noticing the pattern, what do you think will happen to the number of absent students in 6th grade? ______________________

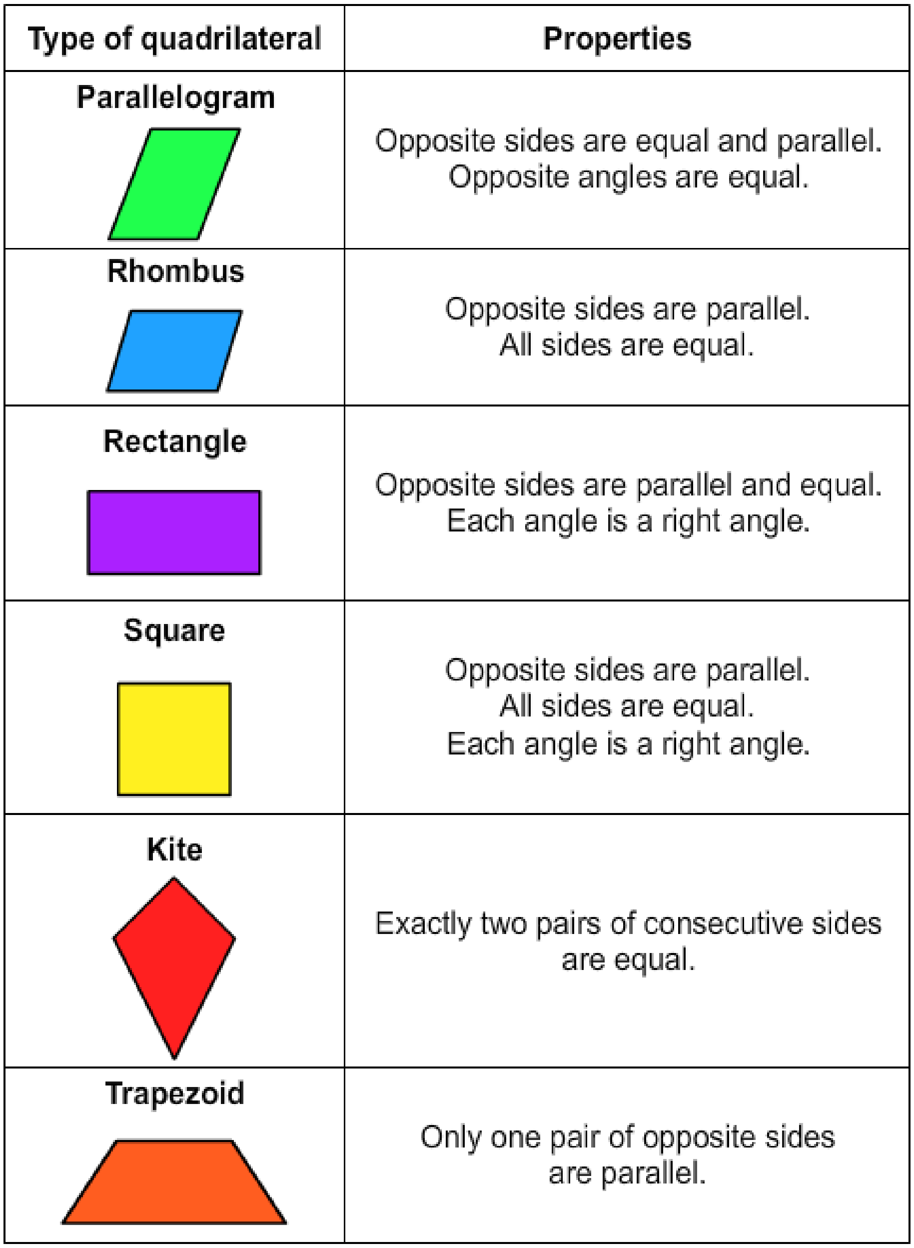
CCSS.MATH.CONTENT.5.G.B.3

Understand that attributes belonging to a category of two-dimensional figures also belong to all subcategories of that category. For example, all rectangles have four right angles and squares are rectangles, so all squares have four right angles.

A polygon is a two-dimensional figure made up of line segments called sides that are connected from end to end.

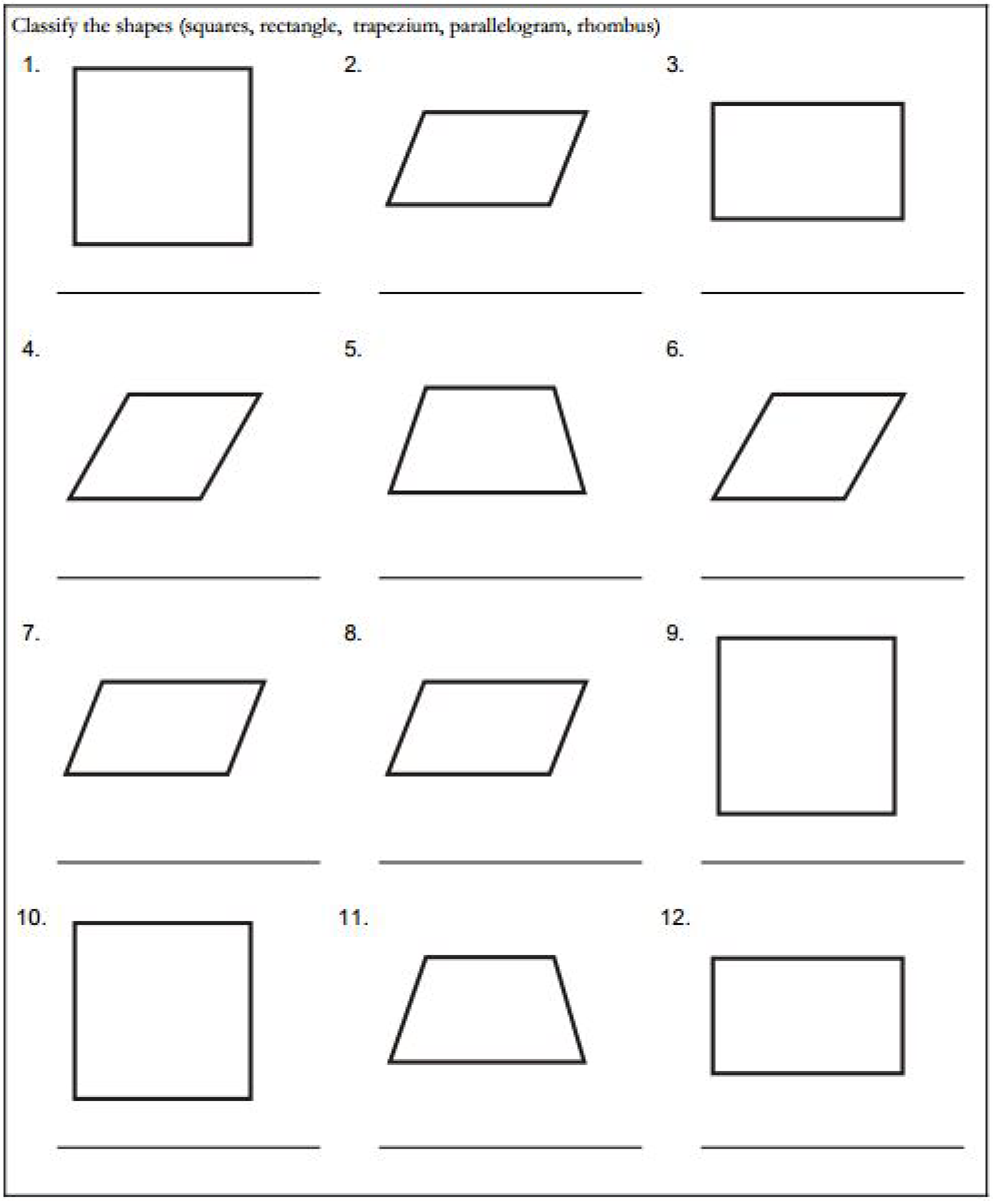
Properties of Polygons

lbartman.com



Type of quadrilateral	Properties
Parallelogram	Opposite sides are equal and parallel. Opposite angles are equal.
Rhombus	Opposite sides are parallel. All sides are equal.
Rectangle	Opposite sides are parallel and equal. Each angle is a right angle.
Square	Opposite sides are parallel. All sides are equal. Each angle is a right angle.
Kite	Exactly two pairs of consecutive sides are equal.
Trapezoid	Only one pair of opposite sides are parallel.

Classify these polygons:


Classify the shapes (squares, rectangle, trapezium, parallelogram, rhombus)

1. ____________
2. ____________
3. ____________
4. ____________
5. ____________
6. ____________
7. ____________
8. ____________
9. ____________
10. ____________
11. ____________
12. ____________

lbartman.com

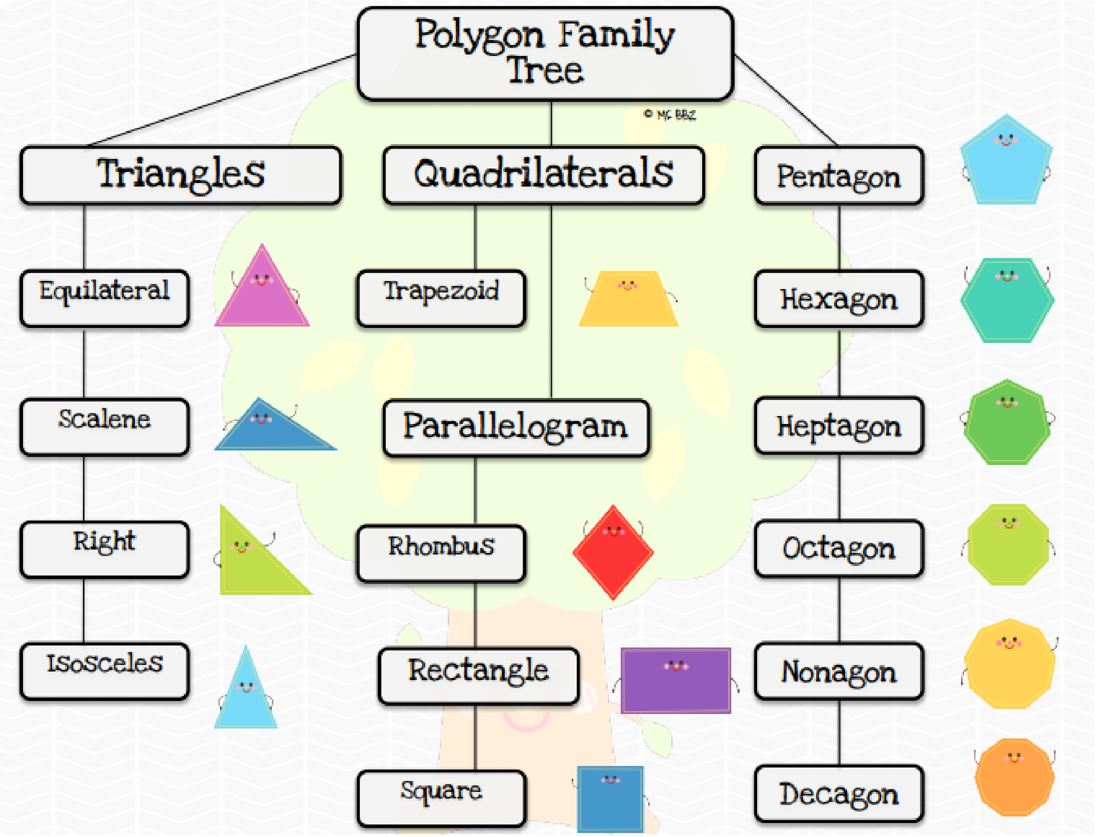
Quadrilaterals

Fill in the table below by drawing and naming the quadrilaterals.

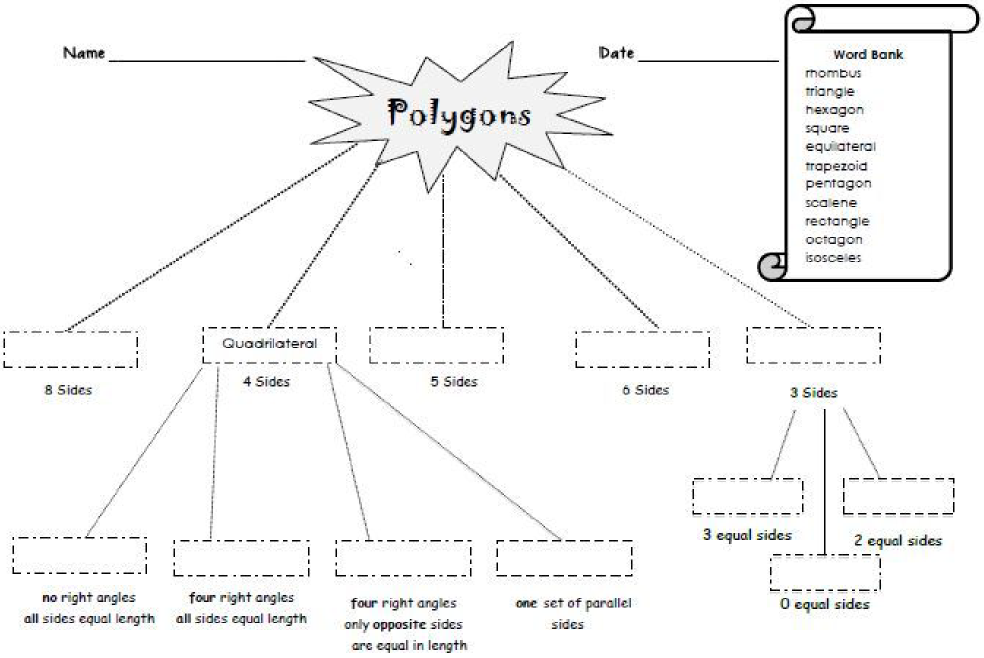
Description	Name	Diagram
Both pairs of opposite sides are parallel. Opposite angles are equal. Opposite sides are equal. The diagonals bisect each other.		
Two pairs of adjacent sides are equal. One pair of opposite angles are equal. Diagonals that cross at right angles. One of its diagonals is bisected by the other.		
All sides equal. 4 right angles. Both pairs of opposite sides are parallel. Equal diagonals which bisect each other at right angles.		
One pair of opposite sides are parallel.		
All sides equal. Both pairs of opposite sides are parallel. Opposite angles are equal. Diagonals that bisect each other at right angles. Diagonals that bisect the angles at the vertices.		
Both pairs of opposite sides are parallel. 4 right angles. Equal diagonals which bisect each other. Opposite sides are equal.		

CCSS.MATH.CONTENT.5.G.B.4

Classify two-dimensional figures in a hierarchy based on properties.



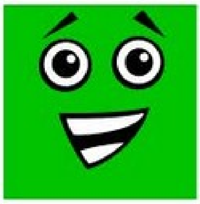
mrssolsclass.blogspot.com pinterest.com

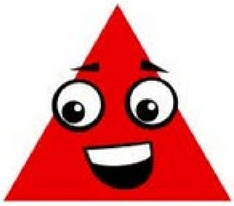


Last one…have some fun!

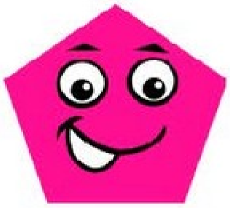
Geometric Shapes

O	H	Q	R	E	C	T	A	N	G	L	E	P
D	V	Q	I	M	H	E	S	Q	W	R	A	K
I	C	A	V	U	L	Q	N	T	H	R	K	O
O	P	X	L	Q	U	O	R	O	A	I	N	N
Z	N	P	P	A	G	I	M	L	C	H	Y	O
E	R	U	R	A	A	B	L	H	R	E	D	G
P	Y	E	T	N	U	E	Z	E	F	X	S	A
A	I	C	G	S	L	C	D	E	H	A	P	T
R	O	L	P	O	I	N	Y	B	E	G	H	N
T	E	L	G	R	I	P	H	U	I	O	E	E
S	U	R	C	L	A	T	Y	C	O	N	R	P
G	A	L	Y	L	M	E	C	R	J	A	E	K
M	E	C	Z	H	F	D	I	M	A	R	Y	P





CIRCLE
CONE
CUBE
CYLINDER
HEXAGON
OCTAGON
OVAL
PARALLELOGRAM
PENTAGON
PYRAMID
RECTANGLE
RHOMBUS
SPHERE
SQUARE
TRAPEZOID
TRIANGLE



puzzle-to-print.com

Answer Key

p. 14 A: 72, 17, 26,4, 84, 16, 44, 37 B: 9, 8, 31, 100, 82, 62 C: 63, 17, 72, 1	p.27 >,>,<,<,<,>,<,<,>,>,<,>,=, <,>,>,>,<,=,>,>,<,>,<,<,>,>
p. 15 A = 4, B = 10, C = 2, D = 6, E =1, F = 15, G = 17 H = 27, I = 33, J = 3, K = 40, L = 22, M = 5, N = 19, O = 11, P = 16, Q = 24, R = 0, S = 12, T = 32, U = 30, V = 18, W = 7, X = 20, Y = 35, Z = 36. April showers bring May flowers and everything's in bloom.	p. 30 11.) 312.21 12.) 734.35 13.) 734.75 14.) 438.22 15.) 373.41 16.) 451.59 17.) 218.34 18.) 497.7 19.) 366.83 20.) 752.92
p. 17 1.) 350-110 = 240 240÷4 = 60 60 + 20 = $80 2.) 3(1.20) + 2(1.50) + 1.70 = 8.30 10 – 8.30 = 1.70 She can buy another box of pens.	p.32 1.) forty-five thousand three hundred and thirty-two 2.) twenty-three and one tenth 3.) four thousand two hundred and nineteen 4.) fifteen thousand seven hundred and seventy-four 5.) eight hundred and eighty-nine and five tenths 6.) seven hundred and seventy-five 7.) sixteen 8.) four hundred and thirty-four and eleven hundredths
p. 18 3.) all animals: 85 + 6 + 4 = 95 95-13-1-4-1-5 = 25 70 animals left 4.) 250(4+5) = 2,250 20(200) = 4,400 12(50) = 600 Total = $7,250	p. 34 6.4, 6.38 .8, .79 2.2, 2.16 14.5, 14.48 59.6, 59.62 .8, .80 4.4, 4.37 81.1, 81.10
p. 20 1.) 12-5 = 7 2.) 4x8 = 32 3.) (24÷6)x3 = 12 4.) (15+7)÷2 = 11 5.) 3(4+1) = 15 6.) 9-5+7 = 11 7.) (12 x 2) ÷3 = 8 8.) 14-8+5= 11 9.) (35÷5) x 3 = 21	p. 36 a. 6256, b. 234, c. 9114, d. 600 e. 3008, f. 1710, g. 6400, h. 1817 i. 6612, j. 540, k. 2499
p. 21 dogs: 8, legs: 8, 40 Dan's age: 5, Sam's age 7, 14 Teams: 5, Students: 15, 35, 60 Original price: 18, Sales price: 12, 24, 28	p.45 1.) 19/35, 2.) 2/6, 3.) 18/40 4.) 19/24 5.) 31/42, 6.) 19/18, 7.) 5/24, 8.) 37/28 9.) 41/30, 10.) 5/36, 11.) 3/10, 12.) 17/12 13.) 23/40, 14.) 7/40 15.) 29/20, 16.) 13/56
p. 25 value of 5: 500,000 value of 4: 4,000,000	46. 11/12, 1 5/12, 1 3/8, 1 1/2, 1, 9/14
p. 26 1749.82, 17.4982 3290.47, 32.9047 172.8, 1.728 169.09, 1.6909 17892.6, 178.926 24232900.01, 242329.0001 14.17, .1417 68.49, .6849 1746.16, 17.4616	p. 49 1.) 1 5/21, 2.) 1 17/24, 3.) 1 1/4 4.) 1 3/16, 5.) 1 29/36, 6.) 1 1/5 7.) 1 1/3, 8.) 1 9/16

p.51 5 2/3 pizza, ½ cup 4 ¾ meatballs, 7/12 fudge 8 ½ cupcakes, 3 13/20 miles	p. 74 1.) 5x4x5 = 100 2.) 2x5x3 = 30 3.) 4x2x4 = 32 4.) 2x4x3 = 24 5.) 3x5x3 = 45 6.) 3x4x2 = 24 7.) 5x2x4 = 40 8.) 4x5x5 = 100 9.) 5x5x5 = 125 10.) 2x2x2 = 8 11.) 5x3x4 = 60
p. 53 1.) 2 1/9 cups 2.) 7 mugs 3.) 9 lawns 4.) 36 days, 5.) 1 1/3 pounds	p. 75 a.) 8 b.) 384 c.) 27 d.) 75 e.) 200 f.) 48 g.) 49 h.) 96 i.) 1000 p. 76 1a.) 9, 9/64 1b.) 6, ¾ 2a.) 154, 77/32
p. 56 $45, 10 2/3, ¼, 3/7	p. 77 1.) Tank B 10,800-9750 = 1050 2.) 1200 ÷ 120 = 10 cm 3.) 3,840
p. 58 1.) 3 baskets 2.) $9.00 3.) 1 ½ baskets 4.) $5.00 5.) 2 baskets, $6.00 6.) 1 basket, $ 3.00 7.) 3 baskets 8.) $23.00	p. 80 1.) 144 2.) 100 3.) 420, 4.) 1,728, 5.) 384 6.) 570 7.) 616 8.) 1300 9.) 748 p. 81 13.) 3,646.0803 14.) 567.6638 15.) 11.844 16.) 2,880
p. 61 1/10, 9/20	p. 84 1.) M 2.) P 3.) H. 4.) G 5.) Q 6.) E 7.) (1,1) 8.) (4,3) 9.) (11,1) 10.) (2,12) 11.) (0,4) 12.) (0,10) p. 86 A (4,5) B (4,4) C (2,2) D (2,1) E (0,3) F (1,3) G (3,5)
p.62 1.) 1/7, 2.) 1/6, 3.) 1/7, 4.) 1/8 5.) 16/27, 6.) 3/16, 7.) 1/15 8.) 5/18 9.) 1/12, 10.) 5/18, 11.) 2/49	p. 87 It's a cat p. 88 Tuesday to Wednesday p. 89 12 kids, It could get lower than 9
p. 66 1.) ¼ ÷ 3. They each had 1/12. 2.) 6 ÷ 1/3. Jenna could share with 18 people.	p. 91 1.) square 2.) parallelogram 3.) rectangle 4.) rhombus 5.) trapezoid 6.) rhombus 7.) parallelogram 8) parallelogram 9.) square 10.) square 11.) trapezoid 12..) rectangle
p. 69 1.) 1,100 grams 2.) $3.25 3.) 12 4.) 4,825 grams of cherries	p. 92 rhombus, kite, square, trapezoid, parallelogram rectangle
p.71 1.) 3 ½ 2.) 25 ¼ p.72 3.) 5 ¾ 4.) 55 hours	You are finished! 

WEBSITES

More help and support for math enrichment can be found on a variety of websites. The following is a list well-reviewed websites.

Education World

www.educationworld.com

Math Levels: K-12th with more emphasis on the primary grades.
Extra: free downloadable worksheets

Education World presents a variety of math resources that all educators and parents can use to liven up instruction and support learning.

This site links to www.freeprintableonline.com and has downloadable pdfs of its own on critical thinking, math crossword puzzles, and hands-on math activities.

Wyzant

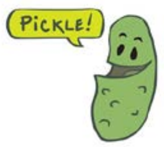
www.wyzant.com

Math Levels: K-12th
Extra: clear table of contents on front page

As soon as you open the first page, you see all the topics you need for lessons, examples, and worksheets.

Math Pickle

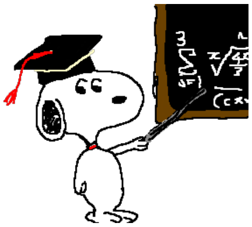
http://mathpickle.com/



Math Levels: K-12th
Extra: good videos and activity resources

Your students can take mini-lessons. Make it a game. Make it a fun project. They will learn without realizing it! This math website has video support, discussion boards, games.

Hooda Math

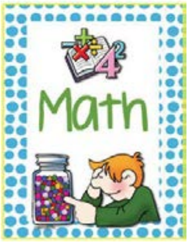


www.hoodamath.com

Math Levels: K-8th
Extra: many fun online games to practice concepts

This website is geared toward helping kids practice and learn through fun computer games.

Arcademics



https://www.arcademics.com

Math Levels: K-6th grade
Extra: arcade type games while practicing math

Games are free, multi-player, and educational. The creator designed these games while conscious about online safety. “Private” games can be set up with a password, so a student and his/her friends could organize games to play against each other in a private game! “Public” games can be joined by anyone at anytime but there is no contact between the outside players and the student. They also monitor player names and block inappropriate ones.

Khan Academy

https://www.khanacademy.org/

Math Levels: 3rd-12th
Extra: easy-to-navigate, interactive lessons

This website is full of helpful videos explaining all sorts of math topics. (they have videos on other school subjects too). They cover topics starting around 3rd grade.

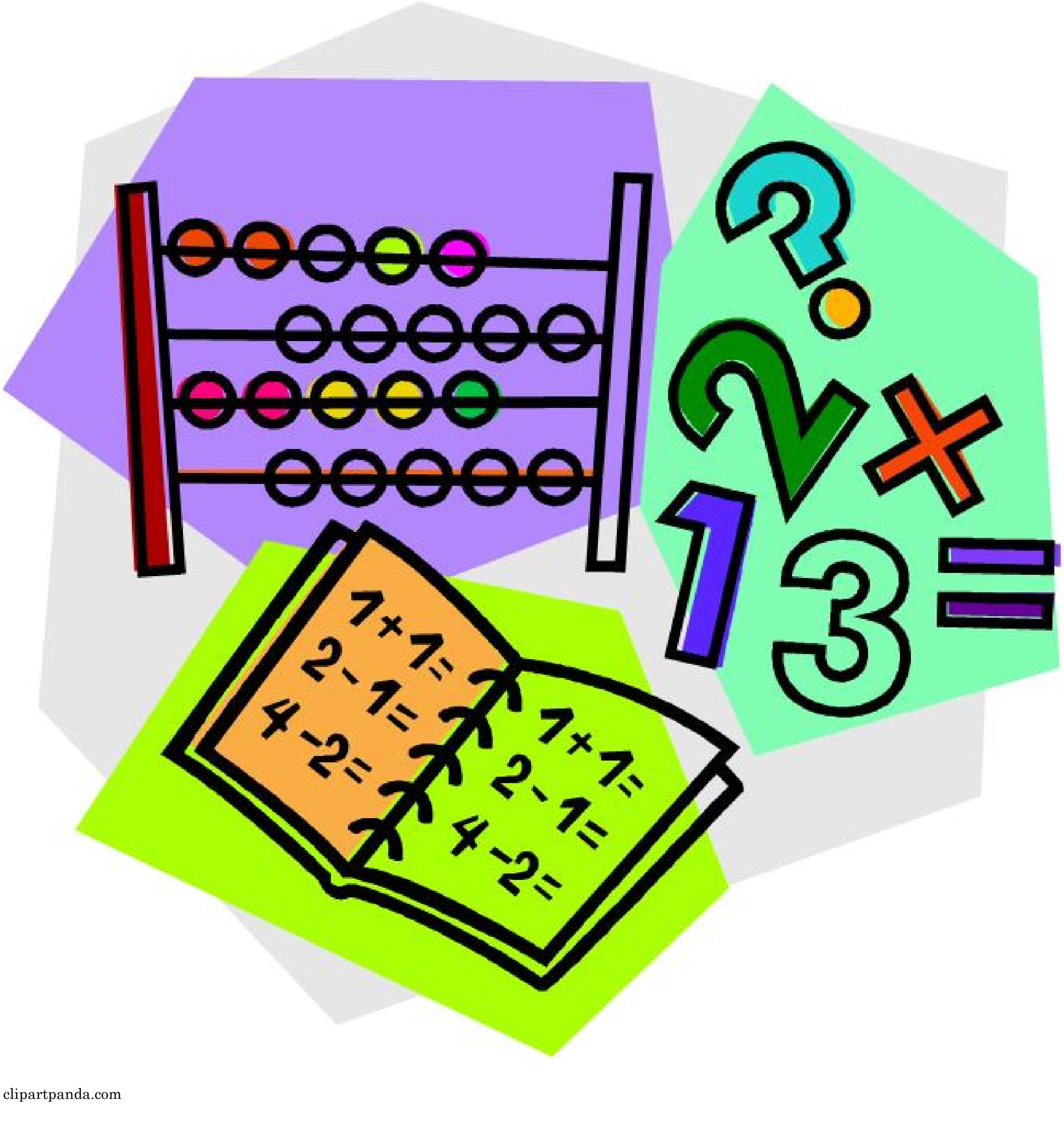
Patrick JMT

http://patrickjmt.com

Math Levels: 3rd-12th
Extra: easy-to-navigate with many videos. The “JMT” in Patrick JMT stands for “Just Math Tutorials.” Math, math, and more math. This site has clear videos and pleasing graphics.

Appendix

Glossary



clipartpanda.com

Harcourt School Publishers

http://www.hbschool.com/glossary/math2/index5.html

addend

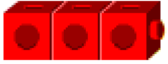
A number that is added to another in an addition problem

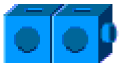
Example:
2 + 3 = 5
The addends are 2 and 3.

addition

The process of finding the total number of items when two groups of items are joined; addition is the inverse of subtraction

Example:



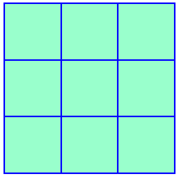


3 + 2 = 5

area

The number of square units needed to cover a surface

Example:



The area is 9 square units.

Associative Property of Addition

The property that states that the way addends are grouped does not change the sum

Example:
(5 + 9) + 3 = 5 + (9 + 3)
14 + 3 = 5 + 12
17 = 17

Associative Property of Multiplication

The property that states that the way factors are grouped does not change the product

Example:
(2 x 3) x 4 = 2 x (3 x 4)
6 x 4 = 2 x 12
24 = 24

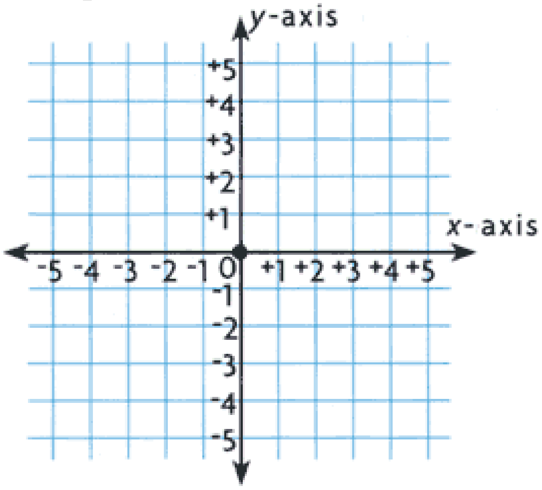
average

The number found by dividing the sum of a set of numbers by the number of addends.

axis

The horizontal or vertical number line used in a coordinate plane; the line at the side or bottom of a graph

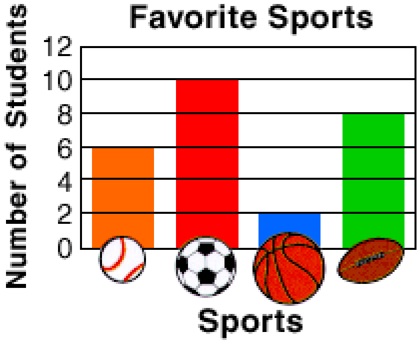
Example:



bar graph

A graph that uses horizontal or vertical bars to display countable data

Example:



base

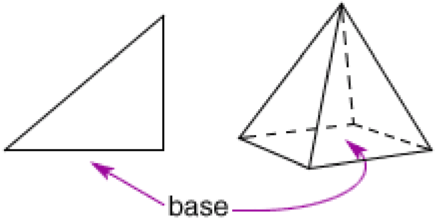
A number used as a repeated factor

Example:
83= 8 x 8 x 8. The base is 8.

base

A side of a polygon or a face of a solid figure by which the figure is measured or named

Examples:



benchmark

A familiar number used as a point of reference

Example:

Use the benchmark to decide which is the most reasonable number of beans in the jar.

100 400 4,000

Benchmark: 50 beans

A reasonable number of beans in the jar is 400.

billion

One thousand million

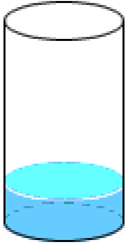
Example:

Billions			Millions			Thousands			Ones		
Hundreds	Tens	Ones	Hundreds	Tens	Ones	Hundreds	Tens	Ones	Hundreds	Tens	Ones
		1,	0	0	0,	0	0	0,	0	0	0

capacity

The amount a container can hold when filled

Example:



cardinal number

A number that tells how many

Examples:
4 puppies
93 cents

centimeter (cm)

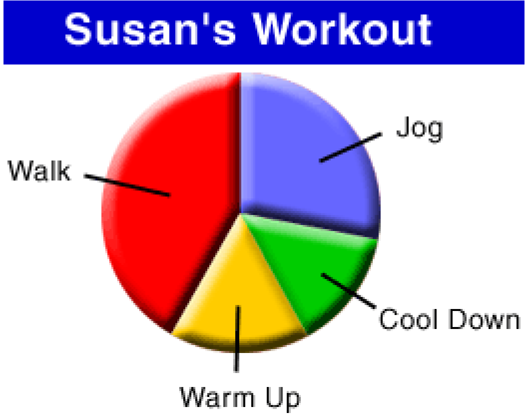
A metric unit for measuring length

.01 meter = 1 centimeter

circle graph

A graph the shows how parts of the data are related to the whole and to each other

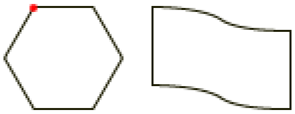
Example:



closed figure

A figure that begins and ends at the same point

Examples:



common factor

A number that is a factor of two or more numbers

Example:

factors of 6: 1, 2, 3, 6

factors of 12: 1, 2, 3, 4, 6, 12

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

common multiple

A number that is a multiple of two or more numbers

Example:

multiples of 4: 4, 8, 12, 16, 20, 24

multiples of 6: 6, 12, 18, 24, 30

A common multiple of 4 and 6 is 24.

Commutative Property of Addition

The property that states that when the order of two or more addends is changed, the sum is the same

Example:

4 + 5 = 5 + 4

Commutative Property of Multiplication

The property that states that when the order of two or more factors is changed, the product is the same

Example:

5 x 7 = 7 x 5

composite number

A whole number having more than two factors

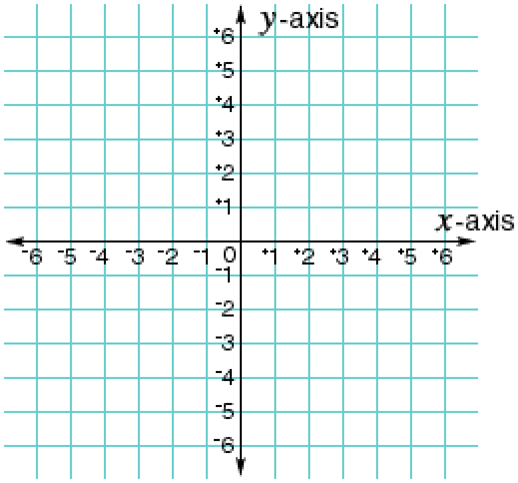
Example:

Composite Numbers		**Not Composite Numbers**	
Number	Factors	Number	Factors
4	1, 2, 4	1	1
6	1, 2, 3, 6	2	1, 2
8	1, 2, 4, 8	3	1, 3
9	1, 3, 9	5	1, 5

coordinate plane

A plane formed by two intersecting and perpendicular number lines called axes

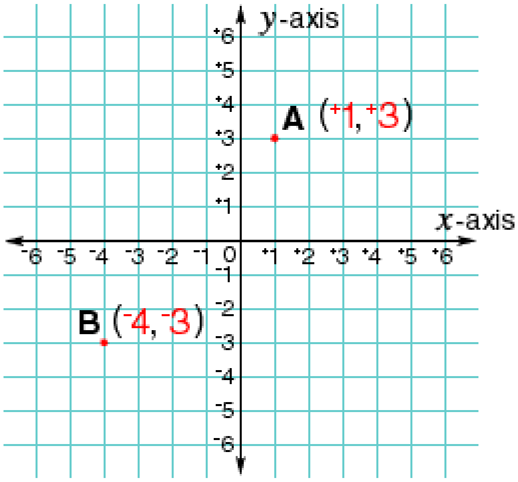
Example:



coordinates

The numbers in an ordered pair

Example:

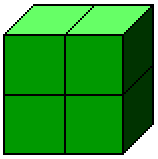


The coordinates of **A** are (1, 3).
The coordinates of **B** are (-4, -3).

cubic unit

A unit of volume with dimensions 1 unit x 1 unit x 1 unit

Example:



4 cubic units

cup

A customary unit used to measure capacity

8 ounces = 1 cup

data

Information collected about people or things.

decimal number

A number with one or more digits to the right of the decimal point

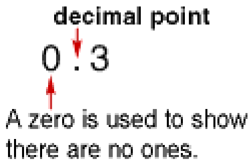
Example:

3.27

decimal point

A symbol used to separate dollars from cents in money, and the ones place from the tenths place in decimal numbers

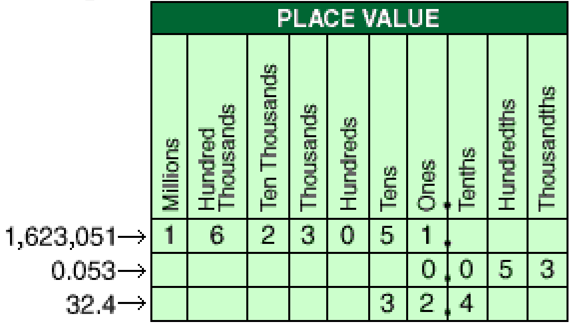
Example:



decimal system

A system of computation based on the number ten

Example:



PLACE VALUE

	Millions	Hundred Thousands	Ten Thousands	Thousands	Hundreds	Tens	Ones	Tenths	Hundredths	Thousandths
1,623,051→	1	6	2	3	0	5	1			
0.053→							0	0	5	3
32.4→						3	2	4		

decimeter

A unit of length in the metric system

10 decimeters = 1 meter

denominator

The number below the bar in a fraction that tells how many equal parts are in the whole

Example:

descending

From greatest to least number

Example:

These numbers are in descending order.
10, 9, 8, 7, 6, 5, 4, 3, 2, 1

difference

The answer in a subtraction problem

Example:

8 – 5 = 3

$$\begin{array}{r} 8 \\ \underline{-\ 5} \\ 3 \end{array}$$

3 is the difference.

digit

Any one of the ten symbols 0, 1, 2, 3, 4, 5, 6, 7, 8, or 9 used to write numbers

dimension

A measure in one direction; the length, width, or height of a figure

Distributive Property of Multiplication

The property that states that multiplying a sum by a number is the same as multiplying each addend by the number and then adding the products

Example:

3 x (4 + 2) = (3 x 4) + (3 x 2)
3 x 6 = 12 + 6
18 = 18

dividend

The number that is to be divided in a division problem

Example:

35 ÷ 5 = 7
The dividend is 35.

divisible

A number is divisible by another number if the quotient is a whole number and the remainder is zero

Example:

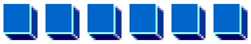
21 is divisible by 3.

$$\begin{array}{r} 7 \\ 3\overline{)21} \\ -\underline{21} \\ 0 \end{array}$$

division

The process of sharing a number of items to find how many groups can be made or how many items will be in each group; division is the inverse of multiplication

Example:



6 ÷ 3 = 2

divisor

The number that divides the dividend.

Example:

18 ÷ 3 = 6 $\begin{array}{r} 6 \\ 3\overline{)18} \end{array}$

The divisor is 3.

equation

An algebraic or numerical sentence that shows that two quantities are equal

Examples:

3 + 7 = 10

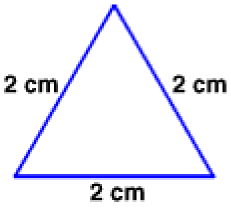
4 – 1 = 3

12 + n = 21

equilateral triangle

A triangle with three congruent sides

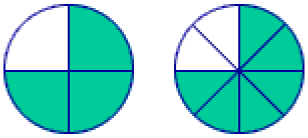
Example:



equivalent

Having the same value

Example:



$\frac{3}{4}$ and $\frac{6}{8}$ name the same amount.

So, $\frac{3}{4}$ and $\frac{6}{8}$ are equivalent.

$$\frac{3}{4} = \frac{6}{8}$$

equivalent decimals

Decimals that name the same amount

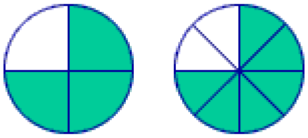
Example:

0.5 = 0.50 = 0.500

equivalent fractions

Fractions that name the same amount

Example:



$\frac{3}{4}$ and $\frac{6}{8}$ name the same amount.

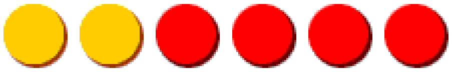
So, $\frac{3}{4}$ and $\frac{6}{8}$ are equivalent fractions.

$$\frac{3}{4} = \frac{6}{8}$$

equivalent ratios

Ratios that make the same comparisons

Example:



The ratio of yellow to red is $\frac{2}{4}$ or $\frac{1}{2}$.

The ratios $\frac{2}{4}$ and $\frac{1}{2}$ are equivalent.

$$\frac{2}{4} = \frac{1}{2}$$

estimate (noun)

A number close to an exact amount

estimate (verb)

To find a number that is close to an exact amount

Example:

32 x 9

↓ ↓

30 x 10 = 300 ← estimate

32 x 9 is about 300.

evaluate

To find the value of a numerical or algebraic expression

Example:

Find $4 \times d$ if $d = 6$.

4×6 ← Replace d with 6.

↓

24

expanded form

A way to write numbers by showing the value of each digit

Examples:

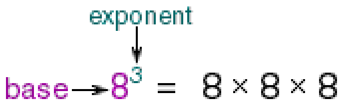
635 = 600 + 30 + 5

1,479 = 1,000 + 400 + 70 + 9

exponent

A number that shows how many times the base is used as a factor

Example:



The exponent is 3, indicating that 8 is used as a factor 3 times.

expression

A mathematical phrase that combines numbers, operation signs, and sometimes variables, but doesn't have an equal sign

Examples:

4 + 3 9 – 2

3 x (2 + 6) 4 + n

factor

A number that is multiplied by another number to find a product
Example:

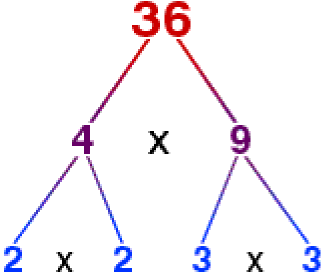
$$4 \times 7 = 28 \qquad \begin{array}{r} 4 \\ \underline{\times\ 7} \\ 28 \end{array}$$

The factors are 4 and 7.

factor tree

A diagram that shows the prime factors of a number

Example:



The prime factors of 36 are 2 and 3.

foot (ft)

A customary unit for measuring length or distance

1 foot = 12 inches

formula

A rule that is expressed with symbols

Example:

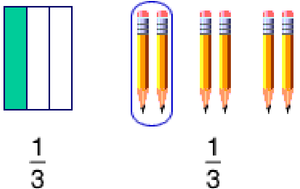
formula for area of a rectangle:

Area = length x width or A = l x w

fraction

A number that names a part of a whole or a part of a group

Example:



$\frac{1}{3}$ is a fraction.

frequency

The number of times an event occurs

frequency table

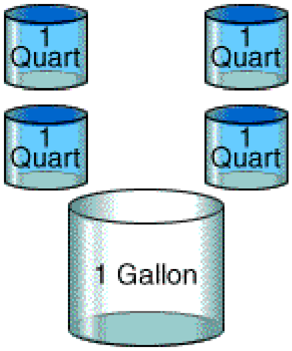
A table that uses numbers to record data about how often something happens

Example:

FREQUENCY TABLE	
Day	Number of Students (Frequency)
Monday	15
Tuesday	13
Wednesday	5
Thursday	9
Friday	17

gallon (gal)

A customary unit for measuring capacity



4 quarts = 1 gallon

gram (g)

A metric unit for measuring mass

1,000 milligrams = 1 gram

greater than (>)

A symbol used to compare two numbers, with the greater number given first

Example:

$8 > 6$

8 is greater than 6.

greatest common factor (GCF)

The greatest factor that two or more numbers have in common

Example:

18: 1, 2, 3, 6, 9, 18

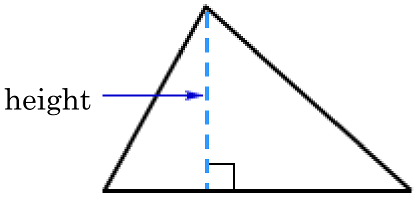
30: 1, 2, 3, 5, 6, 10, 15, 30

6 is the GCF of 18 and 30.

height

The length of a perpendicular from the base to the top of a plane figure or solid figure

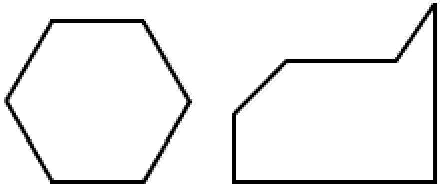
Example:



hexagon

A polygon with six sides and six angles

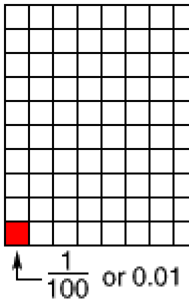
Examples:



hundredth

One of one hundred equal parts

Example:



inch (in.)

A customary unit used for measuring length

12 inches = 1 foot

inequality

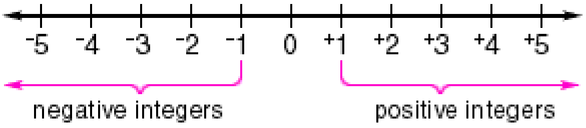
A mathematical sentence that shows that two amounts are not equal

Examples:

integers

The set of whole numbers and their opposites

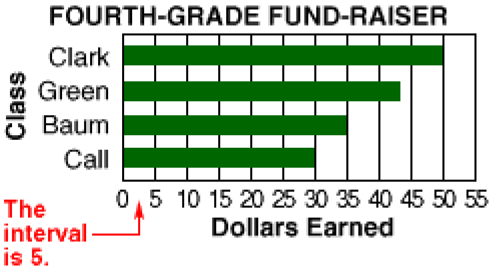
Example:



interval

The distance between one number and the next on the scale of a graph

Example:



inverse operations

Opposite operations that undo each other; addition and subtraction are inverse operations; multiplication and division are inverse operations

Examples:

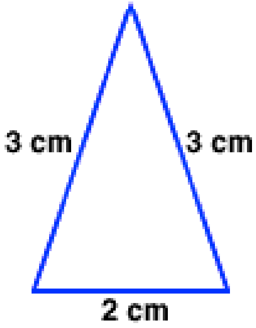
5 + 4 = 9, so 9 – 4 = 5

3 x 4 = 12, so 12 ÷ 4 = 3

isosceles triangle

A triangle with two congruent sides

Example:



kilogram (kg)

A metric unit for measuring mass

1,000 grams = 1 kilogram

kiloliter (kL)

A metric unit for measuring capacity

1,000 liters = 1 kiloliter

kilometer (km)

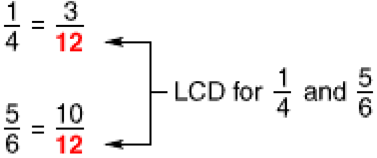
A metric unit for measuring length

1,000 meters = 1 kilometer

least common denominator (LCD)

The least common multiple of two or more denominators

Example:



least common multiple (LCM)

The smallest number, other than zero, that is a common multiple of two or more numbers

Example:

multiples of 6: 6, 12, 18, 24, 30, 36

multiples of 9: 9, 18, 27, 36, 45, 54

The LCM of 6 and 9 is 18.

less than (<)

A symbol used to compare two numbers, with the lesser number given first

Example:

6 < 8

6 is less than 8.

like fractions

Fractions that have the same denominator

Example:

$$\frac{1}{4} = \frac{2}{4}$$

line

A straight path in a plane that goes on forever in opposite directions

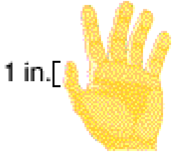
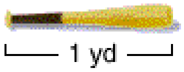
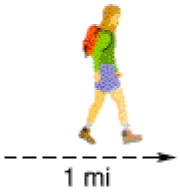
Example:

line AB or line BA

linear unit

A measure of length, width, height, or distance

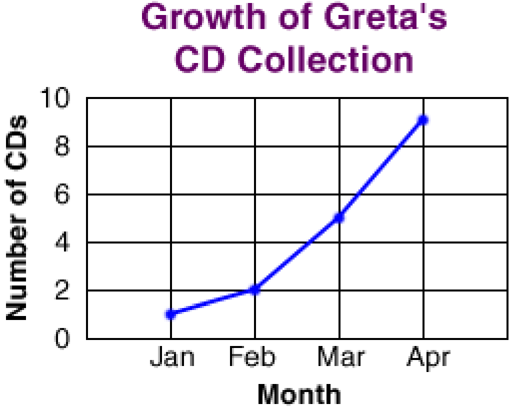
Examples:

An inch is about the length of your thumb from the first  knuckle to the tip.	A foot is  about the height of a cat.
A yard is about the  length of a baseball bat.	A mile is about the distance you can walk in 20 minutes. 

line graph

A graph that uses a line to show how data change over time

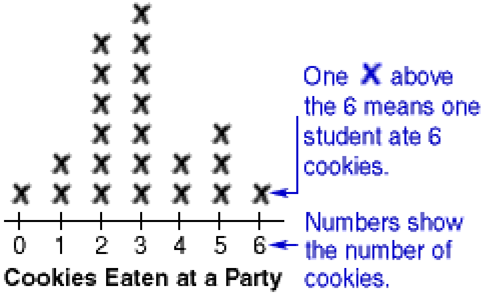
Example:



line plot

A graph that shows frequency of data along a number line

Example:



line segment

A part of a line that includes two points, called endpoints, and all the points between them

Example:

line segment AB or line segment BA

liter (L)

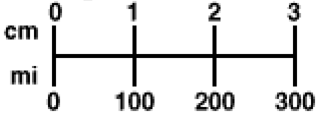
A metric unit for measuring capacity

1 liter = 1,000 milliliters

map scale

A ratio that compares the distance on a map to the actual distance

Example:



The scale is 1 cm to 100 mi.

mean

The number found by dividing the sum of a set of numbers by the number of addends; see also average

Example:

74, 91, 63, 92, 85

$$\begin{array}{r} 74 \\ 91 \\ 63 \\ 92 \\ +\ 85 \\ \hline 405 \end{array} \quad \begin{array}{l} \text{number of} \rightarrow \\ \text{addends} \end{array} \quad \begin{array}{r} 81 \\ 5\overline{)405} \\ \underline{40} \\ 05 \\ \underline{5} \\ 0 \end{array}$$

The mean of 74, 91, 63, 92, and 85 is 81.

median

The middle number or the average of the two middle numbers in an ordered set of data

Example:

$1,\ 3,\ \underset{\uparrow\text{median}}{4},\ 6,\ 7$

The median of 1, 3, 4, 6, and 7 is 4.

meter

A metric unit for measuring length and distance

1 meter = 100 centimeters

mile

A customary unit for measuring length and distance

5,280 feet = 1 mile

milligram

A metric unit for measuring mass

1,000 milligrams = 1 gram

milliliter (mL)

A metric unit for measuring capacity

1,000 milliliters = 1 liter

millimeter (mm)

A metric unit for measuring length

1 millimeter = 0.001 meter

million

1,000 thousands; written as 1,000,000

Example:

Millions			Thousands			Ones		
Hundreds	Tens	Ones	Hundreds	Tens	Ones	Hundreds	Tens	Ones
		1,	0	0	0,	0	0	0

mixed number

A number represented by a whole number and a fraction

Example:

$2\frac{1}{2}$

multiple

The product of a given whole number and another whole number

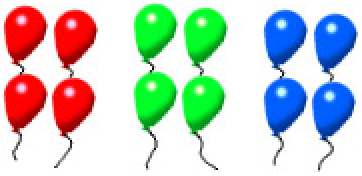
Examples:

$$\begin{array}{r} 10 \\ \underline{\times 1} \\ 10 \end{array} \quad \begin{array}{r} 10 \\ \underline{\times 2} \\ 20 \end{array} \quad \begin{array}{r} 10 \\ \underline{\times 3} \\ 30 \end{array} \quad \begin{array}{r} 10 \\ \underline{\times 4} \\ 40 \end{array} \leftarrow \text{multiples of 10}$$

multiplication

The process of finding the total number of items in equal-sized groups, or of finding the total number of items in a given number of groups when each group contains the same number of items; multiplication is the inverse of division.

Example:



3 x 4 = 12

multistep problem

A problem requiring more than one step to solve
Example:

The soccer players sold bottles of water to earn money for equipment. They charged \$2.25 for each bottle of water. They sold 52 bottles on Saturday and 45 bottles on Sunday. How much did they earn?

Step 1

Add to find the total number of bottles sold.

52 ← bottles sold on Saturday

+45 ← bottles sold on Sunday

97

The players sold 97 bottles of water.

Step 2

Multiply to find the amount of money earned.

\$2.25 ← price for each bottle

x 97 ← total number of bottles

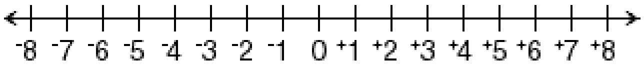
\$218.25

The players earned \$218.25

number line

A line with equally spaced tick marks named by numbers

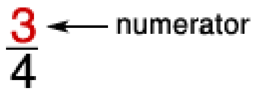
Example:



numerator

The number above the bar in a fraction that tells how many equal parts of the whole are being considered

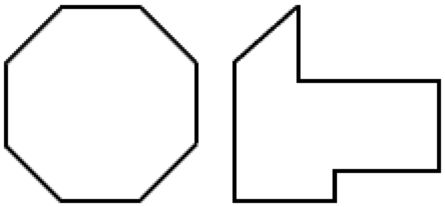
Example:



octagon

A polygon with eight sides

Examples:

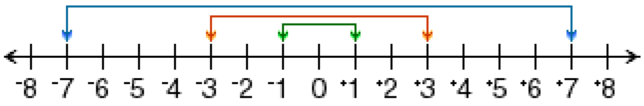


opposites

Two numbers that are the same distance, but in opposite directions, from zero on a number line

Example:

These pairs of numbers are opposites on the number line.

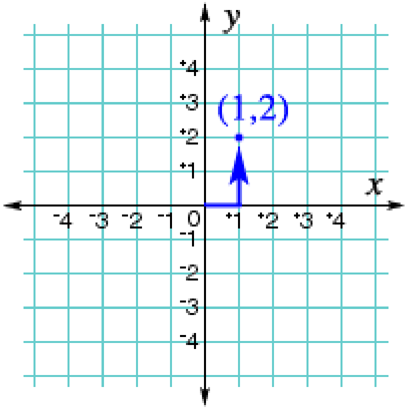


ordered pair

A pair of numbers used to locate a point on a coordinate plane; the first number tells how far to move horizontally, and the second number tells how far to move vertically

Example:

(**1,2**) represents 1 unit to the right of zero and 2 units up.



order of operations

Rules for performing operations in expressions with more than one operation

1. Do the operations inside parentheses.
2. Multiply any exponents.
3. Multiply and divide from left to right.
4. Add and subtract from left to right.

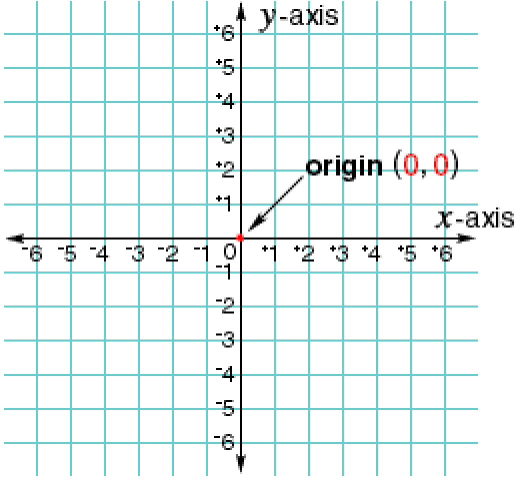
Example:

6 + (4 x 2) ÷ 2 – 5	Multiply inside parentheses.
6 + 8 ÷ 2 – 5	Divide.
6 + 4 – 5	Add.
10 – 5	Subtract.
5	

origin

The point where the x-axis and the y-axis in the coordinate plane intersect, (**0, 0**)

Example:



ounce (oz)

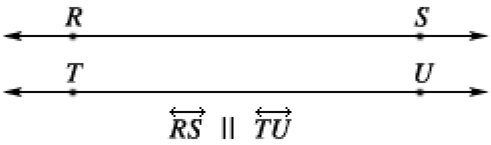
A customary unit for measuring weight

16 ounces = 1 pound

parallel lines

Lines in a plane that never intersect

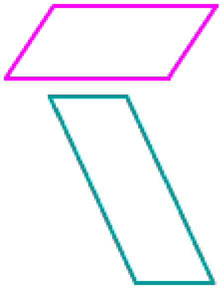
Example:



parallelogram

A quadrilateral whose opposite sides are parallel and congruent

Examples:



parentheses

The symbols used to show which operation or operations in an expression should be done first

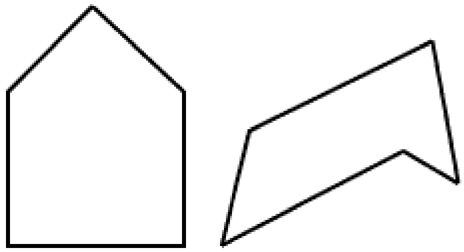
Example:

(12 + 4) – 3

pentagon

A polygon with five sides

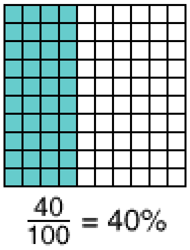
Examples:



percent

The ratio of a number to 100

Example:

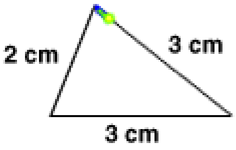


40% of the squares are shaded.

perimeter

The distance around a figure

Example:

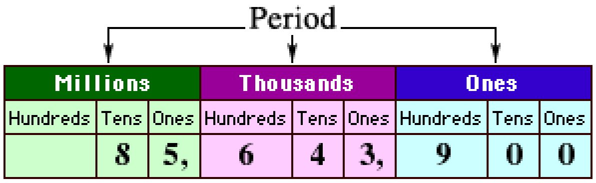


2 cm + 3 cm + 3 cm = 8 cm
The perimeter of this figure is 8 centimeters.

period

Each group of three digits separated by commas in a multi-digit number

Example:

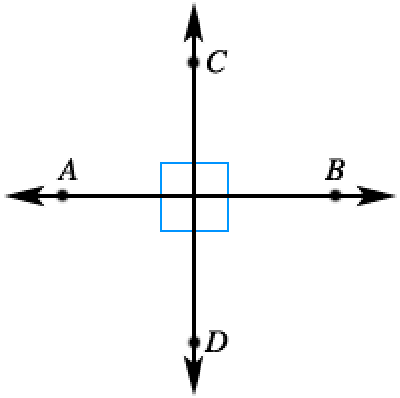


Millions			Thousands			Ones		
Hundreds	Tens	Ones	Hundreds	Tens	Ones	Hundreds	Tens	Ones
	8	5,	6	4	3,	9	0	0

perpendicular lines

Two lines that intersect to form four right angles

Example:



$\overleftrightarrow{AB} \perp \overleftrightarrow{CD}$

pint (pt)

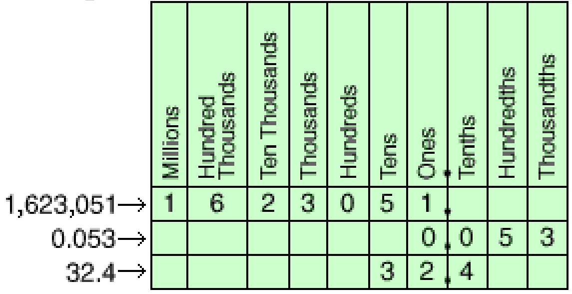
A customary unit for measuring capacity

2 cups = 1 pint

place value

Place value determines the value of a digit in a number, based on the location of the digit.

Example:



	Millions	Hundred Thousands	Ten Thousands	Thousands	Hundreds	Tens	Ones	Tenths	Hundredths	Thousandths
1,623,051→	1	6	2	3	0	5	1			
0.053→							0	0	5	3
32.4→						3	2	4		

point

An exact location in space, usually represented by a dot

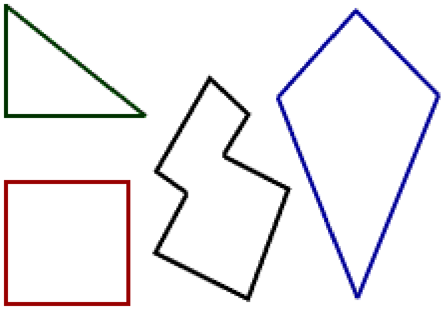
Example:

point A

polygon

A closed plane figure formed by three or more line segments

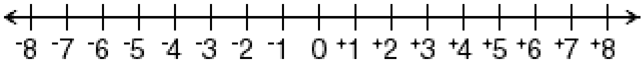
Examples:



positive integer

Any integer greater than zero

Example:



pound (lb)

A customary unit for measuring weight

16 ounces = 1 pound

prediction

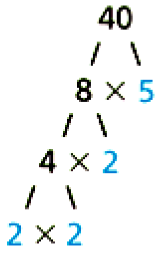
A reasonable guess as to what will happen

prime factorization

A number written as the product of all its prime factors

Example:

What is the prime factorization of 40?



So, 40 = 2 × 2 × 2 × 5.

prime number

A whole number greater than 1 that has exactly two factors, one and itself

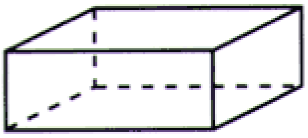
Example:

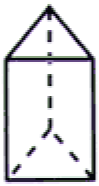
Prime		**Not Prime**	
Number	Factors	Number	Factors
2	1, 2	4	1, 2, 4
3	1, 3	6	1, 2, 3, 6
5	1, 5	9	1, 3, 9

prism

A solid figure that has two congruent, polygon-shaped bases, and other faces that are all rectangles

Examples:


rectangular prism


triangular prism

product

The answer to a multiplication problem

Example:

$$6 \times 2 = 12 \qquad \begin{array}{r} 6 \\ \underline{\times\ 2} \\ 12 \end{array}$$

The product is 12.

Property of One

The property that states that the product of any number and 1 is that number

Examples:

5 x 1 = 5

16 x 1 = 16

proportion

An equation that shows that two ratios are equal

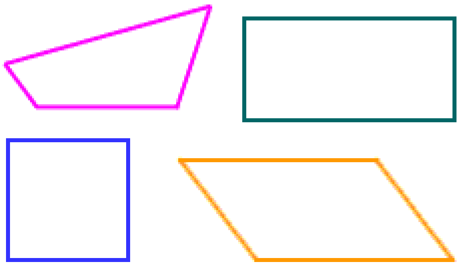
Example:

$$\frac{3}{4} = \frac{6}{8}$$

quadrilateral

A polygon with four sides

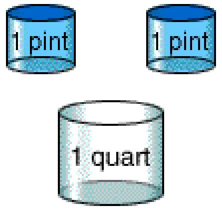
Examples:



quart (qt)

A customary unit for measuring capacity

Example:



2 pints = 1 quart

quotient

The number, not including the remainder, that results from dividing
Example:

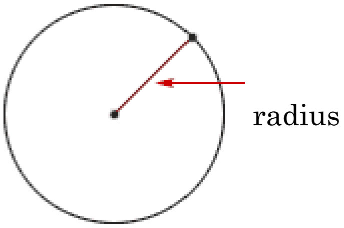
35 ÷ 5 = 7 $\begin{array}{r} 7 \\ 5\overline{)35} \end{array}$

The quotient is 7.

radius

A line segment with one endpoint at the center of a circle and the other endpoint on the circle

Example:



range

The difference between the greatest number and the least number in a set of data

Example:

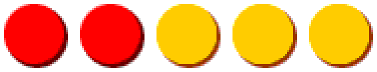
<table>
<tr><th colspan="2">Heights of Fifth Graders</th></tr>
<tr><td>Height in Inches</td><td>Number of Students</td></tr>
<tr><td>49</td><td>|</td></tr>
<tr><td>50</td><td>| | |</td></tr>
<tr><td>51</td><td>| |</td></tr>
<tr><td>52</td><td>| | | |</td></tr>
<tr><td>53</td><td>| | | |</td></tr>
<tr><td>54</td><td>| |</td></tr>
<tr><td>55</td><td>|</td></tr>
</table>

$$\overset{\substack{\text{Greatest}\\ \text{number}\\ \downarrow}}{55} \quad \overset{\substack{\text{Least}\\ \text{number}\\ \downarrow}}{-49} \quad \overset{\substack{\textbf{Range}\\ \downarrow}}{=6}$$

ratio

The comparison of two numbers by division

Example:



Compare:	Ratio:	Type of Ratio:
red counters to all counters	2 to 5	part to whole
all counters to red counters	5 to 2	whole to part
red counters to yellow counters	2 to 3	part to part

reciprocal

One of two numbers whose product is 1; two numbers are reciprocals of each other if their product equals 1

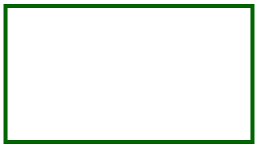
Example:

8 and $\frac{1}{8}$ are reciprocals since 8 x $\frac{1}{8}$ = 1.

rectangle

A parallelogram with four right angles

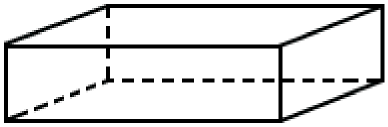
Example:



rectangular prism

A solid figure in which all six faces are rectangles

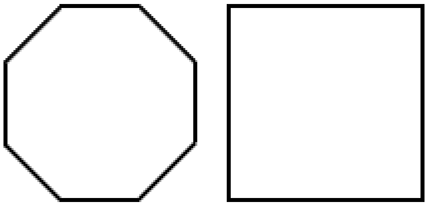
Example:



regular polygon

A polygon in which all sides are congruent, and all angles are congruent

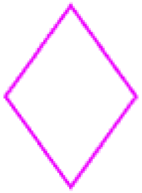
Examples:



rhombus

A parallelogram with four congruent sides

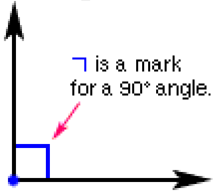
Example:



right angle

An angle formed by perpendicular lines, line segments, or rays and with a measure of 90°

Example:



rounding

Replacing a number with one that tells about how many or how much

Examples:

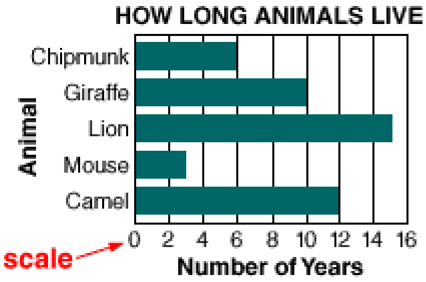
374 rounds to 370.

1,520 rounds to 1,500.

scale

On a graph, the numbers placed at fixed distances to help label the graph

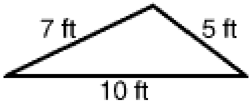
Example:



scalene triangle

A triangle with no congruent sides

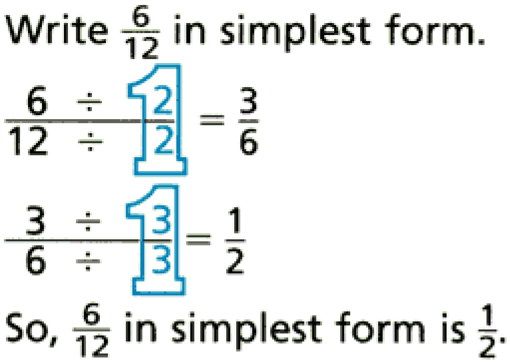
Example:



simplest form

A fraction is in simplest form when the numerator and denominator have only 1 as their common factor

Example:



Write $\frac{6}{12}$ in simplest form.

$$\frac{6 \div 2}{12 \div 2} = \frac{3}{6}$$

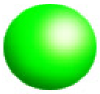
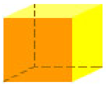
$$\frac{3 \div 3}{6 \div 3} = \frac{1}{2}$$

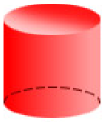
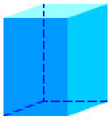
So, $\frac{6}{12}$ in simplest form is $\frac{1}{2}$.

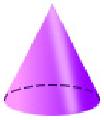
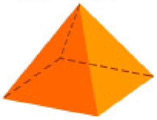
solid figure

A three-dimensional figure

Examples:

sphere   cube

cylinder   rectangular prism

cone   square pyramid

solution

A value that, when substituted for a variable in an equation, makes the equation true

Example:

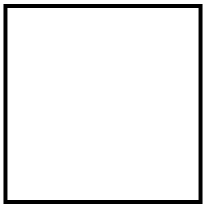
$x + 4 = 7$

Since $3 + 4 = 7$, then $x = 3$.

square

A rectangle with 4 equal sides

Example:



square number

The product of a number and itself

Example:

$3 \times 3 = 9$; 9 is a square number.

square unit

A unit of area with dimensions 1 unit x 1 unit

Example:

1 square unit

standard form

A way to write numbers using the digits 0-9

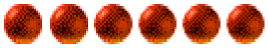
Example:

3,027

subtraction

The process of finding how many are left when a number of items are taken away from a group of items; the process of finding the difference when two groups are compared; subtraction is the inverse of addition

Example:



6 – 2 = 4

sum

The answer to an addition problem

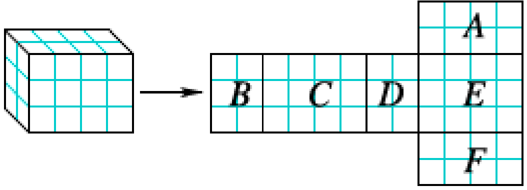
Example:

12 + 7 = 19
The sum is 19.

surface area

The sum of the areas of all the faces, or surfaces, of a solid figure

Example:



Surface Area = A + B + C + D + E + F

= 8 + 6 + 12 + 6 + 12 + 8 = 52

The surface area is 52 units^2.

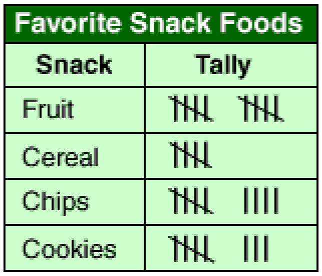
survey

A method of gathering information about a group

tally table

A table with categories for recording each piece of data with tally marks as it is collected

Example:

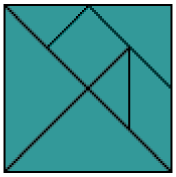


Favorite Snack Foods	
Snack	**Tally**
Fruit	卌 卌
Cereal	卌
Chips	卌 ||||
Cookies	卌 |||

tangram

A puzzle consisting of seven polygon-shaped pieces that can be rearranged to make various figures or shapes

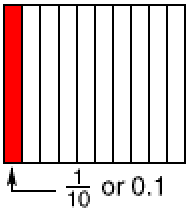
Example:



tenth

A decimal or fraction that names 1 part of 10 equal parts

Example:



ten-thousandth

A decimal or fraction that names 1 part of 10,000 equal parts

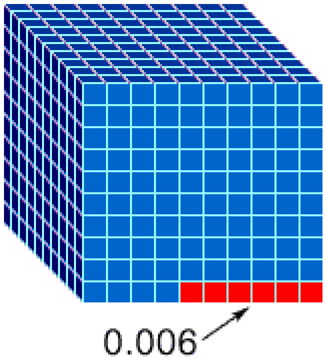
Example:

0.0035 = thirty-five ten-thousandths

thousandth

A decimal or fraction that names 1 part of 1,000 equal parts

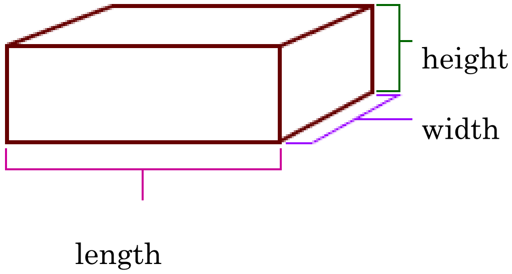
Example:



three-dimensional

Measured in three directions, such as length, width, and height

Example:



The rectangular prism is a three-dimensional figure.

ton (T)

A customary unit for measuring weight

2,000 pounds = 1 ton

trapezoid

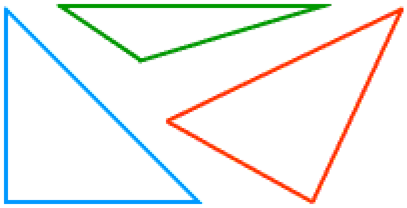
A quadrilateral with one pair of parallel sides

Examples:

triangle

A polygon with three sides

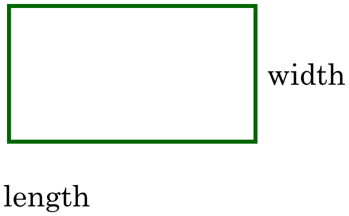
Examples:



two-dimensional

Measured in two directions, such as length and width

Example:



unlike fractions

Fractions with different denominators

Example:

$$\frac{1}{4} \qquad \frac{3}{8}$$

$\frac{1}{4}$ and $\frac{3}{8}$ are unlike fractions.

variable

A letter or symbol that stands for one or more numbers

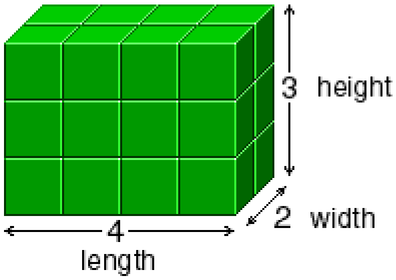
Example:

$$7 + \underset{\substack{\uparrow \\ \text{variable}}}{n}$$

volume

The measure of the amount of space a solid figure occupies

Example:



The volume of this figure is 24 cubic units.

whole number

One of the numbers 0, 1, 2, 3, 4, . . . The set of whole numbers goes on without end.

word form

A way to write numbers in standard English

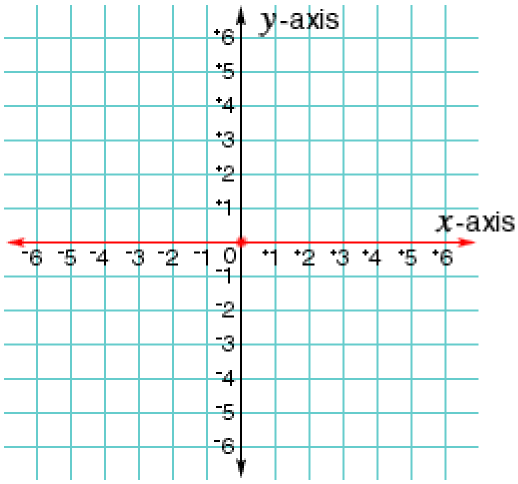
Example:

257 is: two-hundred fifty-seven

x-axis

The horizontal number line on a coordinate plane

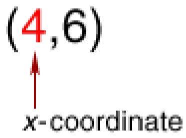
Example:



x-coordinate

The first number in an ordered pair, which tells the distance to move right or left from (0, 0)

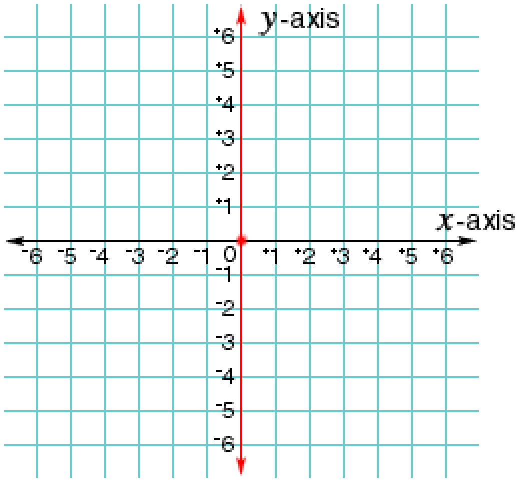
Example:



y-axis

The vertical number line on a coordinate plane

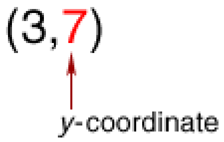
Example:



y-coordinate

The second number in an ordered pair, it tells the distance to move up or down from (0, 0)

Example:



Zero Property of Addition

The property that states that when you add zero to a number, the sum is that number

Examples:

4 + 0 = 4

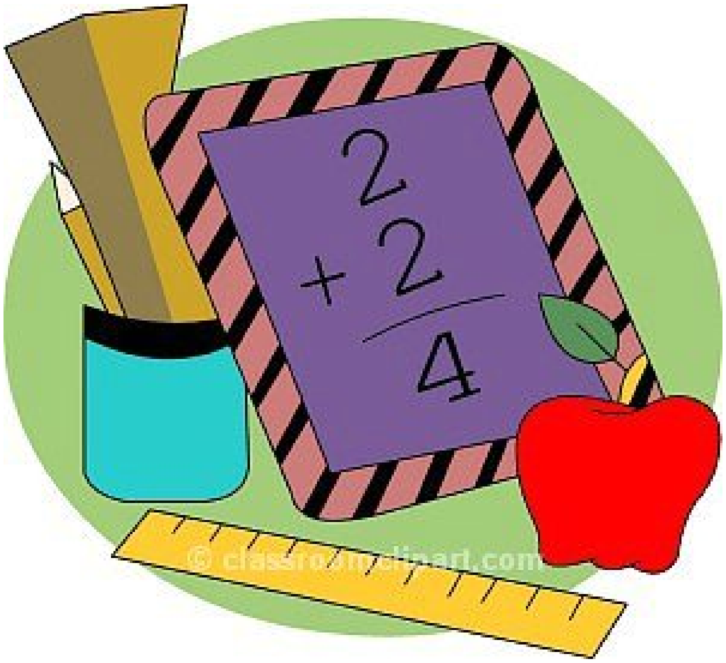
59 + 0 = 59

Zero Property of Multiplication

The property that states that when you multiply by zero, the product is zero

Examples:

13 x 0 = 0
0 x 7 = 0



Tables

Customary Units
Length
1 foot (ft) = 12 inches (in.)
1 yard (yd) = 3 feet or 36 inches
1 mile (mi) = 1, 760 yards or 5,280 feet
Capacity
1 tablespoon (tbsp) = 3 teaspoons (tsp)
1 cup (c) = 8 fluid pines (fl oz)
1 pint (pt) = 2 cups
1 quart (qt) – 2 pints
1 gallon (gal) = 4 quarts
Mass/Weight
1 pound (lb) = 16 ounces (oz)
1 ton (T) = 2,000 pounds

Time
1 minute (min) = 60 seconds (sec)
1 hour (hr) = 60 minutes
1 day = 24 hours
1 week (wk) = 7 days
1 year (yr) = 12 months
1 year = 365 days
1 leap year = 366 days

Metric Units
Length
1 meter (m) = 1,000 millimeters (mm)
1 meter (m) = 100 centimeters
1 meter (m) = 10 decimeters
1 kilometer (km) = 1,000 meters
Capacity
1 liter (L) = 1,000 milliliters
1 metric cup = 250 milliliters
1 kiloliter (kL) = 1,000 liters
Mass/Weight
1 gram (g) = 1,000 milligrams (mg)
1 kilogram (kg) = 1,000 grams

Formulas
Perimeter of a polygon = sum of the lengths of the sides
Perimeter of a rectangle: $P = 2l + 2w$
Perimeter of a square: $P = 4s$
Circumference of a circle: $C = d\pi$
Area of a circle: $A = \pi r2$
Area of a rectangle: $A = lw$
Area of a parallelogram: $A = bh$
Area of a triangle: $A = \frac{1}{2}bh$
Volume of a rectangular prism: $V = lwh$
Volume of a triangular prism: $V = \frac{1}{2}Bh$

Symbols	
=	is equal to
≠	is not equal to
>	greater than
<	less than
≈	approximately
3:8,⅜,3 to 8	ratio of 3 to 8
%	percent
⊥	perpendicular lines
∥	parallel lines
↔	line
(x,y)	ordered pair
π	pi (approximately 3.14)

http://www.hbschool.com/glossary/math2/index5.html

Harcourt School Publishers

HANDBOOK REFERENCES

accuteach.com

appletasticlearning.com

arcademics.com

bubbazartwork.com

canstockphoto.com

chibird.com

classroomcaboodle.com

clipart.com

clipartpanda.com

commoncoresheets.com

cpalms.org

crafting-connections.blogspot.com

cutebasic.blogspot.com

descargardropbox.com

deviantart.com

drawception.com

dutapro.com

educationworld.com

etsy.com

favim.com

fractionsworksheets.com

games4gains.com

gigidiaries.com

goalbookapp.com

homeschoolmath.com

hoodamath.com

ideastocker.com

investorsgrouphamilton.com

justapinch.com

keepcalmandteachfifthgrade.blogspot.com

khanacademy.org

lakegenevamath.com

lbartman.com

learnzillion.com

lumoslearning.com

mariafresa.net

math.niu.edu/mathed/hbk-ictm.pdf

mathcoachscorner.com

mathchimp.com

mathpickle.com

mathsalamanders.com

mathworksheets4kids.com

misskahrimanis.blogspot.com

mrssolsclass.blogspot.com

mycutegraphics.com

newkidscenter.com

opened.com

parents.com

patrickjmt.com/

pinterest.com

puzzle-to-print.com

shanahan3.pbworks.com

shutterstock.com

slideplayer.com

smmusd.org/edservices/commoncore/pdf/CCSParentHandbook.pdf

student-tutor.com

superteacherworksheets.com

tdittrich.blogspot.com

teacherspayteachers.com

tes.com

virallyapp.com

weebly.com

wordpress.com

worksheetworks.com

wyzant.com

yousearch.com