math MAMMOTH

Grade 5-A Worktext

T he four operations

L arge numbers and the calculator

P roblem solving

D ecimals, part 1

G raphing and statistics

Light Blue Series

By Maria Miller

Sample worksheet from
https://www.mathmammoth.com

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Chapter 4: Decimals, Part 1

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Foreword

Math Mammoth Grade 5-A and Grade 5-B worktexts comprise a complete math curriculum for the fifth grade mathematics studies that meets and exceeds the Common Core Standards.

Fifth grade is the time to focus on fractions and decimals and their operations in great detail. Students also deepen their understanding of whole numbers, get introduced to the calculator, learn more problem solving and geometry, and study statistical graphs.

The year starts out with a study of whole numbers and their operations. Students review multi-digit multiplication and learn long division with two-digit divisors. We also review divisibility and prime factorization from fourth grade.

In the second chapter, the focus is on large numbers and using a calculator. This is the first time a calculator is introduced in Math Mammoth complete curriculum—thus far, all calculations have been done with mental math or with paper and pencil. I want students to learn to be critical in their use of the calculator and use it with good judgment. Every exercise where calculator use is allowed is marked with a little picture of a calculator.

The third chapter is about equations and problem solving. We study simple equations with the help of a balance and bar models. The main goal is to get students used to the concept of an equation and what it means to solve an equation. Students also solve a fair amount of word problem with the help of the visual bar model.

The fourth chapter is about decimals and some of the operations with decimals (the rest will be studied in chapter 6). Fifth grade is the time when students learn all the basic operations with decimals. In this chapter, we focus on place value with decimals, addition and subtraction of decimals, and multiplication and division of decimals by whole numbers. Multiplying decimals by decimals and dividing decimals by decimals is covered in chapter 6.

In chapter 5 we study graphing in a coordinate grid, line and bar graphs, and average and mode. Today's world has become increasingly complex with lots of data presented in the media, so our children need a good grasp of statistical graphs to be able to make sense of all of that information.

In part 5-B, students study more about decimals, operations with fractions, and geometry.

I wish you success with teaching math!

Maria Miller, the author

Chapter 1: The Four Operations
Introduction

We start fifth grade by studying the four basic operations. This includes studying the order of operations, simple equations and expressions, long multiplication, long division, divisibility, primes, and factoring.

The main line of thought throughout this chapter is that of a mathematical *expression*. In mathematics, an expression consists of numbers, letters, and operation symbols, but does not contain an equal sign (an equation does). Students write simple expressions for problems which they solve. They study the correct order of operations in an expression. An *equation* in mathematics consists of an expression that equals another expression (expression = expression). We also study simple equations, both with and without the help of visual bar models.

Next, we review multi-digit multiplication, starting with partial products (multiplying in parts) and how that can be visualized geometrically. Then it is time for long division, especially practicing long division with two-digit divisors. We also study why long division works, in the lesson *Long Division and Repeated Subtraction*. Throughout the lessons there are also word problems to solve.

Lastly, we study the topics of divisibility, primes, and factoring. Students learn the common divisibility rules for 2, 3, 4, 5, 6, 8, 9, and 10. In prime factorization, we use factor trees.

Although the chapter is named "The Four Operations," please notice that the idea is not to practice each of the four operations separately, but rather to see how they are used together in solving problems and in simple equations. We are trying to develop the students' *algebraic thinking*, including the abilities to: translate problems into mathematical operations, comprehend the many operations needed to yield an answer to a problem, "undo" operations, and so on. Many of the ideas in this chapter are preparing them in advance for algebra.

The Lessons in Chapter 1

Helpful Resources on the Internet

MENTAL MATH

Math Mahjong
A Mahjong game where you need to match tiles with the same value.
http://www.sheppardsoftware.com/mathgames/mixed_mahjong/mahjongMath_Level_3.html

Pop the Balloons
Pop the balloons in the order of their value. You need to use all four operations.
http://www.sheppardsoftware.com/mathgames/numberballoons/BalloonPopMixed.htm

ORDER OF OPERATIONS

Interactive Order of Operations Practice
Click on the correct operation in the expression.
http://www.softschools.com/math/order_of_operations/games/

Order of Operations Practice
A simple online quiz of 10 questions. Uses parentheses and the four operations.
http://www.onlinemathlearning.com/order-of-operations-practice.html

The Order of Operations Millionaire
Answer multiple-choice questions that have to do with the order of operations, and win a million.
http://www.math-play.com/Order-of-Operations-Millionaire/order-of-operations-millionaire.html

Exploring the Order of Operations (Object Interactive)
Click on the correct operation to be done first in the given expression. The program then solves that operation, and you click on the *next* operation to be performed. Lastly the resource includes a game where you click on the falling blocks in the order that the order of operations would dictate.
http://www.learnalberta.ca/content/mejhm/html/object_interactives/order_of_operations/use_it.html

Choose Math Operation
Choose the mathematical operation(s) that make the equation true. Practice the role of zero and one in basic operations or operations with negative numbers. Helps develop number sense and logical thinking.
https://www.homeschoolmath.net/operation-game.php

Quick Calculate
Practice your arithmetic with all four operations plus the order of operations.
https://www.mathplayground.com/quick_calculate.html

Free worksheets for the order of operations
Generate printable and customizable worksheets for the order of operations. Choose from five operations and parentheses. You can choose the number range used, the number of problems, and more.
https://www.homeschoolmath.net/worksheets/order_of_operations.php

BAR MODELS

Thinking Blocks: Addition and Subtraction
Model and solve addition and subtraction word problems using this interactive math tool. This link takes you to the Thinking Blocks main page; scroll down to the section titled Addition and Subtraction.
https://www.mathplayground.com/thinkingblocks.html

Thinking Blocks: Multiplication and Division
Model and solve multiplication and division word problems using this interactive tool. The link takes you to the Thinking Blocks main page; scroll down to the section on multiplication and division.
https://www.mathplayground.com/thinkingblocks.html

FUN WITH PROBLEM SOLVING

Calculator Chaos
Most of the keys have fallen off the calculator. Make certain numbers using the keys that are left.
https://www.mathplayground.com/calculator_chaos.html

SpeedMath Deluxe
Create an equation from the four given digits using addition, subtraction, multiplication and division. Make certain that you remember the order of operations. It sometimes includes negative numbers.
http://education.jlab.org/smdeluxe/index.html

Random Coins
Can you make $1.00 from Random Coins? Drag and drop the coins.
https://www.mathsisfun.com/money/random-coins.html

LONG DIVISION & MULTIPLICATION

Amoeba Multiplication Game
Practice partial products, or multiplication by splitting numbers. Choose "Medium Level".
http://downloads.bbc.co.uk/skillswise/maths/ma12pape/game/ma12pape-game-written-multiplication/multiplication.swf

Area and the Distributive Property
Practice the idea how partial products tie in with the area of a rectangle (the distributive property).
https://www.khanacademy.org/math/cc-third-grade-math/cc-third-grade-measurement/cc-third-grade-area-distributive-property/e/area-and-the-distributive-property

Multiply 2-Digit Numbers with Area Model
Use an area model to decompose factors and multiply.
https://www.khanacademy.org/math/arithmetic/multiplication-division/area-models-multiplication/e/multiplying-2-digit-numbers-with-area-models

Estimator Quiz
Practice your estimation skills in this customizable interactive quiz. Choose "multiplication".
http://www.shodor.org/interactivate/activities/EstimatorQuiz/

Interactive Multiplication Practice
Improve your multi-digit multiplication skills with this 10-question online quiz.
https://www.thatquiz.org/tq-1/?-jg44-lf-p0

Multiplication with Money
Spin the wheel. At the end of each spin, practice multiplying amounts of money.
http://www.kidsmathtv.com/learn/multiplication-with-money-values-game-for-5th-grade-spin-the-wheel-team-game/

Understanding Remainders
Use arrays and practice problems to understand remainders. Also includes a bonus game!
https://www.khanacademy.org/math/arithmetic/arith-review-multiply-divide/arith-review-remainders/a/understanding-remainders

Drag and Drop Math
An interactive tool to practice long division or long multiplication.
https://mrnussbaum.com/drag-and-drop-math/

**Sample worksheet from
https://www.mathmammoth.com**

Mr. Martini's Classroom: Long Division
An interactive long division tool.
http://www.thegreatmartinicompany.com/longarithmetic/longdivision.html

Long Division
Solve long division problems interactively. Choose the levels with 2-digit divisors.
http://www.longdiv.co.uk/activity/

Long Division Tic Tac Toe
Play Tic Tac Toe while solving long division problems. This exercise has multiple-choice answers.
http://www.math-play.com/Tic-Tac-Toe-Long-Division-Game/Tic-Tac-Toe-Long-Division-Game.html

Long Division by "Chunking"
Solve division problems by using the "chunking method" — also called division by repeated subtraction.
http://www.chunkydivision.co.uk/activity/index.htm

Short Division
A page that explains short division in detail. Short division is the same algorithm as long division, but some steps are only done in one's head, not written down.
http://www.themathpage.com/ARITH/divide-whole-numbers.htm

FACTORS AND PRIMES

Find a Factor Maze Game
Find your way through the maze by clicking on factors of a given number.
https://www.mathmammoth.com/practice/

Divisibility Quiz Generator
Generate customized quizzes to practice the rules of divisibility.
http://www.mathwarehouse.com/arithmetic/numbers/divisibility-quiz.php

Primes and Divisibility Quiz
Practice basic concepts of primes and divisibility with this interactive self-check quiz.
http://www.phschool.com/webcodes10/index.cfm?wcprefix=ama&wcsuffix=1254

Arrays and factors
Drag rectangles to show the factorizations of a given number on a grid.
http://www.shodor.org/interactivate/activities/FactorizeTwo/

Octopus Factors
Move counters up the legs of an octopus but only when the number on the circle is a multiple of the number on the card.
http://www.counton.org/games/map-numbers/octopus/

Factor Game
Choose a number from the game board, and your opponent gets all the numbers that are its proper factors. Adjust the number of rows and columns of the board to get a more challenging game. This game can easily be adapted to be played offline, with paper and colored pencils.
http://illuminations.nctm.org/Activity.aspx?id=4134

Product Game
The players choose factors and the product of those are colored in on the game board. The player who gets four products in a row wins. You can play against the computer or with a friend. This game can easily be adapted to be played offline, with paper and colored pencils.
http://illuminations.nctm.org/Activity.aspx?id=4213

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Prime Factorization Calculator
This tool allows you to enter a composite number, and it produces a list of the prime numbers that, when multiplied, produce the original composite number.
http://www.dadsworksheets.com/prime-factorization-calculator.html

Sliding Tile Factorization Game
Slide a number over another to capture it. You can only do this if the number you slide is a factor of the other. Number 1 is only supposed to be used to capture prime numbers.
http://www.visualmathlearning.com/Games/sliding_factors.html

Not a Factor
Choose a number that is *not* a factor of the given number.
http://www.helpingwithmath.com/resources/games/target_factors01/not_factor.html

Factorization Forest
A fun game where for each number you factorize, you will get to grow a tree in your forest!
https://mrnussbaum.com/forest/

Factoring Calculator
This tool lists all the factors of a given number and has an interesting visual that pairs the factors of the number. You can find all the factors of even very large numbers. It's fun to experiment with!
http://www.dadsworksheets.com/factoring-calculator.html

Factor Trees at Math Playground
Factor numbers to their prime factors using an interactive factor tree.
https://www.mathplayground.com/factortrees.html

MathGoodies Interactive Factor Tree Game
Type the missing number into the factor tree, and you will see the factor tree being drawn.
http://www.mathgoodies.com/factors/prime_factors.html

FOR FURTHER STUDY

Unique Prime Factorization
A video explaining the fundamental theorem of arithmetic: that each composite number has a unique prime factorization.
https://www.youtube.com/watch?v=5kl28hmhin0

Primes, Factors and Divisibility—Explorer at CountOn.org
Explore and learn more about divisibility tests, primes, and factors.
http://www.counton.org/explorer/primes

The Prime Pages
Learn about the largest known primes, how primes are found, how many there are, and more.
http://primes.utm.edu/

The Cryptoclub. Using Mathematics to Make and Break Secret Codes (book)
Cryptoclub kids try to break the codes of secret messages, and at the same time learn more and more about encrypting and decrypting. The book contains problems to solve at the end of each chapter, little tips, and historical information on how cryptography has been used over the centuries.
http://www.amazon.com/gp/product/156881223X?tag=mathmammoth-20

Primality of 1 from Wikipedia
Discussing whether 1 should or should not be counted as a prime number.
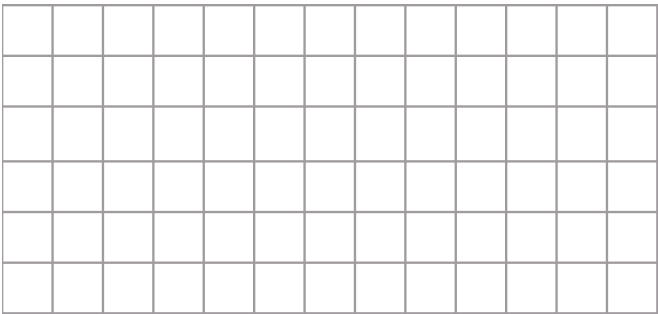https://en.wikipedia.org/wiki/Prime_number#Primality_of_one
http://primefan.tripod.com/Prime1ProCon.html

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More Multiplication

Now we will study the multiplication algorithm with a 3-digit number on the bottom. This means we have three partial products to do, so the multiplication process takes three lines.

```
  2 6
  4 2 9
× 2 2 7
───────
  3 0 0 3
```

```
    1
  4 2 9
× 2 2 7
───────
  3 0 0 3
  8 5 8 0
```

```
    1
  4 2 9
× 2 2 7
───────
  3 0 0 3
  8 5 8 0
8 5 8 0 0
```

```
    4 2 9
  × 2 2 7
  ───────
    3 0 0 3
    8 5 8 0
+ 8 5 8 0 0
  ─────────
  9 7 3 8 3
```

First multiply 7 × 429, ignoring the 2 and 2 in 227.

Next multiply 20 × 429. Place a zero in the ones place, and then multiply as if it was just 2 × 429.

Then, 200 × 429. Since you are multiplying by 200, <u>place a zero in the ones <i>and</i> in the tens places</u>, and then multiply 2 × 429.

Lastly add.

1. Multiply. Remember: you will need to place *two zeros* in the third line.

a.
```
      1 9 1
  ×   2 4 5
```

b.
```
      4 0 9
  ×   2 2 8
```

c.
```
      2 4 6
  ×   1 3 7
```

d.
```
      8 1 5
  ×   7 2 3
```

e.
```
      2 0 7
  ×   8 0 3
```

f.
```
      1 2 5
  ×   6 6 2
```

Sample worksheet from
https://www.mathmammoth.com

2. Practice 4-digit by 2-digit and 5-digit by 2-digit multiplications.

a.	b.	c.
1 4 9 1 × 2 7	2 0 8 5 × 3 5	8 1 1 6 × 1 8

d.	e.	f.
2 0 5 1 6 × 3 7	3 1 4 4 7 × 2 9	1 2 7 0 4 × 4 5

3. Solve.

A large shipping container can hold 15,000 pounds. A company packs 155 boxes of windows in it, each weighing 32 lbs. How much weight can they put in the container after that?

4. Let's review! Multiply mentally. (Remember the shortcut? Multiply without the zeros, then tag as many zeros at the end of the answer as there are in the factors.)

a. $500 \times 200 =$	b. $30 \times 210 =$
c. $250 \times 40 =$	d. $2,000 \times 400 =$
e. $2 \times 800 \times 20 =$	f. $30 \times 40 \times 50 =$

When the factors end in zeros, we can take a shortcut! Study the examples carefully.

Example 1:

```
       1  1
       9 5 6
   ×   2 0 0
   ───────────
   1 9 1 2 0 0
```

Here, you can first place two zeros in the ones and tens places in the answer, and then just multiply 2×956.

Example 2:

```
     4  1  1
          9 5 0
     ×    8 2 0
   ───────────────
            0 0 0
      1 9 0 0 0
   + 7 6 0 0 0 0
   ───────────────
   7 7 9 0 0 0
```

Be careful... the first "line" consists totally of zeros. On the second line, first place a zero, then multiply. On the third line, first place TWO zeros, then multiply.

```
     4  1  1
          9 5
     ×    8 2
   ───────────
        1 9 0
   + 7 6 0 0
   ───────────
     7 7 9 0
```

It is easier to multiply 82×95 and tag two zeros to the final answer to get 779,000.

5. Multiply.

a. $500 \times 29 =$ _____

Simply multiply 5×29, then tag _____ zeros to the final answer.

b. $340 \times 210 =$ _____

Multiply _____ × _____ , then tag ____ zeros to the final answer.

c. $280 \times 700 =$ _____

Multiply _____ × _____ , then tag ____ zeros to the final answer.

d. $99 \times 9{,}900 =$ _____

e. $500 \times 1{,}800 =$ _____

f. $24{,}500 \times 30 =$ _____

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A Two-Digit Divisor 1

It is helpful to write the multiplication table of the divisor before you divide.

Example 1.
This division is by 16. See below the multiplication table of 16:

$3 \times 16 = 48$
$4 \times 16 = 64$
$5 \times 16 = 80$
$6 \times 16 = 96$
$7 \times 16 = 112$
$8 \times 16 = 128$
$9 \times 16 = 144$

```
    0 3
16)5 5 6 8
```

16 goes into 5 zero times, so we look at 55.

How many times does 16 go into 55?

Check in the table on the left. We see it goes into 55 three times.

```
    0 3 4
16)5 5 6 8
  -4 8
     7 6
```

Now, how many times does 16 go into 76?

From the table we can see that it is four times.

```
    0 3 4 8
16)5 5 6 8
  -4 8
     7 6
   - 6 4
     1 2 8
   - 1 2 8
           0
```

Lastly, 16 goes into 128 exactly 8 times, and the division is over.

Example 2.
We are dividing by 32. Below is the multiplication table of 32:

$3 \times 32 = 96$
$4 \times 32 = 128$
$5 \times 32 = 160$
$6 \times 32 = 192$
$7 \times 32 = 224$
$8 \times 32 = 256$
$9 \times 32 = 288$

```
    0 1
32)4 7 0 7
  -3 2
   1 5
```

32 goes into 47 once.

```
    0 1 4
32)4 7 0 7
  -3 2
   1 5 0
  -1 2 8
       2 2
```

32 goes into 150 four times.

```
    0 1 4 7
32)4 7 0 7
  -3 2
   1 5 0
  -1 2 8
       2 2 7
     - 2 2 4
             3
```

32 goes into 224 seven times. Notice there is a remainder.

1. Divide. First write a multiplication table for the divisor. Check each answer by multiplying.

Table of 21:
$2 \times 21 =$
$3 \times 21 =$
$4 \times 21 =$
$5 \times 21 =$
$6 \times 21 =$
$7 \times 21 =$
$8 \times 21 =$
$9 \times 21 =$

```
2 1)3 8 2 2
```

2. Divide. First write a multiplication table for the divisor. Check each answer by multiplying.

a.

Table of 15:
2 × 15 =
3 × 15 =
4 × 15 =
5 × 15 =
6 × 15 =
7 × 15 =
8 × 15 =
9 × 15 =

$15\overline{)4815}$

b.

Table of 12:
2 × 12 =
3 × 12 =
4 × 12 =
5 × 12 =
6 × 12 =
7 × 12 =
8 × 12 =
9 × 12 =

$12\overline{)5148}$

c.

Table of 25:
2 × 25 =
3 × 25 =
4 × 25 =
5 × 25 =
6 × 25 =
7 × 25 =
8 × 25 =
9 × 25 =

$25\overline{)6275}$

d.

Table of 16:
2 × 16 =
3 × 16 =
4 × 16 =
5 × 16 =
6 × 16 =
7 × 16 =
8 × 16 =
9 × 16 =

$16\overline{)1504}$

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Chapter 2: Large Numbers and the Calculator
Introduction

In this chapter, we study large numbers and place value up to billions—that is, up to 12-digit numbers. Students will also add, subtract, and round large numbers, and learn about exponents and powers. Concerning exponents and powers, the focus is on powers of ten (such as 10^2, 10^5, 10^8, and so on), which is what the student should master in this grade level. If your student has difficulties with exponents in general, there is no need to worry. Exponents and powers are taught from scratch again in Math Mammoth grade 6.

In this chapter, students will be introduced to the calculator for the first time, and therefore they will need a simple calculator (preferably a physical one, not one on a computer or other device) about half-way through this chapter.

I have delayed the use of a calculator (as compared to many other math curricula) for good reasons. I have received numerous comments on the harm that indiscriminate calculator usage can cause. If children are allowed to use calculators freely, their minds get "lazy," and they will start relying on calculators even for simple things such as 6×7 or $320 + 50$. It is just human nature!

As a result, students may enter college without even knowing their multiplication tables by heart. Then they have trouble if they are required to use mental math to solve simple problems.

Therefore, we educators need to *limit* calculator usage until the students are much older. Children *cannot* decide this for themselves, and definitely not in fifth grade.

However, I realize that the calculator is extremely useful, and students do need to learn how to use it. In this curriculum, I try to not only show the students how to use a calculator, but also *when* to use it and when *not* to use it.

This chapter includes many problems where calculator usage is appropriate. We also practice estimating the result before using a calculator to find the exact answer, and choosing whether mental math or a calculator is the best "tool" for the calculation.

The Lessons in Chapter 2

Helpful Resources on the Internet

Online Place Value Practice
Practice writing numbers that are given in expanded form.
https://www.mathmammoth.com/practice/place-value#mode=write-number&max-digits=12&question-number=10

Expanded Form Quiz
Practice addition in expanded form with this 10-question quiz.
https://www.thatquiz.org/tq-c/?-j28-l9-p0

Can you say really big numbers?
Enter a really big number, try to say it out loud, and see it written.
http://www.mathcats.com/explore/reallybignumbers.html

Fruit Splat Compare Numbers
Compare numbers by choosing < , > , or = . Choose level six.
http://www.sheppardsoftware.com/mathgames/placevalue/FSCompareNumbers.htm

Place Value Quiz
Practice identifying the place values of the digits in large numbers with this 10-question quiz.
https://www.thatquiz.org/tq-c/?-j21-l9-p0

Quiz on Large Numbers
Test your knowledge about numbers with this 10-question multiple choice quiz.
http://www.proprofs.com/quiz-school/story.php?title=NTczNDc3

Megapenny Project
This page visualizes big numbers with pictures of pennies.
http://nanospace.molecularium.com/attractions/mega_penny/

Powers of Ten
A 9-minute movie that illustrates the dramatic changes of scale when zooming in or out by powers of ten (40 powers of ten), starting from a picnic blanket and ending in the universe, and then starting from a hand, all the way to a proton inside an atom.
https://www.youtube.com/watch?v=0fKBhvDjuy0

Free Exponent Worksheets
Create a variety of customizable and printable worksheets to practice exponents.
https://www.homeschoolmath.net/worksheets/exponents.php

Exponents Quiz from ThatQuiz.org
A 10-question quiz, fairly easy, and not timed. You can change the parameters as you like.
http://www.thatquiz.org/tq-2/?-j1-l4-p0

Pyramid Math
Choose "POW' to practice exponents. Drag the triangle with the right answer to the vase.
http://www.mathnook.com/math/pyramidmath.html

Picture Matching - Exponent Values
Match the powers with their values and reveal a pretty picture.
http://www.studystack.com/picmatch-275044

Exponent Game
A card game to practice exponents. Limit the cards to small numbers, instead of using the whole deck.
http://www.learn-with-math-games.com/exponent-game.html

Otter Rush
Choose the correct value for "x" in exponent expressions (such as $2^x = 16$) in this racing game.
https://www.mathplayground.com/ASB_Otter_Rush.html

Adding and Subtracting Powers of Ten
This interactive quiz practices adding and subtracting powers of ten with numbers up to 1,000,000.
http://snappymaths.com/addsub/addsubp10/interactive/addsubpowers10/addsubpowers10.htm

ROUNDING AND ESTIMATING

Rounding Quiz
Practice rounding large numbers in this interactive 10-question quiz.
http://www.softschools.com/quizzes/math/rounding/quiz837.html

Online Rounding Practice
Practice your rounding skills with this interactive exercise.
https://www.mathmammoth.com/practice/rounding#number-range=0to1000000000&round-to=any-place

Alice's Cross-Number Puzzle
Respond correctly to the clues and when you finish, your answers will form upside-down calculator words.
http://www.dr-mikes-math-games-for-kids.com/alices-cross-number-puzzle.html

Estimation Valley Game
Practice estimation with this math golf game. The better you estimate, the more accurate your shot!
https://mrnussbaum.com/estimationvalley/

Estimation at AAA Math
Exercises about rounding whole numbers and decimals, front-end estimation, estimating sums and differences. Each page has an explanation, interactive practice, and games.
http://www.aaamath.com/B/est.htm

CALCULATOR

Using a Calculator
Practice your calculator skills with this challenging quiz! Note: Some of the questions use concepts not studied in this grade.
http://www.transum.org/software/SW/Starter_of_the_day/Students/Using_A_Calculator.asp?Level=1

Powers Puzzle
This exploratory math exercise will get students to exploring numbers with the use of a calculator.
http://www.dr-mikes-math-games-for-kids.com/powers-puzzle.html

Magical Calculator Birthday Math Trick
Have fun with this amazing calculating trick!
http://www.dr-mikes-math-games-for-kids.com/magical-calculator-birthday-math-trick.html

Calc-a-hundred
In this game for two players, take turns multiplying numbers on a calculator to see who can be the first one to make the total equal one hundred point something.
https://www.transum.org/Software/SW/Starter_of_the_day/starter_October5.ASP

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Adding and Subtracting Large Numbers

Just like 25 marbles + 54 marbles = 79 marbles, so will 25 million + 54 million = 79 million.

Just keep in mind:

A thousand thousands makes a million, and **a thousand millions makes a billion**.

800,000 + 200,000	**Half a million**
Think of it as 800 thousand + 200 thousand. The answer is 1,000 thousand or 1,000,000.	Think of it as half of a thousand thousands, or 500 thousands = 500,000.
34,999,000 + 1,000	**2 billion − 300 million**
This is 34 million 999 thousand + 1 thousand, making 34 million 1000 thousand or 35 million.	Think of it as 2,000 million − 300 million, which makes 1,700 million or 1,700,000,000.

1. Add.

	a. 90,000	**b. 99,000,000**	**c. 999,000**
+ 1,000			
+ 10,000			
+ 100,000			
+ 1,000,000			

2. Match.

a.		**b.**	
1/2 million	750,000	1 million − 50,000	100,000,000
a hundred hundreds	100,000	1 million − 500,000	500,000
1/10 million	10^6	10^8	950,000,000
1/4 million	500,000	1 billion − 500 million	1/2 billion
3/4 million	10^4	1 billion − 50 million	950,000
a thousand thousands	200,000	1 million − 5,000	995,000
2/10 million	250,000	1 billion − 5 million	995,000,000

3. Add or subtract. Simply write the numbers under each other, lining up the digits and the commas in the same places. Use the usual addition or subtraction algorithm, regrouping the same way as you have learned before.

a. 329,145,000 + 2,809,125,093

b. 5,049 + 45,390,000 + 5,483,700

c. 45,700 + 90,567,000 + 2,560 + 2,300,560

d. 290,800 + 254,000,230 + 56,391 + 2,381

e. 480,560,000 − 23,980,000

f. 1,000,000 − 156,990

g. 22,300,000 − 4,431,190

h. 7,014,289,000 − 3,103,559,391

4. Subtract and compare. Think of each million as a *thousand thousands*!
Use extra paper if necessary.

a. 1 million − 500 thousand =	**b.** 1 million − 50 thousand =
1 million − 100 thousand =	1 million − 10 thousand =
3 million − 400 thousand =	7 million − 20 thousand =

5. Continue counting for seven more numbers in each set:

a.	b.	c.
458,000,000	79,650,000	450,996,000
468,000,000	79,800,000	450,997,000
478,000,000	79,950,000	450,998,000

Each difference is	Each difference is	Each difference is
_____	_____	_____

6. Complete the addition path.

35,647,000	add 10,000 →		add a million →	

add 100 thousand ↓

	add 10 million ←		add a thousand ←	
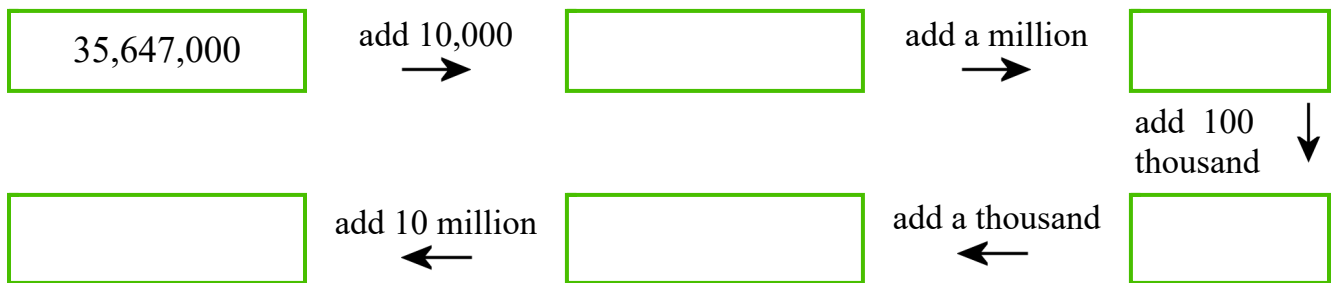
Puzzle Corner

Solve for the unknown x or N.

a. $x + 400,000 = 4,000,000$

$x =$ _____

b. $x - 350,000 = 2,000,000$

$x =$ _____

c. $200,000 + N + 600,000 = 7,000,000$

N = _____

d. $2 \times N = 3,000,000$

N = _____

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Chapter 3: Problem Solving
Introduction

We start out this chapter by studying simple equations, presented as pan balance puzzles. The pan balance works very well for modeling the process of solving equations. In the second lesson, students use the bar model to help them solve equations. The equations on this level are very simple. More complex equations are presented in grades 6 and especially in grade 7 (pre-algebra).

The bulk of this chapter is then spent on the topic of problem solving, focusing on problems that involve a fractional part of a whole in some manner.

Encourage the student to draw a bar model for the problems, as it is such a helpful tool. Some of the problems here could even be found in regular Algebra 1 textbooks where they would naturally be solved with algebra. However, the bar model enables us to solve them without algebra; yet, it helps the students' algebraic thinking. Essentially, one block in the bar model corresponds to the unknown x in an equation.

The Lessons in Chapter 3

Helpful Resources on the Internet

Pan Balance - Numbers
Enter a numerical expression in one pan and then in the other. The pans will raise or lower depending on which expression is "heavier" (has a greater value). When the expressions are equivalent, the pans will balance and the full equation will be entered into the *Balanced Equations* table. This tool strengthens students' understanding of EQUALITY <u>as a relationship</u>, not as an operation. Many students view the equals sign as an operation of "find the answer," which is incorrect. These students find it difficult to understand equations such as $11 = 4 + 7$ or $3 \times 5 = 17 - 2$.
https://www.nctm.org/Classroom-Resources/Illuminations/Interactives/Pan-Balance----Numbers/

Pan Balance - Shapes
This interactive balance builds algebraic thinking. Find the weight of each shape by placing shapes on the two pans. Try to find situations where the weights are equal. One square always weighs 1 unit.

Balance Scale Activity
Use your intuition about balance to help solve the problems in this interactive online exercise.
If you need help there is a video to watch for instruction.
http://www.learner.org/courses/learningmath/algebra/session6/part_c/index.html

Algebra Balance Equations
Replicate the given equation by moving the blocks of *X* and 1 to the sides of the balance scale. Then use addition, subtraction, multiplication, and division to each side to solve for *x*.
http://www.hoodamath.com/mobile/games/algebrabalanceequations.html

Thinking Blocks
An interactive math tool developed to help students learn how to solve multi-step word problems with the help of bar models. Choose "Find a Fraction of a Number" to practice the topic of the lesson *Problem Solving with Bar Models 1*.
https://www.mathplayground.com/tb_fractions/index.html

Thinking Blocks
An interactive math tool developed to help students learn how to solve multi-step word problems with the help of bar models. Choose "Compare Quantities" to practice the topic of the lesson *Problem Solving with Bar Models 3*.
https://www.mathplayground.com/tb_multiplication/index.html

Thinking Blocks
Choose "Find the Total or Part" to practice topics of the lesson *Problem Solving with Bar Problems 4*.
https://www.mathplayground.com/tb_fractions/index.html

Stable Scales Quiz
In each picture, the scales are balanced. Can you find the weight of the items on the scales?
https://www.transum.org/Software/SW/Starter_of_the_day/Students/Stable_Scales_Quiz.asp

Algebra Puzzle
Find the value of each of the three objects presented in the puzzle. The numbers given represent the sum of the objects in each row or column.
https://www.mathplayground.com/algebra_puzzle.html

Calculator Chaos
Most of the keys have fallen off the calculator and you have to make certain numbers using the keys that are left.
https://www.mathplayground.com/calculator_chaos.html

ArithmeTiles
Use the four operations and numbers on neighboring tiles to make the target numbers. This game uses Shockwave.
http://www.primarygames.com/math/arithmetiles/

SpeedMath Deluxe
Create an equation from the four given digits using addition, subtraction, multiplication and division. Make sure that you remember the order of operations. It includes negative numbers sometimes.
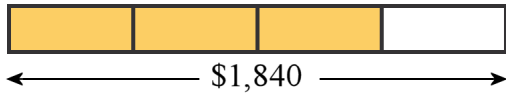http://education.jlab.org/smdeluxe/

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Problem Solving with Bar Models 1

A fractional part of a whole

Problem. Jackie earns $1,840 monthly and Jessie earns 3/4 as much. How much does Jessie earn?

$1,840

Solution. In the model, Jackie's salary is divided into four equal parts (blocks). To find 3/4 of it, <u>first find 1/4 of it</u>, which is **one block** in the model.
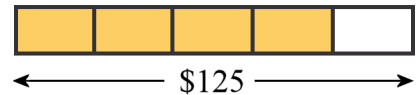
$$\$1,840 \div 4 = \$460$$

Then multiply that result by three:
$3 \times \$460 = \$1,380$.
So, Jessie earns $1,380.

Solve. Draw a bar model. Write an expression (number sentence) for <u>each</u> calculation you do.

1. A camera that cost $125 was discounted by 1/5 of its price. What is the new price?

   $125

   _____ ÷ _____ = _____

   _____

2. A pizza that weighs 680 g is divided into five equal pieces. How much do two pieces weigh?

   _____ ÷ _____ = _____

   _____ × _____ = _____

3. A bottle of water costs 2/3 as much as a bottle of juice that costs $1.50. How much do *two* bottles of water and *two* bottles of juice cost?

A Fractional Part More

Problem. The school year in country A is 180 days long. In country B it is 1/6 part longer than that. How long is the school year in country B?

← —— 180 —— →
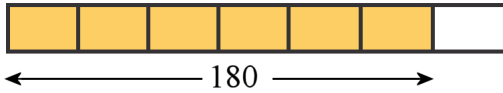
Solution. First, we divide the 180-day school year into 6 parts, to find how much one "block" is in the model:

$180 \div 6 = 30$. So, one block is 30 days.

Then we *add* one-sixth more to the whole bar model, and that is how long the school year is in country B.

$$180 + 30 = 210$$

So, the school year in country B is 210 days long.

Solve. Draw a bar model. Write an expression (number sentence) for each calculation you do.

4. The price of a train ride is $12. It went up by 1/6. What is the new price?

    _____ ÷ _____ = _____

    _____ + _____ = _____

5. A cafeteria lunch used to cost $4.50 but the price was increased by 1/5. What is the price now?

6. A one-way bus ride from Helen's home to town costs $1. The bus company will raise the price by 1/10 in June.

   a. How much will a one-way ride cost in June?

   b. How much more will a two-way ride (home to town to home) cost Helen in June than in May?

7. A T-shirt cost $10.50, but now it is discounted by 2/5 of its price.
   Annie bought *ten* shirts with the discounted price. What is the total cost?

8. Duckville has 3,687 inhabitants, which is 3/5
   of the number of inhabitants in Eagleby.
   How many people *in total* live in Eagleby and Duckville?

A package of 10 small envelopes costs $2.50, and a package of
10 large ones costs 2/5 more. Find the total cost of buying
50 envelopes of each kind.

Puzzle Corner

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Chapter 4: Decimals, Part 1
Introduction

In this first chapter about decimal arithmetic, students study place value with decimals, add and subtract decimals, and learn to multiply and divide decimals by whole numbers. We study more about decimal multiplication and division in chapter 6, along with conversions between measurement units. Some of the decimal lessons can appear boring, plus there are quite a few of them, so I hope that by breaking up the decimal topics into two chapters, students will not get "bogged down" by the number of topics to study. It can also help them retain the concepts, because we review some topics from this chapter in chapter 6.

The first two lessons deal with place value, first with tenths and hundredths (up to two decimal digits), and then with thousandths (three decimal digits). Then we briefly look at decimals on a number line. These first lessons are very important, since understanding decimal place value is the foundation for understanding other operations with decimals.

We start building on this foundation in the lesson *Add and Subtract Decimals — Mental Math*. Students solve sums such as $0.8 + 0.06$ based on their knowledge of place value. The value of that sum is 0.86, not 0.14, like students with a misconception could answer.

Adding and subtracting decimals in columns comes next. This is the common algorithm where the decimal points (or all places) need to be lined up before adding or subtracting. Students also learn to compare and round decimals.

Then lastly for this chapter, we study multiplying and dividing decimals by whole numbers, both using mental math, and using column-multiplication and long division. The mental math strategies are based on understanding decimal place value. One reason I include so many mental calculations is because they help students understand the concepts of decimal arithmetic and of place value.

You might wonder why *Math Mammoth Grade 5* presents decimals before fractions. The traditional way is to teach fractions first because then we can show that decimals are simply fractions of a specific type — namely, they are fractions with denominators that are powers of ten (for example, 0.45 is simply the fraction 45/100).

There are several reasons I present decimals before fractions. First, students have studied some about both decimals and fractions in earlier grades, so they should have the necessary background to comprehend that the decimals we are studying here *are* fractions. Therefore, I see no need to study all fraction arithmetic in 5th grade before decimal arithmetic.

Secondly, I feel that decimal arithmetic is somewhat easier than fraction arithmetic, and students already know more about it than they know about all the fraction arithmetic that is studied in 5th grade (in 5-B). Thus, studying decimal arithmetic first may be easier for some students.

The Lessons in Chapter 4

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Helpful Resources on the Internet

Decimal Arithmetic - Videos by Maria
These are my videos where I explain all about decimal arithmetic: adding, subtracting, multiplying, dividing, comparing and rounding decimals, plus some problem solving. Suitable for grades 5-6.
https://www.mathmammoth.com/videos/grade_5/5th-grade-videos.php#decimals

CONCEPT OF DECIMAL

Decimal Demonstrator
An interactive visual model that uses cups to demonstrate decimal numbers up to two decimal digits.
http://www.ictgames.com/decimalDemonstrator/index.html

Zoomable Decimal Number Line
Click on this interactive number line to zoom in more and more and explore decimal numbers.
https://www.mathsisfun.com/numbers/number-line-zoom.html

Decimals Number Line White Board
An illustrative tool that demonstrates decimals on a number line.
http://www.active-maths.co.uk/fractions/whiteboard/dec_no_line1.html

Scales
Move the pointer on the scale to match the decimal number given to you. Refresh the page from your browser to get another problem to solve.
http://www.interactivestuff.org/sums4fun/scales.html

Puppy Pull Game: Fractions to Decimals
Help your team win the tug contest by converting fraction words to decimal numbers!
http://www.mathplayground.com/ASB_Puppy_Pull_Decimals.html

Fractions & Decimals Matching Mystery Picture Game
Find matching pairs of fractions and decimals while uncovering a hidden picture.
https://www.mathmammoth.com/practice/fractions-decimals

Fraction Decimal Pairs
Choose from five different Fraction Decimal Pair activities that practice matching fractions with their equivalent decimal numbers.
http://www.transum.org/software/SW/Starter_of_the_day/Students/Pairs.asp?Topic=15

PLACE VALUE

Decimals in Expanded Form
Practice converting decimals between standard form and expanded form in this interactive exercise.
https://www.khanacademy.org/math/arithmetic/decimals/decimal-place-value/e/writing-and-interpreting-decimals

Place Value Strategy
Organize the digits given by the spinner to make the largest number possible.
http://www.decimalsquares.com/dsGames/games/placevalue.html

Decimal Place Value Card Game
Try to form the highest decimal number using playing cards in this quick and easy card game for 2-4 players.
http://games4gains.com/blogs/teaching-ideas/41379652-decimal-place-value-with-playing-cards

Decimal Darts
Practice estimation and decimal numbers while trying to pop balloons with darts. Requires Shockwave.
http://www.decimalsquares.com/dsGames/games/darts.html

Decimal Challenge
Guess a secret decimal number between 0 and 10. Each time the computer tells you whether your guess was too high or too low.
http://www.interactivestuff.org/sums4fun/decchall.html

Decimal Detective
Identify the decimal numbers digit-by-digit with the help of given hints. Choose Sergeant Level.
http://flash.topmarks.co.uk/3286

COMPARING AND ORDERING

Switch
Put the sequence of decimal numbers in ascending order by switching them around. Refresh the page from your browser to get another problem to solve.
http://www.interactivestuff.org/sums4fun/switch.html

Smaller and Smaller Maze
Practice ordering decimal numbers to find your way through the maze.
http://www.counton.org/magnet/kaleidoscope/smaller/

Decimals in Space
An Asteroids-style game where you first answer a question about the smallest decimal and then get to shoot asteroids, earning points based on the numbers on them.
http://www.mathwarehouse.com/games/our-games/decimal-games/decimal-place-value-math-game

Order Decimals Quiz
Place the decimal numbers in the correct order in this 10-question online quiz.
https://www.thatquiz.org/tq-6/?-j20-lc-p0

Compare Decimals Quiz
Practice comparing decimal numbers in this 10-question online quiz.
https://www.thatquiz.org/tq-B/?-jk-la-p0

ROUNDING

Round Decimals Using the Number Line
Practice using the number line to round decimals in this interactive online activity.
https://www.khanacademy.org/math/cc-fifth-grade-math/cc-5th-place-value-decimals-top/cc-5th-rounding-decimals/e/rounding-decimals-using-a-number-line

Rounding Numbers (Choose level 3)
Practice rounding decimal numbers. Get five correct in a row to take penalty shots!
http://www.abcya.com/rounding_numbers.htm

ADDITION & SUBTRACTION

Sock
Push the green blocks into the holes, and add the numbers on them, to make the target number.
http://www.interactivestuff.org/sums4fun/sock.html

Number Conundrum
Can you solve the conundrum? Each number is the sum of the two numbers directly beneath it. Select "Hard" from the settings icon.
http://www.mathplayground.com/number_conundrum/number_conundrum_decimal_numbers.html

Add and Subtract Decimals Quiz
Practice adding and subtracting decimals with up to three decimal digits in this 10-question online quiz.
https://www.thatquiz.org/tq-3/?-j123-lk-p0

Decimal Plus
Practice mental and written methods for adding and subtracting decimal numbers in this online exercise.
http://www.transum.org/Maths/Activity/Decimals/Add.asp?Level=2

Decimals Workshop
Practice adding, subtracting, multiplying, or dividing decimals with this customizable interactive exercise.
http://mrnussbaum.com/decimals-workshop/

Decimal Squares Blackjack
Play cards with decimals, trying to get as close to 2 as possible without going over. Requires Shockwave.
http://www.decimalsquares.com/dsGames/games/blackjack.html

MULTIPLICATION

Decimals Workshop
Practice adding, subtracting, multiplying, or dividing decimals with this customizable interactive exercise.
http://mrnussbaum.com/decimals-workshop/

Multiply Decimals by Whole Numbers
Polish your decimal multiplication skills with this interactive online exercise.
https://www.khanacademy.org/math/cc-fifth-grade-math/cc-5th-arith-operations/cc-5th-mult-decimals/e/multiplying-decimals-without-the-standard-algorithm-2

Decimal Times - Mental Multiplication
Practice mental and written methods for multiplying and dividing decimal numbers in this interactive online exercise.
http://www.transum.org/Maths/Activity/Decimals/

Multiply with Decimals: Simple Word Problems
Practice multiplying decimals by whole numbers with these interactive word problems.
https://www.studyladder.com/games/activity/multiply-decimals-by-whole-numbers-22247

DIVISION

Long Division to Decimal Places
This is a short tutorial about dividing whole numbers to decimal digits. At the bottom of the page you will find a short online quiz.
https://www.mathsisfun.com/long_division3.html

Long Division — Choose "Decimal Division"
Enter the numbers that you want to divide and click on the button "Do division" to see a step-by-step illustration of the solution.
http://www.mathsonline.org/pages/longdiv.html

Decimal Long Division Worksheets
Use these randomly generated worksheets for extra practice.
https://www.homeschoolmath.net/worksheets/decimal_division.php#long

PROBLEM SOLVING

Burnside's Billions Game
Mr. Burnsides is leaving you his fortune, but under one condition… You need to buy up his 27 favorite world landmarks in the next 40 days! This game involves foreign currency, exchange rates, and large-scale calculations involving decimals.
https://www.mrnussbaum.com/billions/

FOR REVIEW

Decimal and Whole Number Jeopardy
Review place value, comparing, and rounding decimals. Also, practice number patterns.
http://www.quia.com/cb/8142.html

Fractions & Decimals Matching Game
Practice converting fractions to decimals while also uncovering a hidden picture in this fun matching game!
https://www.mathmammoth.com/practice/fractions-decimals

Online Decimal Rounding Practice
Improve your decimal rounding skills with this interactive exercise.
https://www.mathmammoth.com/practice/rounding#number-range=decimals&decimal-place=3

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Add and Subtract Decimals in Columns

Adding and subtracting decimals in columns (where you write one number under the other) is easy. Simply write the numbers carefully one under the other, **aligning each place, AND aligning the decimal points**. Then add and subtract as if there were no decimal points. Lastly, put a decimal point in the answer.	Line up the ones, the tenths, the hundredths, and the thousandths. $1.457 + 6.7 + 5$ $= 1.457 + 6.700 + 5.000$ <u>Notice</u>: you can write zeros in the empty places.	$\begin{array}{r} 1 \\ 1.457 \\ 6.700 \\ +\ 5.000 \\ \hline 13.157 \end{array}$

1. Add or subtract. Line up the different places and the decimal points carefully.

a. $190 + 342.25 + 45.808$

$+$

b. $145.5 - 24.93$

$-$

c. $1.293 + 12.6 + 605.99$

$+$

d. $253 - 23.28$

$-$

2. Mrs. Wood's precious puppy weighed 0.236 kg when it was born. At the next checkup, it weighed 0.37 kg. How much weight had it gained?

Sample worksheet from
https://www.mathmammoth.com

3. Find the missing numbers. Use mental math if you can.

− 0.06	− 0.08	− 0.1	− 0.04	− 0.2	− 0.07	− 0.02	− 0.03

8.28 _____ _____ _____ _____ _____ _____ _____ 7.68

4. Calculate:

   a. $1.09 - 0.549$

   b. $0.82 + 45.1 + 8.492 + 305$

5. Dad caught some fish that weighed 1.19 kg, 1.565 kg, 2.1 kg and 1.47 kg.

   a. What was the total weight of the catch?

   b. How much short of 7 kg was his catch?

6. Allison checked some distances using an online map service.

From	To	Distance (miles)
home	library	2.3
home	store	0.67
library	store	1.055
home	Sheila's	1.08
store	Sheila's	1.508
library	Sheila's	1.25

Find the total distance for these routes:

a. From Allison's home to the library, then to the store, and then home again.

b. From the library to Sheila's house, to the store, then to Allison's house.

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Divide Decimals by Whole Numbers 1

To divide a decimal by a whole number with long division is very easy.

Simply divide normally, as if there were no decimal point. Then, **put the decimal point in the quotient in the same place** as it is in the dividend.

See the example on the right. It is your task to finish checking the division by multiplication. Verify that the multiplication gives you the original dividend, 41.51.

```
      0 5.9 3
  7 ) 4 1.5 1
     - 3 5
        6 5
      - 6 3
          2 1
        - 2 1
            0
```

Check:

```
   5 . 9  3
 ×        7
 ─────────
```

1. Divide. Check each division result with multiplication.

a.   5) 5.3 0

Check:

b.   6) 2.3 8 8

Check:

c.   19) 2 3.9 4

Check:

d.   23) 5 7.6 3 8

Check:

You know that when dividing whole numbers, there can be a remainder. For example, 24 ÷ 5 = 4 R4.

But, we can continue such divisions into decimal digits. To do that, <u>add decimal zeros to the dividend</u>.

Example 1. This is the division 24 ÷ 5 but with 24 written as 24.0.

It is actually an even division, with a quotient of 4.8.

```
      0 4.8
  5 )2 4.0
      2 0
        4 0
      - 4 0
          0
```

Check:

```
     4
   4.8
 ×   5
 2 4.0
```

How do you know how many decimal zeros to add to the dividend, so the division will be even?

You cannot tell that before you divide. Just start with maybe 2-3 zeros, and see how the division goes. You can always add more zeros to the dividend if you need to. Besides, not every decimal division is even! We will see an example of that on the next page.

2. Divide in two ways: first by indicating a remainder, then by long division. Add a decimal point and decimal zeros to the dividend. Lastly, check your answer by multiplying.

a. 31 ÷ 4 = _____ R _____

```
4 ) 3 1
```
Check:

b. 56 ÷ 5 = _____ R _____

```
5 ) 5 6
```
Check:

c. 15 ÷ 8 = _____ R _____

```
)
```
Check:

d. 45 ÷ 20 = _____ R _____

```
)
```
Check:

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Chapter 5: Statistics and Graphing
Introduction

This chapter starts out with a study of the coordinate grid, but only in the first quadrant. Besides learning how to plot points, students also plot ordered pairs (points) from number patterns or rules. This is actually the beginning of the study of *functions*.

Practicing the use of the coordinate grid is a natural "prelude" to the study of line graphs, which follows next. The goals are that the student will be able to:

- read line graphs, including double line graphs, and answer questions about data already plotted;

- draw line graphs from a given set of data.

The goals for the study of bar graphs are similar to those for the study of line graphs, in that the student will need to both:

- read bar graphs and double bar graphs, and answer questions about data already plotted; and

- draw bar graphs and histograms from a given set of data.

In order to make histograms, it is necessary to understand how to group the data into categories ("bins"). The lesson *Making Histograms* explains the method we use to make categories if the numerical data is not already categorized.

Toward the end of the chapter, we study average (also called the *mean*) and mode, and how these two concepts relate to line and bar graphs. Other math curricula commonly introduce the median, too, but I decided to omit it from 5th grade. There is plenty of time to learn that concept in subsequent grades. Introducing all three concepts at the same time tends to jumble the concepts together and confuse them — and all that a lot of students are able to grasp from that is only the calculation procedures. I feel it is better to introduce and contrast initially only the two concepts, the mean and the mode, in order to give the student a solid foundation. We will introduce the median later, and then compare and contrast it with the other two.

This chapter also includes an optional statistics project, in which the student can develop investigative skills.

The Lessons in Chapter 5

Helpful Resources on the Internet

COORDINATE GRID

Cali and the Coordinate System
Move Cali on the given coordinates, which are only positive numbers. How long will it take you to feed Cali 10 times?
https://www.math10.com/en/math-games/games/geometry/games-cali-coordinate-system.html

Soccer Coordinates Game
Plot the coordinates on the coordinate grid correctly to block the soccer ball from entering the goal.
http://www.xpmath.com/forums/arcade.php?do=play&gameid=90

Coordinate Grid Quiz from ThatQuiz.org
Practice plotting a point and giving the coordinates of a given point (in the first quadrant).
https://www.thatquiz.org/tq-7/?-j48-l5-p0

Number Pattern Tables
Apply the rule to find the missing number in the table.
https://www.studyladder.com/games/activity/number-pattern-tables--20584

Interpret Relationships Between Number Patterns
Generate patterns using given rules, identify relationships between terms, and graph ordered pairs consisting of corresponding terms from the patterns.
https://www.khanacademy.org/math/pre-algebra/applying-math-reasoning-topic/number-patterns/e/visualizing-and-interpreting-relationships-between-patterns

Graph a Two-Variable Relationship
Practice identifying relationships between variables with this interactive exercise.
https://www.ixl.com/math/grade-5/graph-a-two-variable-relationship

GRAPHING AND GRAPHS

Easy Practice Problems for Reading Bar Graphs
First, customize your bar chart. Then, click on the buttons on the left side to get questions to answer.
http://www.topmarks.co.uk/Flash.aspx?f=barchartv2

Graphs Quiz from That Quiz.org
Questions about different kinds of graphs (bar, line, circle graph, multi-bar, stem-and-leaf, box plot, scatter graph). You can modify the quiz parameters to your liking.
http://www.thatquiz.org/tq-5/math/graphs

Sample worksheet from
https://www.mathmammoth.com

Survey Game
First, ask children their favorite hobby or color. Then, make a frequency table, a bar graph, and a pictogram from the results.
http://www.kidsmathgamesonline.com/numbers/mathdata.html

Line Graphs Quiz
Answer the questions about the line graph in this interactive 10-question quiz.
https://www.thatquiz.org/tq-5/?-j10f14-l5-p0

Histograms at Maths is Fun
Learn about histograms in this short and clear tutorial. At the end of the page you will find quiz questions.
https://www.mathsisfun.com/data/histograms.html

Creating Histograms at Khan Academy
Use the given data to create a histogram in this interactive exercise.
https://www.khanacademy.org/math/cc-sixth-grade-math/cc-6th-data-statistics/histograms/e/creating-histograms

Create Double Bar Graphs Using Tables
Use the data in the table to complete the bar graph in this interactive exercise.
http://www.mathgames.com/skill/6.96-create-double-bar-graphs-using-tables

Interpret Double Bar Graphs
Read the double bar graphs and answer the questions in this interactive quiz.
http://www.mathgames.com/skill/6.95-interpret-double-bar-graphs

Statistics Interactive Activities from Shodor
A set of interactive tools for exploring and creating different kinds of graphs and plots. You can enter your own data or explore the examples.
http://www.shodor.org/interactivate/activities/BarGraph/

http://www.shodor.org/interactivate/activities/Histogram/

http://www.shodor.org/interactivate/activities/CircleGraph/

http://www.shodor.org/interactivate/activities/MultiBarGraph/

Math Goodies Interactive Data and Graphs Lessons
Clear lessons with examples and interactive quiz questions, covering the concept and construction of line graphs, bar graphs, circle graphs, comparing graphs, and exercises.
http://www.mathgoodies.com/lessons/toc_vol11.html

Interactive tool for creating graphs
Customize your own bar graph, line graph, or pie chart using this interactive tool.
https://www.mathsisfun.com/data/data-graph.php

Create a Graph
Create bar graphs, line graphs, pie graphs, area graphs, and xyz graphs to view, print, and save.
http://nces.ed.gov/nceskids/createagraph/default.aspx

Sample worksheet from
https://www.mathmammoth.com

Data Grapher
Use this tool to create bar graphs, line graphs, pie charts, and pictographs. You can enter multiple rows and columns of data, select which set(s) to display in a graph, and choose the type of representation.
http://illuminations.nctm.org/Activity.aspx?id=4098

MEAN, MEDIAN, MODE, AND RANGE

Math - Elephants - Line Graphs & Mean
Interactive exercises for interpreting a line graph, drawing a line graph, and calculating the mean.
https://en.e-learningforkids.org/math/lesson/elephants-plant-line-graphs-mean/

Mean/Mode Quiz
A 10-question quiz about calculating the mode and the mean.
http://www.thatquiz.org/tq-p-z1/?-j6g00-l5-p0

The Mean Machine
Use this interactive tool to see how average is calculated.
http://www.mathsisfun.com/data/mean-machine.html

Calculating the Mean
Practice calculating the mean with this interactive exercise from Khan Academy.
https://www.khanacademy.org/math/cc-sixth-grade-math/cc-6th-data-statistics/mean-and-median/e/calculating-the-mean

Study Jams: Mode
This site gives step-by-step illustrations of how to find the mode for a set of data.
http://studyjams.scholastic.com/studyjams/jams/math/data-analysis/mode.htm

Mean, Median, and Mode
How to calculate the mean, the median, and the mode for sets of data given in different ways. There are also interactive exercises.
http://www.cimt.org.uk/projects/mepres/book8/bk8i5/bk8_5i2.htm

Using and Handling Data
Simple explanations for finding the mean, median, or mode.
http://www.mathsisfun.com/data/central-measures.html

Measures Activity
Enter your own data and the program will calculate the mean, median, mode, range, and some other statistical measures.
http://www.shodor.org/interactivate/activities/Measures

Coordinate Grid

This is a **coordinate grid**.

The long black line across the bottom, with the "*x*" near its end, is called the ***x*-axis**.

The vertical line that has "*y*" near the top is called the ***y*-axis**.

You can see one point, called "A," that is drawn or *plotted* on the grid.

It has two numbers *associated*, or matched, with it. Those two numbers are called the **coordinates** of the point A.

The first number is called the **x-coordinate** of the point A, and the second number is called the **y-coordinate** of the point A.

The x-coordinate of the point A is 4 because if you drew a line straight down from A, it would *intersect*, or "hit," the *x*-axis at 4. The y-coordinate of the point A is 6 because if you drew a line straight left from A, it would intersect the *y*-axis at 6.

We write the two coordinates of a point inside parentheses, separated by a comma.
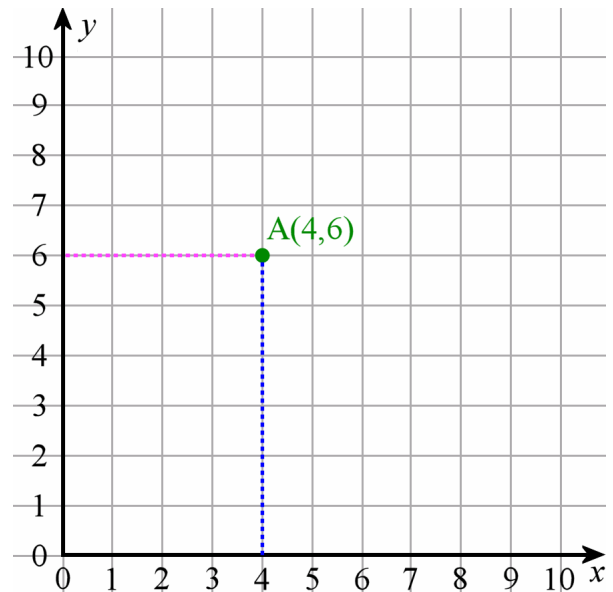
Note: The order of the two coordinates matters. The *first* number is ALWAYS the *x*-coordinate, and the *second* number is ALWAYS the *y*-coordinate, not the other way around.
So (5, 8) means that the *x*-coordinate is 5 and the *y*-coordinate is 8.

1. Write the two coordinates of the points plotted on the coordinate grid. For points A and B, the helping lines are drawn in. (The helping lines are not necessary to draw; they are just that — *helping* lines. You can draw them if they help you.)

A (___ , ___)   B (___ , ___)

C (___ , ___)   D (___ , ___)

E (___ , ___)   F (___ , ___)

G (___ , ___)   H (___ , ___)
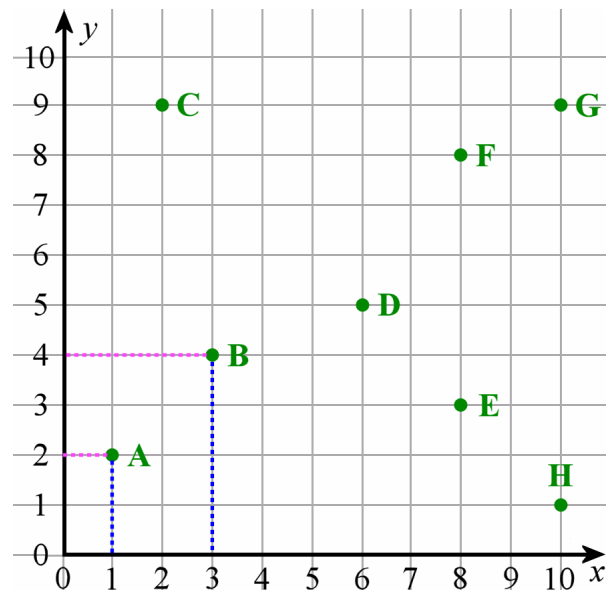
Sample worksheet from
https://www.mathmammoth.com

Notice especially the points that are located on the two axes.

If a point lies on the *y*-axis, its *x*-coordinate is zero. A is (0, 6) and B is (0, 3) .

If the point lies on the *x*-axis, its *y*-coordinate is zero. D is (5, 0) and E is (9, 0).

The point C has the coordinates (0, 0). This point (0, 0) is called the **origin**.
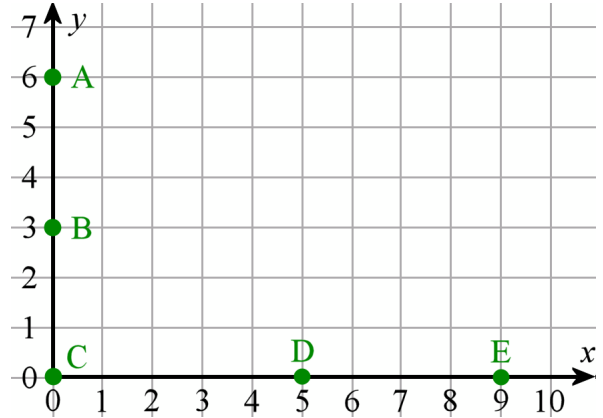
2. Plot and label the following points on the coordinate grid. (You may draw helping lines at first, but try to learn to plot the points without actually drawing them.)

A (2, 8)   B (0, 5)   C (4, 0)

D (9, 10)   E (8, 5)   F (1, 4)

G (1, 0)   H (0, 8)   I (3, 7)
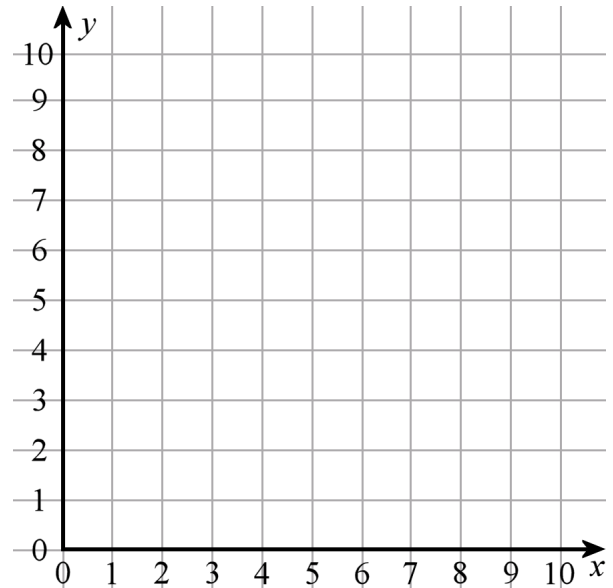
3. The coordinate grid is very useful for many things. For example, computer drawing programs use it frequently. Let's say "LINE (5,6) - (2,7)" means a straight line segment that is drawn from the point (5, 6) to the point (2, 7).

Draw the following line segments (joining the two given points). Use a ruler!
The first one is already done for you.

What figure is formed?

LINE (1, 0) - (1, 5)   LINE (1, 5) - (0, 5)

LINE (0, 5) - (4, 7)   LINE (4, 7) - (8, 5)

LINE (8, 5) - (7, 5)   LINE (3, 0) - (3, 3)

LINE (5, 0) - (5, 3)   LINE (3, 3) - (5, 3)

LINE (1, 0) - (7, 0)   LINE (7, 0) - (7, 5)
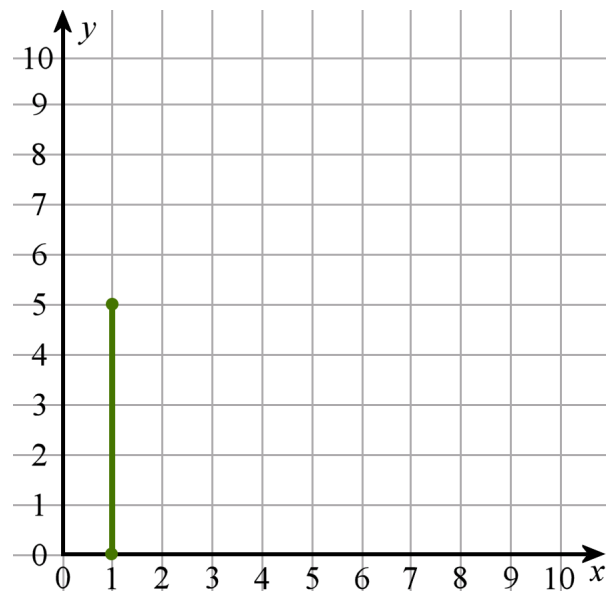
This example shows point A moving four units down and then two units to the right. The new location is called point A′ (read "A prime").

Originally A's coordinates were (1, 6). After the movement, the coordinates are (3, 2).

Notice how you can just add two units to the *x*-coordinate (movement two units to the right), and subtract four units from the *y*-coordinate (the movement four units straight down).

Point B is originally at (5, 7). It moves four units to the right and two up. You add four to the *x*-coordinate, and two to the *y*-coordinate. Its new coordinates are (9, 9).

- Movement right or left affects the *x*-coordinate.
- Movement up or down affects the *y*-coordinate.
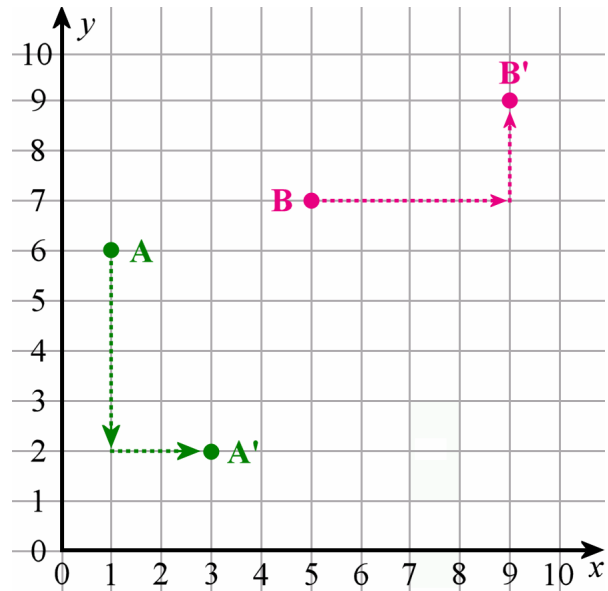
4. The three vertices of a triangle are (2, 0), (5, 1) and (3, 4). The triangle is moved three units to the right and two up.

   a. Plot the vertices of the triangle before and after the movement. Use two different colors for the two triangles.

   b. Write the coordinates of the vertices after the movement.
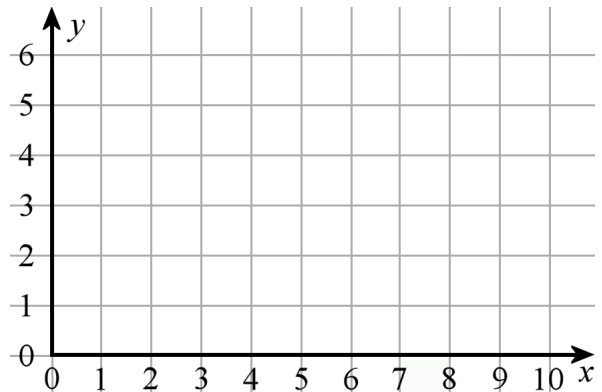
5. Determine how the line segment has been moved:

   Each point moved _____ units to the (right/left)

   and _____ units (up / down).

   Now move the triangle ABC the same way. Let's call the new triangle A′B′C′. Write the coordinates of the vertices of the triangle A′B′C′ after the movement.
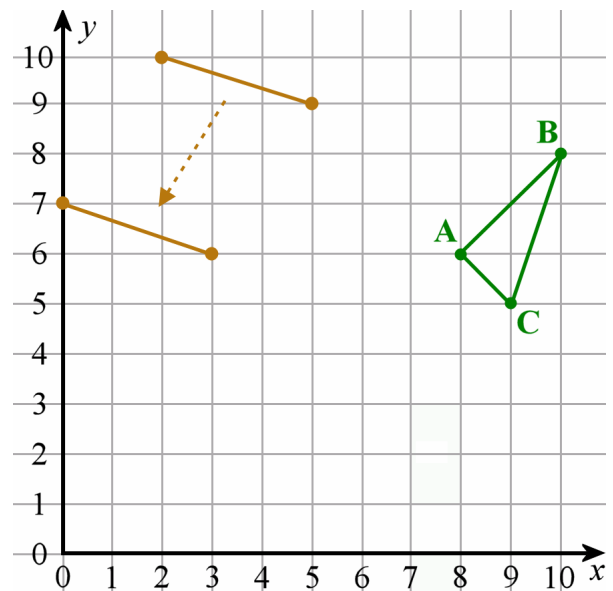
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math MAMMOTH

Grade 5-B Worktext

Decimals, part 2

Fractions: add and subtract

Fractions: multiply and divide

Geometry

By Maria Miller

Contents

3

Foreword

Math Mammoth Grade 5-B Worktext covers the second half of fifth grade mathematics studies. In part 5-A, students have studied the four operations with whole numbers, large numbers, problem solving, decimal arithmetic, and statistical graphs. In this part, 5-B, we study more about decimals, a lot about fractions and fraction arithmetic, and geometry.

Chapter 6 continues our study of decimals. The focus is on multiplying decimals by decimals, dividing decimals by decimals, and conversions between measuring units.

Chapter 7 covers the addition and subtraction of fractions—another topic of focus for 5th grade, besides decimals. The most difficult topic of this chapter is adding and subtracting unlike fractions, which is done by first converting them to equivalent fractions with a common denominator.

In chapter 8, we study the multiplication and division of fractions from various angles.

Chapter 9 takes us to geometry, starting with a review of angles and polygons. From there, students will learn to draw circles, to classify triangles and quadrilaterals, and the concept of volume in the context of right rectangular prisms (boxes).

I wish you success with teaching math!

Maria Miller, the author

Chapter 6: Decimals, Part 2
Introduction

In this chapter, we focus on decimal multiplication and division, and conversions between measurement units.

We start out with the topic of multiplying decimals by decimals. This is typically a fairly easy topic, as long as students remember the rule concerning the decimal digits in the answer. This rule could be confused with the other rules of decimal arithmetic that we also study in this chapter. In 6th grade, I provide a proof for the rule using fraction multiplication. I didn't include it here, because the chapter already contains so many new topics for students that including the justification for the rule may just cause an overload, plus, students haven't studied fraction multiplication yet.

Then we learn about multiplication as *scaling*. We cannot view decimal multiplications, such as 0.4 × 1.2, as repeated addition. Instead, they are viewed as scaling — shrinking or enlarging — the number or quantity by a scaling factor. So, 0.4 × 1.2 is thought of as scaling 1.2 by 0.4, or as four-tenths *of* 1.2. You may recognize this as the same as 40% of 1.2.

Next, we learn about decimal divisions that can be done with mental math. Students divide decimals by whole numbers (such as 0.8 ÷ 4 or 0.45 ÷ 4) by relating them to equal sharing. They divide decimals by decimals in situations where the divisor goes evenly into the dividend, thus yielding a whole-number quotient (e.g. 0.9 ÷ 0.3 or 0.072 ÷ 0.008).

In the next lesson, *More Division with Decimals*, we simply review long division with decimals, when the divisor is a whole number.

The following topic is multiplying and dividing decimals by powers of ten. This is presented with the help of place value charts. The actual concept is that the number being multiplied or divided *moves* in the place value chart, as many places as there are zeros in the power of ten. As a shortcut, we can move the decimal point. However, the movement of the decimal point is an "illusion" — that is what seems to happen — but in reality, the number itself got bigger or smaller; thus, its digits actually changed positions in the place value system.

Next, we study the metric system and how to convert various metric units (within the metric system), such as converting kilograms to grams, or dekaliters to hectoliters. The first of the two lessons mainly deals with very commonly used metric units, and we use the meaning of the prefix to do the conversion. For example, centimeter is a hundredth part of a meter, since the prefix "centi" means 1/100. Knowing that gives us a means of converting between centimeters and meters.

The second lesson deals with more metric units, even those not commonly used, such as dekaliters and hectograms, and teaches a method for conversions using a chart. These two methods for converting measuring units within the metric system are sensible and intuitive, and help students not to rely on mechanical formulas.

Then we turn our attention to dividing decimals by decimals, which then completes our study of all decimal arithmetic. The principle here is fairly simple, but it is easy to forget (multiply both the dividend and the divisor by a power of ten, until you have a whole-number divisor).

After learning that, students practice measurement conversions within the customary system, rounding measurements, and some generic problem solving with decimals. Recall that not all students need all the exercises; use your judgment.

Problems accompanied by a small picture of a calculator are meant to be solved with the help of a calculator. Otherwise, a calculator should not be allowed.

The Lessons in Chapter 6

Helpful Resources on the Internet

Decimal Arithmetic - Videos by Maria
These are my videos where I explain all about decimal arithmetic: adding, subtracting, multiplying, dividing, comparing and rounding decimals, plus some problem solving. Suitable for grades 5-6.
https://www.mathmammoth.com/videos/grade_5/5th-grade-videos.php#decimals

MULTIPLICATION

Exploring Multiplication of Decimals
Enter two numbers with one decimal digit, and you will see the product as a rectangular area.
http://www.hbschool.com/activity/elab2004/gr6/1.html

Decimals Workshop
Practice adding, subtracting, multiplying, or dividing decimals with this customizable interactive exercise.
http://mrnussbaum.com/decimals-workshop/

Multiply Decimals by Whole Numbers
Polish your decimal multiplication skills with this interactive online exercise.
https://www.khanacademy.org/math/cc-fifth-grade-math/cc-5th-arith-operations/cc-5th-mult-decimals/e/multiplying-decimals-without-the-standard-algorithm-2

Decimal Times — Mental Multiplication
Practice mental and written methods for multiplying and dividing decimal numbers in this interactive online exercise.
http://www.transum.org/Maths/Activity/Decimals/

Multiply with Decimals: Simple Word Problems
Practice multiplying decimals by whole numbers with these interactive word problems.
https://www.studyladder.com/games/activity/multiply-decimals-by-whole-numbers-22247

DIVISION (AND MULTIPLICATION)

Divide Decimals by Whole Numbers In Your Head
Practice mental division of decimals by whole numbers in this interactive exercise.
https://www.khanacademy.org/math/cc-fifth-grade-math/cc-5th-arith-operations/cc-5th-dividing-decimals/e/dividing-decimals-without-the-standard-algorithm-3

Divide Decimals by Decimals in Your Head
Practice mental division of tenths by tenths in this online exercise.
https://www.khanacademy.org/math/cc-fifth-grade-math/cc-5th-arith-operations/cc-5th-dividing-decimals/e/dividing-decimals-without-the-standard-algorithm-6

Long Division to Decimal Places
This is a short tutorial about dividing whole numbers to decimal digits. At the bottom of the page you will find a short online quiz.
https://www.mathsisfun.com/long_division3.html

Dividing Decimals
This is a short tutorial about dividing decimals, whether by whole numbers or by decimals. At the bottom of the page you will find a short online quiz.
https://www.mathsisfun.com/dividing-decimals.html

Divide and Multiply Decimals Quiz
Practice multiplying and dividing decimals by powers of ten in this 10-question quiz.
https://www.thatquiz.org/tq-3/?-j12c-l5-p0

Multiply and Divide Decimals Quiz
Use this interactive exercise to polish your decimal multiplication and division skills.
https://campus.mangahigh.com/en/px/38/0/0

Long Division - choose "Decimal division"
Enter the numbers that you want to divide and click on the button "Do division" to see a step-by-step illustration of the solution.
http://www.mathsonline.org/pages/longdiv.html

Decimal Long Division Worksheets
Use these randomly generated worksheets for extra practice.
https://www.homeschoolmath.net/worksheets/decimal_division.php#long

Multiply and Divide Decimals by Powers of Ten
Practice multiplying and dividing by powers of ten with this multiple-choice quiz.
http://www.mathgames.com/skill/6.46-multiply-and-divide-decimals-by-powers-of-ten

UNITS OF MEASUREMENT

Conversion Quizzes - ThatQuiz.org
A customizable online quiz about conversions between measuring units. The options include both metric and customary systems and six different difficulty levels.
http://www.thatquiz.org/tq-n/science/metric-system/

Horrendous Soup Game
Make a recipe for the most disgusting soup you can imagine in this fun game that practices conversion between metric units of measurement.
http://mrnussbaum.com/soup

Metric System Conversions Quiz
Practice converting between different units of measurement in the metric system with this 10-question online quiz.
https://www.thatquiz.org/tq-n/?-j17v-l4-p0

Metric Millionaire
Practice the metric system with these interactive multiple-choice word problems.
https://www.quia.com/rr/30535.html?AP_rand=837779130

Word Problems Involving Measurement Conversions
Solve word problems that involve converting between metric measures of distance, volume, and mass, as well as measures of time.
https://www.khanacademy.org/math/on-sixth-grade-math/on-measurement/on-unit-conversion/e/converting-measurements-word-problems

Inches Measurement Worksheets
Measurement worksheets for identifying specific points on an imperial inch ruler including whole inch units and fractional inch units.
https://www.dadsworksheets.com/worksheets/inches-measurement-inches-on-ruler.html

Common Conversion Factors Practice
Practice memorizing the common conversion factors in this interactive exercise.
http://www.sporcle.com/games/12121/measurement-conversion

Convert Mixed Customary Units
Practice converting customary units of measurement in this interactive online exercise.
http://www.mathgames.com/skill/5.10-convert-mixed-customary-units

Convert Customary Units
Fill in the tables to convert between US customary measures of distance, volume, and mass.
https://www.khanacademy.org/math/cc-fifth-grade-math/cc-5th-measurement-topic/cc-5th-unit-conversion/e/converting-units--us-customary-

Customary Unit Conversion Printable Worksheets
Use these randomly generated worksheets for extra practice. Refresh the page (F5) to get a different worksheet.
https://www.homeschoolmath.net/worksheets/measuring-customary.php#grade5

Converting Units - Word Problems
Solve word problems that involve converting between US customary measures of distance, volume, and mass in this interactive exercise from Khan Academy.
https://www.khanacademy.org/math/cc-fifth-grade-math/cc-5th-measurement-topic/cc-5th-unit-word-problems/e/converting-units-word-problems--us-customary-

PROBLEM SOLVING

Burnside's Billions Game
Mr. Burnsides is leaving you his fortune, but under one condition… You need to buy up his 27 favorite world landmarks in the next 40 days! This game involves foreign currency, exchange rates, and large-scale calculations involving decimals.
https://www.mrnussbaum.com/billions/

**Sample worksheet from
https://www.mathmammoth.com**

FOR REVIEW

Decimals Challenge Board
Click on the the numbers on the "Challenge Board" to get questions and earn points by answering them correctly.
https://www.quia.com/cb/95593.html

Decimal and Whole Number Jeopardy
Review place value, comparing, and rounding decimals. Also, practice number patterns.
http://www.quia.com/cb/8142.html

Multiply Decimals by Decimals

Multiplying decimals is easy! You simply multiply as if there were no decimal points. Then place the decimal point in the answer following this rule:

The answer will have **as many decimal places/digits** as there are, IN TOTAL, in all of the factors.

Example 1. 0.05×0.7	**Example 2.** $12 \times 2 \times 0.3 \times 0.2$
Multiply in your head: $5 \times 7 = 35$. The factor 0.05 has **two** and 0.7 has **one** decimal digit. The answer has to have **three**, so the answer is 0.035.	Multiply mentally: $12 \times 2 \times 3 \times 2 = 144$. The factors have 0, 0, 1, and 1 decimal digits—a total of 2. The answer has to have 2 decimal digits/places, so the answer is 1.44.

1. Multiply first as if there were no decimal points. Then add the decimal point to the answer.

a. $0.5 \times 0.3 =$ _____	**c.** $0.4 \times 0.08 =$ _____	**e.** $8 \times 0.3 =$ _____
b. $0.9 \times 0.6 =$ _____	**d.** $0.7 \times 0.02 =$ _____	**f.** $0.1 \times 2.7 =$ _____
g. $0.2 \times 0.1 =$ _____	**i.** $0.9 \times 0.01 =$ _____	**k.** $0.7 \times 0.3 =$ _____
h. $0.8 \times 0.1 =$ _____	**j.** $9 \times 0.06 =$ _____	**l.** $7 \times 0.03 =$ _____

The answer to a decimal multiplication may end in one or more *decimal* zeros. That is no problem. You may **simplify the final answer** by dropping the ending decimal zeros.

Example 3. To solve 50×0.006, first multiply in your head $50 \times 6 = 300$. The factors (50 and 0.006) have 0 and 3 decimal places, so the answer will have **3**. Therefore, the answer is 0.300, but it *simplifies* to 0.3.	**Example 4.** To solve 400×0.05, we first multiply $400 \times 5 = 2000$. The factors have 0 and 2 decimal digits, so the answer will have **2**. The answer is 20.00. You can simplify that to 20.

2. Multiply. Simplify your final answer.

a. $0.4 \times 0.5 =$ _*0.20*_ = _*0.2*_	**e.** $40 \times 0.05 =$ _____ = _____
b. $20 \times 0.06 =$ _____ = _____	**f.** $0.6 \times 0.2 \times 0.5 =$ _____ = _____
c. $3 \times 0.2 \times 0.5 =$ _____ = _____	**g.** $600 \times 0.004 =$ _____ = _____
d. $300 \times 0.002 =$ _____ = _____	**h.** $0.4 \times 0.5 \times 60 =$ _____ = _____

The shortcut to decimal multiplication

1) Multiply as if there were no decimal points.

2) Place the decimal point in the answer. The **number of decimal digits** in the answer is the **SUM** of the number of decimal digits in the factors.

Example 5. To solve 0.81×2.5, multiply **as if it was 81×25**. In other words, ignore the decimal points. (Also, "081" is the same as 81 so we can ignore the zero, too.)

Since 0.81 has *two* decimal digits, and 2.5 has *one*, the answer will have *three*. The final answer is therefore 2.025.

```
        8 1
    ×   2 5
    ─────────
        4 0 5
  + 1 6 2 0
    ─────────
    2 0 2 5
```

Does that make sense? We can estimate:

$0.81 \times 2.5 \approx 0.8 \times 3 = 2.4$
or $0.81 \times 2.5 \approx 0.8 \times 2.5 = 2$.

Yes, a final answer of 2.025 makes sense, since it is close to our estimates.

Example 6. This time, we include the decimal points when writing calculating 1.49×0.7, but even so, we multiply **as if it was 149×7**. Imagine the decimal points are not there! And there is NO need to align the decimal points like in addition and subtraction.

The final answer has *three* decimal places, since the factors have two and one, respectively.

```
        3 6
      1.4 9       ← two decimal places
    ×   0.7       ← one decimal place
    ─────────
    1.0 4 3       ← three decimal places
```

Estimate: $1.49 \times 0.7 \approx 1.5 \times 0.7 = 1.05$.

If the estimate was *not* close to our final answer, there would probably be an error somewhere.

3. Solve with long multiplication. Also, estimate. Write the longer number on top.

a. 0.3×1.19 Estimate: _____	**b.** 0.9×51.7 Estimate: _____	**c.** 204.5×0.4 Estimate: _____
d. 2.2×0.72 Estimate: _____	**e.** 5.6×2.8 Estimate: _____	**f.** 3.34×4.2 Estimate: _____

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Example 7. Strawberries cost $5.15/kg, and you buy 0.7 kg. What is the total cost?

If you were to buy 3 kilograms of strawberries, you would multiply
3 × $5.15 to find the total price. When you buy 0.7 kg, you do the
SAME: **multiply the price by 0.7.** The total cost is
0.7 × $5.15 = 3.605 (see the multiplication on the right).

Since this is a money amount, it needs rounded to two decimals: $3.61.

Note that the answer also makes sense: 0.7 kg of strawberries should
cost less than 1 kg of strawberries, which was $5.15.

```
    1 3
    5 1 5
  ×     7
  ───────
  3 6 0 5
```

4. Find the total cost. Write a multiplication.

   a. Ribbon costs $1.10 per meter, and you buy 0.4 meters.

   Cost: _____ × _____ = _____

   b. Nuts cost $8 per pound. You buy 0.3 pounds.

   Cost: _____ × _____ = _____

   c. A phone call costs $7 per hour. You talk for 1.2 hours.

   Cost: _____ × _____ = _____

   d. Lace costs $2.20 per meter, and you buy 1.5 meters.

   Cost: _____ × _____ = _____

5. Lauren went to a farmer's market, and bought
   0.4 kg of blueberries at $9.20/kg, 3.5 kg of
   potatoes at $1.20/kg, and 1.2 kg of carrots at
   1.85/kg. Find the total cost.

6. You're trying to find out how much it costs
   to feed your pet parrot for a <u>year</u>.

   You have figured that your parrot eats about
   90 grams, which is 0.09 kg, of parrot feed in
   a day. Also, parrot feed costs $7.08/kg.
   So, what is the cost of feeding your parrot
   for a year (not just a day)? Round your
   answer to the nearest dollar.

7. Multiply.

a. 0.7×1.1 = _____	**c.** 0.002×9 = _____	**e.** $0.4 \times 4 \times 0.2$ = _____
b. 0.02×0.5 = _____	**d.** 1.1×0.3 = _____	**f.** $6 \times 0.06 \times 0.2$ = _____

8. Find the missing factors.

a. $0.5 \times$ _____ $= 0.35$	**d.** $4 \times$ _____ $= 2.4$	**g.** $0.9 \times$ _____ $= 7.2$
b. $0.5 \times$ _____ $= 0.035$	**e.** $4 \times$ _____ $= 0.024$	**h.** $0.9 \times$ _____ $= 0.081$
c. $0.05 \times$ _____ $= 0.035$	**f.** $4 \times$ _____ $= 0.24$	**i.** $0.9 \times$ _____ $= 0.54$

9. Solve by long multiplication or in your head. Place the letter of each problem under the right answer, and solve the riddle.
   Hint: Sometimes you can figure out the correct answer by estimating.

0.8×2.7 U 10×0.042 S 2.09×1.7 R 200×0.008 O

1.6×2.05 D 1.5×1.5 E 70×0.05 S $0.5 \times 0.4 \times 0.7$ Y

10×0.04 L 3.45×0.7 I 0.05×2.4 E $0.01 \times 600 \times 0.2$ F

                               1.06×0.4 E 15.2×0.18 B

Riddle: *What did number 22 say to 21.21?*   *"YOU'RE...*

2.736	0.424	0.42	2.415	3.28	2.25		0.14	1.6	2.16	3.553	3.5	0.12	0.4	1.2

Multiplication as Scaling

Scaling means expanding or shrinking something by some factor.
Multiplication can be thought of <u>as scaling</u>.

This red stick ——— is 40 pixels long. Let's **scale** it to be four times as long:
 	
    ——— → ————————
 	
We can write a multiplication "equation":
 	
4 × ——— = ————————
 	
Using pixels, 4 × 40 px = 160 px.
	Now let's scale the same red stick to be 0.4 (four-tenths) as long as it is at first:
	
	    ——— → —
	
	Notice, it shrank! We write a multiplication:
	
	0.4 × ——— = —
	
	In pixels, 0.4 × 40 px = 16 px.

The number we multiply by (4 and 0.4 above) is called the **scaling factor**.

- If the scaling factor is more than 1, such as 2.3, the resulting stick is *longer* than the original one.

- If the scaling factor is less than 1, such as 0.5 or 0.66, the resulting stick is *shorter*.

1. The stick is being *shrunk*. How long will it be in pixels? Compare the problems.

a. 0.1 × ——— = .
 	
   0.1 × 40 px = _____ px
	b. 0.3 × ——— = —
	
	   0.3 × 40 px = _____ px
		c. 0.6 × ——— = —
		
		   0.6 × 40 px = _____ px

d. 0.2 × ——— = —
 	
   0.2 × 40 px = _____ px
	e. 0.5 × ——— = —
	
	   0.5 × 40 px = _____ px
		f. 0.9 × ——— = ———
		
		   0.9 × 40 px = _____ px

Let's **expand** this stick ——— (40 px) to be 1.2 times as long, like this:

1.2 × ——— = ————

In pixels, it is now 1.2 × 40 = 48 pixels long.

2. The red stick ——— is 50 pixels long. It is being *expanded*. Fill in the blanks.

a. 1.5 × ——— = ————
 	
   1.5 × 50 px = _____ px
	b. 1.3 × ——— = ————
	
	   1.3 × 50 px = _____ px

c. 2.2 × ——— = ————
 	
   2.2 × 50 px = _____ px
	d. 3.3 × ——— = —————
	
	   3.3 × 50 px = _____ px

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Chapter 7: Fractions: Add and Subtract
Introduction

In 5th grade, students study most aspects of fraction arithmetic: addition, subtraction, multiplication, and then in some special cases, division. Division of fractions is studied in more detail in 6th grade.

This chapter starts out with lessons on various ways to add and subtract mixed numbers. These are meant partially to review and partially to develop speed in fraction calculations. The lesson *Subtracting Mixed Numbers 2* presents an optional way to subtract, where we use a negative fraction. This is only meant for students who can easily grasp subtractions such as $(1/5) − (4/5) = −3/5$, and is not intended to become a "stumbling block." Simply skip the method if your student does not understand it easily.

Students have already added and subtracted *like* fractions in fourth grade. Now it is time to "tackle" the more complex situation of *unlike* fractions. To that end, we first review how to convert fractions into other equivalent fractions. These lessons use a visual model of splitting pie pieces further, and from that, we develop the common procedure for equivalent fractions.

This skill is used immediately in the next lessons about adding and subtracting unlike fractions. We begin this topic by using visual models, and then gradually advance toward the abstract. Several lessons are devoted to understanding and practicing the basic concept, and also to applying this new skill to mixed numbers.

The lesson *Comparing Fractions* reviews some mental math methods for comparing fractions. Students also learn a "brute force" method based on converting fractions to equivalent fractions. This chapter ends with a lesson on measuring in inches, using units as small as 1/16 of an inch.

The Lessons in Chapter 7

Helpful Resources on the Internet

MIXED NUMBERS

Clara Fraction Ice Cream Shop
Convert improper fractions to mixed numbers, while scooping various ice cream flavors onto the cone.
https://mrnussbaum.com/clarafraction/

Fraction Models
Explore improper fractions, mixed numbers, decimals, and percentages using several models: bar, area, pie, and set. Adjust numerators and denominators to see how they alter the models.
http://illuminations.nctm.org/Activity.aspx?id=3519

Fractions Workshop
Choose "Add mixed fractions with like denominators" and the number of problems you would like to do.
https://mrnussbaum.com/fractions-workshop-ipad.html

Subtracting Mixed Fractions Quiz (Like Denominators)
Drag and drop each answer to the corresponding subtraction problem.
http://www.fractions4kids.com/subtracting-mixed-fractions-quiz/

Subtracting Mixed Numbers with Borrowing
Learn how to borrow mixed fractions with this animation.
https://www.wisc-online.com/learn/formal-science/mathematics/abm701/subtracting-mixed-number-fractions-with-borro

EQUIVALENT FRACTIONS

Equivalent Fractions
You are given a fraction that is shown with a visual model and on a number line, and you need to construct two *other* fractions that are equivalent to the given fraction. Drag two sliders to choose the denominators for your fractions and then click pieces to color them.
http://illuminations.nctm.org/Activity.aspx?id=3510

Fresh Baked Fractions
Practice equivalent fractions by clicking on a fraction that is not equal to others.
http://www.funbrain.com/fract/

Triplets: Equivalent Fractions
Sort the space teams by equivalent fractions to make sure all the athletes get to the correct starting place before the games begin.
https://www.mathplayground.com/Triplets/index.html

Fishy Fractions
Feed Ulani the pelican by choosing the fish with the correct equivalent fraction.
http://streaming.discoveryeducation.com/braingames/iknowthat/Fractions/FractionGame.cfm?Topic=equivalentfractions

Fraction Worksheets: Equivalent Fractions with Visual Models
Create custom-made worksheets for equivalent fractions. Choose to include pie images or not.
https://www.homeschoolmath.net/worksheets/equivalent_fractions.php

Sample worksheet from
https://www.mathmammoth.com

Fraction Worksheets: Equivalent Fractions, Simplifying, Convert to Mixed Numbers
Create custom-made worksheets for these fraction operations.
https://www.homeschoolmath.net/worksheets/fraction-b.php

ADDITION AND SUBTRACTION

Fraction Videos 1: Addition and Subtraction
A set of videos by the author that cover topics in this chapter.
https://www.mathmammoth.com/videos/fractions_1.php

Adding Fractions with Uncommon Denominators Tool at Conceptua Fractions
A tool that links a visual model to the procedure of adding two unlike fractions.
https://www.conceptuamath.com/app/tool/adding-fractions-with-uncommon-denominators

Add Unlike Fractions with Number Line Models
Practice adding unlike fractions. Click "EXPLAIN" to see a visual illustration and the answer.
http://www.visualfractions.com/AddUnlike/

Drop Zone
Practice making a sum of one using fractions in this interactive online activity.
https://www.brainpop.com/games/dropzone/

Add Mixed Numbers with Unlike Denominators - Quiz
Use this simple online quiz for extra practice.
http://www.mathgames.com/skill/5.72-add-mixed-numbers-with-unlike-denominators

Fruit Shoot Fractions
This game practices addition of fractions. There are several different levels to choose from.
http://www.sheppardsoftware.com/mathgames/fractions/FruitShootFractionsAddition.htm

Fruit Splat
Practice finding the least common denominator. This game has three different levels to choose from.
http://www.sheppardsoftware.com/mathgames/fractions/LeastCommonDenomimator.htm

Fraction Word Problems
Practice adding and subtracting fractions with these interactive word problems.
https://mrnussbaum.com/grade5standards/568-2/

Math Balloons: Fractions
Answer whether the fraction additions are true or false in this timed activity.
http://www.mathnook.com/math/math-balloons-fractions.html

Fraction Bars Blackjack
The computer gives you two fraction cards. You have the option of getting more or "holding". The object is to get as close as possible to 2, without going over, by adding the fractions on your cards.
http://fractionbars.com/Fraction_Bars_Black_Jack/

Old Egyptian Fractions
Puzzles to solve: add fractions like a true Old Egyptian Math Cat!
http://www.mathcats.com/explore/oldegyptianfractions.html

Fraction Worksheets: Addition, Subtraction, Multiplication, and Division
Create custom-made worksheets for the four operations with fractions and mixed numbers.
https://www.homeschoolmath.net/worksheets/fraction.php

ORDERING AND COMPARING

Comparing Fractions Tool at Conceptua Fractions
An interactive tool where students place numbers, visual models, and decimals on a number line.
http://www.conceptuamath.com/app/tool/comparing-fractions

Comparison Shoot Out
Choose level 2 or 3 to compare fractions and shoot the soccer ball to the goal.
http://www.fuelthebrain.com/games/comparison-shootout/

Comparing Fractions—XP Math
Simple timed practice with comparing two fractions.
http://xpmath.com/forums/arcade.php?do=play&gameid=8

Visual Fractions Game
Find a fraction between two given fractions with the help of this visual tool.
https://www.mathplayground.com/visual_fractions.html

Fractional Hi Lo
The computer has selected a fraction. You make guesses and it tells if your guess was too high or low.
http://www.theproblemsite.com/games/hilo.asp

My Closest Neighbor
A neat card game where you need to make a fraction that is as close as possible to the given fraction.
https://denisegaskins.com/2014/08/06/fraction-game-my-closest-neighbor/

Comparing/Ordering Fractions Worksheets
Create customizable worksheets for comparing or ordering fractions. You can include pie images.
https://www.homeschoolmath.net/worksheets/comparing_fractions.php

MEASURING & GENERAL

Measure It!—Practice measuring lines in inches.
https://www.funbrain.com/measure/

Measuring—Practice measuring with a virtual ruler. Choose the category "Inches, Sixteenths".
http://www.abcya.com/measuring.htm

Sal's Sub Shop—Cut the subs to the given measurements.
https://mrnussbaum.com/sal/

Fraction Word Problems
Practice your fraction skills with this interactive jeopardy game.
https://jeopardylabs.com/play/fraction-word-problems

Who Wants Pizza?—A tutorial and interactive exercises about fraction addition and multiplication.
http://math.rice.edu/~lanius/fractions/

Fraction Lessons—Tutorials, examples, and videos explaining all the basic fraction topics.
http://www.mathexpression.com/learning-fractions.html

Online Fraction Calculator
https://www.homeschoolmath.net/worksheets/fraction_calculator.php

Fraction Terminology

As we study fraction operations, it is important that you understand the terms, or words, that we use. This page is for reference. You can post it on your wall or even make your own fraction poster based on it. Some of the terms below you already know; some we will study in this chapter.

$\dfrac{3}{11}$ The top number is the **numerator**. It *enumerates,* or numbers (counts), *how many* pieces there are.
The bottom number is the **denominator**. It *denominates,* or names, *what kind* of parts they are.

A mixed number has two parts: a whole-number part and a fractional part.

For example, $2\dfrac{3}{7}$ is a mixed number. Its whole-number part is 2, and its fractional part is $\dfrac{3}{7}$.

The mixed number $2\dfrac{3}{7}$ actually means $2 + \dfrac{3}{7}$.

Like fractions have the same denominator. They have the same kind of parts. It is easy to add and subtract like fractions, because all you have to do is look at *how many* of that kind of part there are.
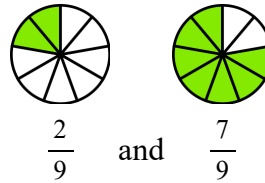
$\dfrac{2}{9}$ and $\dfrac{7}{9}$ are like fractions.

Unlike fractions have a different denominator. They have different kinds of parts. It is a little more complicated to add and subtract unlike fractions. You need to first change them into like fractions. Then you can add or subtract them.
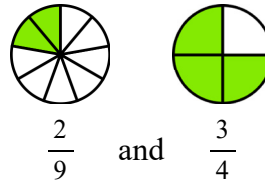
$\dfrac{2}{9}$ and $\dfrac{3}{4}$ are unlike fractions.

A proper fraction is a fraction that is less than 1 (less than a whole pie). 2/9 is a proper fraction.

$\dfrac{2}{9}$ is a proper fraction.

An improper fraction is more than 1 (more than a whole pie). Being a *fraction*, it is written as a fraction and *not* as a mixed number.
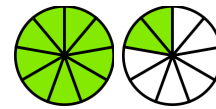
$\dfrac{11}{9}$ is an improper fraction.

Equivalent fractions are equal in value. If you think in terms of pies, they have the same amount of "pie to eat," but they are written using different denominators, or are "cut into different kinds of slices."
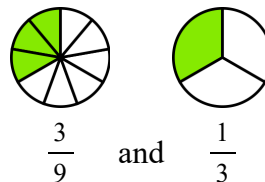
$\dfrac{3}{9}$ and $\dfrac{1}{3}$ are equivalent fractions.

Simplifying or reducing a fraction means that, for a given fraction, you find an equivalent fraction that has a "simpler," or smaller, numerator and denominator. (It has fewer but bigger slices.)
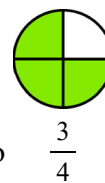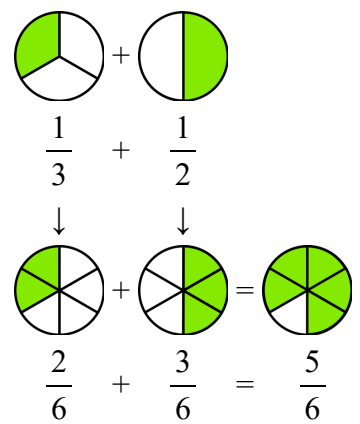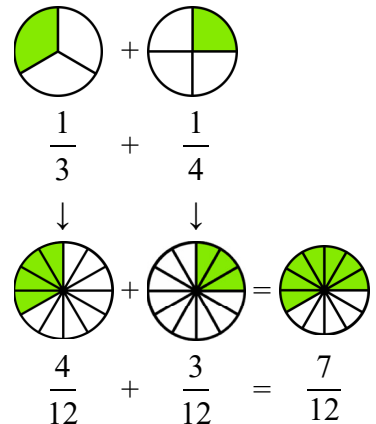
$\dfrac{9}{12}$ simplifies to $\dfrac{3}{4}$.

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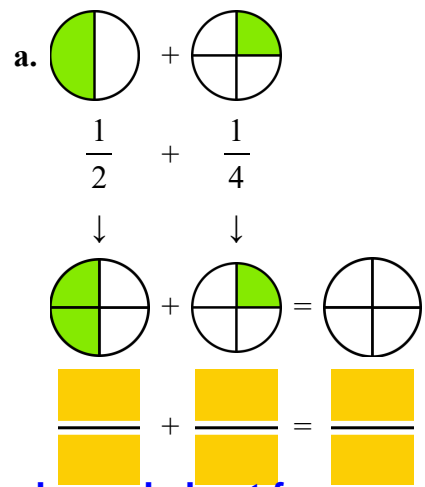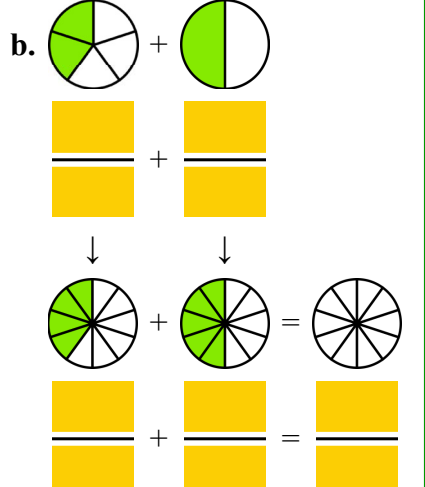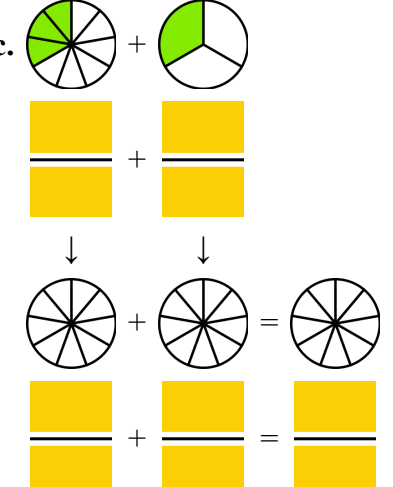
Adding and Subtracting Unlike Fractions

Cover the page below the black line. Then try to figure out the addition problems below.

$\dfrac{1}{3}$ + $\dfrac{1}{2}$ = What fraction would this be?

$\dfrac{1}{3}$ + $\dfrac{1}{4}$ = What fraction would this be?

$\dfrac{1}{3}$ + $\dfrac{1}{2}$

↓ ↓

$\dfrac{2}{6}$ + $\dfrac{3}{6}$ = $\dfrac{5}{6}$

$\dfrac{1}{3}$ + $\dfrac{1}{4}$

↓ ↓

$\dfrac{4}{12}$ + $\dfrac{3}{12}$ = $\dfrac{7}{12}$
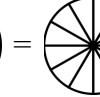
Did you solve the problems above?

The solution is this:

We convert the fractions so that they become *like* fractions (with a same denominator), using equivalent fractions.
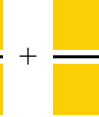
Then we can add or subtract.
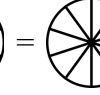
1. Write the fractions shown by the pie images. Convert them into equivalent fractions with the same denominator (like fractions), and then add them. Color the missing parts.

a.

$\dfrac{1}{2}$ + $\dfrac{1}{4}$

↓ ↓

b.

c.

2. Convert the fractions to like fractions first, then add or subtract. In the bottom problems (d-f), you need to figure out what kind of pieces to use, but the *top* problems (a-c) will help you do that!

a. $\frac{1}{2} + \frac{1}{6}$

$\downarrow \qquad \downarrow$

$\square + \frac{1}{6} = \square$

b. $\frac{1}{8} + \frac{1}{4}$

$\downarrow \qquad \downarrow$

$\frac{1}{8} + \square = \square$

c. $\frac{1}{6} + \frac{1}{4}$

$\downarrow \qquad \downarrow$

$\square + \square = \square$

d. $\frac{5}{6} - \frac{1}{2}$

$\downarrow \qquad \downarrow$

$\frac{5}{6} - \square = \square$

e. $\frac{5}{8} - \frac{1}{4}$

$\downarrow \qquad \downarrow$

$\square - \square = \square$

f. $\frac{5}{6} - \frac{1}{4}$

$\downarrow \qquad \downarrow$

$\square - \square = \square$

3. Convert the fractions to like fractions first, then add or subtract. In the bottom problems (d-f), you need to figure out what kind of pieces to use, but the *top* problems (a-c) will help you do that!

a. $\frac{1}{2} + \frac{1}{8}$

$\downarrow \qquad \downarrow$

$\square + \square = \square$

b. $\frac{3}{10} + \frac{1}{5}$

$\downarrow \qquad \downarrow$

$\square + \square = \square$

c. $\frac{2}{5} + \frac{1}{2}$

$\downarrow \qquad \downarrow$

$\square + \square = \square$

d. $\frac{1}{2} + \frac{3}{8}$

$\downarrow \qquad \downarrow$

$\square + \square = \square$

e. $\frac{9}{10} - \frac{2}{5}$

$\downarrow \qquad \downarrow$

$\square - \square = \square$

f. $\frac{4}{5} - \frac{1}{2}$

$\downarrow \qquad \downarrow$
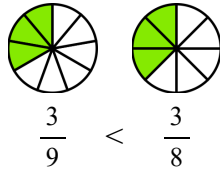
$\square - \square = \square$

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Comparing Fractions

Sometimes it is easy to know which fraction is the greater of the two. Study the examples!

$$\frac{7}{9} > \frac{2}{9}$$
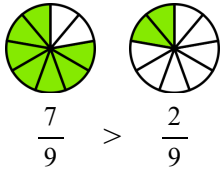
With **like fractions**, all you need to do is to check **which fraction has more "slices,"** and that fraction is greater.

$$\frac{3}{9} < \frac{3}{8}$$

If both fractions have the **same number of pieces**, then the one with bigger pieces is greater.

$$\frac{4}{7} > \frac{5}{12}$$
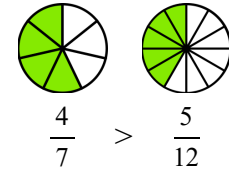
Sometimes you can **compare to 1/2**. Here, 4/7 is clearly more than 1/2, and 5/12 is clearly less than 1/2.

1. Find the fractions that are more than 1/2.

$$\frac{2}{5} \qquad \frac{5}{8} \qquad \frac{5}{6} \qquad \frac{5}{12} \qquad \frac{10}{21} \qquad \frac{8}{14} \qquad \frac{4}{10} \qquad \frac{28}{50}$$
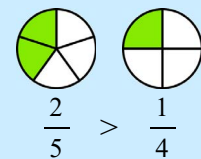
2. Compare the fractions, and write > , < , or = .

a. $\frac{1}{8}$ $\frac{1}{10}$	**b.** $\frac{4}{9}$ $\frac{1}{2}$	**c.** $\frac{6}{10}$ $\frac{1}{2}$	**d.** $\frac{3}{9}$ $\frac{3}{7}$
e. $\frac{4}{7}$ $\frac{6}{13}$	**f.** $\frac{7}{4}$ $\frac{7}{6}$	**g.** $\frac{5}{14}$ $\frac{5}{9}$	**h.** $\frac{4}{20}$ $\frac{2}{20}$
i. $\frac{2}{11}$ $\frac{2}{5}$	**j.** $\frac{13}{27}$ $\frac{5}{8}$	**k.** $\frac{12}{24}$ $\frac{1}{2}$	**l.** $\frac{1}{20}$ $\frac{1}{8}$

A fraction that is more than one (like 6/5) must be bigger than a fraction that is less than one.

$$\frac{6}{5} > \frac{9}{10}$$

In some cases, you might be able to imagine pie pictures in your mind, and "see" which fraction is bigger.

$$\frac{2}{5} > \frac{1}{4}$$

3. Compare the fractions, and write > , < , or = .

a. $\frac{3}{4}$ $\frac{8}{5}$	**b.** $\frac{8}{7}$ $\frac{3}{3}$	**c.** $\frac{49}{100}$ $\frac{61}{100}$	**d.** $\frac{7}{9}$ $\frac{8}{7}$
e. $\frac{9}{10}$ $\frac{3}{4}$	**f.** $\frac{6}{5}$ $\frac{9}{12}$	**g.** $\frac{4}{4}$ $\frac{9}{11}$	**h.** $\frac{1}{3}$ $\frac{3}{9}$

Sometimes none of the "tricks" explained in the previous page work, but we do have one more up our sleeve!

Convert both fractions into like fractions. Then compare.

In the picture on the right, it is hard to be sure if 3/5 is really more than 5/9. Convert both into 45th parts, and then it is easy to see that 27/45 is more than 25/45. Not by much, though!

$$\frac{3}{5} \qquad \frac{5}{9}$$
$$\downarrow \qquad \downarrow$$
$$\frac{27}{45} \quad > \quad \frac{25}{45}$$
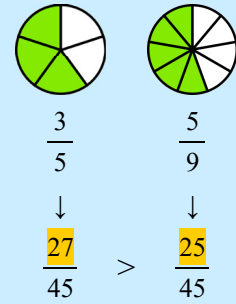
4. Convert the fractions into like fractions, and then compare them.

a.	$\frac{2}{3}$ $\downarrow$	$\frac{5}{8}$ $\downarrow$	b.	$\frac{5}{6}$ $\downarrow$	$\frac{7}{8}$ $\downarrow$	c.	$\frac{1}{3}$ $\downarrow$	$\frac{3}{10}$ $\downarrow$	d.	$\frac{8}{12}$ $\downarrow$	$\frac{7}{10}$ $\downarrow$
e.	$\frac{5}{8}$ $\downarrow$	$\frac{7}{12}$ $\downarrow$	f.	$\frac{11}{8}$ $\downarrow$	$\frac{14}{10}$ $\downarrow$	g.	$\frac{6}{10}$ $\downarrow$	$\frac{58}{100}$ $\downarrow$	h.	$\frac{6}{5}$ $\downarrow$	$\frac{11}{9}$ $\downarrow$
i.	$\frac{7}{10}$ $\downarrow$	$\frac{5}{7}$ $\downarrow$	j.	$\frac{43}{100}$ $\downarrow$	$\frac{3}{10}$ $\downarrow$	k.	$\frac{9}{8}$ $\downarrow$	$\frac{8}{7}$ $\downarrow$	l.	$\frac{7}{10}$ $\downarrow$	$\frac{2}{3}$ $\downarrow$

5. One cookie recipe calls for 1/2 cup of sugar. Another one calls for 2/3 cup of sugar. Which uses more sugar, a triple batch of the first recipe, or a double batch of the second?

How much more?

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Chapter 8: Fractions: Multiply and Divide
Introduction

This is another long chapter devoted solely to fractions. It rounds out our study of fraction arithmetic. (If you feel that your student(s) would benefit from taking a break from fractions, you can optionally have them study chapter 9 on geometry in between chapters 7 and 8.)

We start out by simplifying fractions. Since this process is the opposite of making equivalent fractions, studied in chapter 7, it should be relatively simple for students to understand. We also use the same visual model, just backwards: This time the pie pieces are joined together instead of split apart.

Next comes multiplying a fraction by a whole number. Since this can be solved by repeated addition, it is not a difficult concept at all.

Multiplying a fraction by a fraction is first explained as taking a certain part of a fraction, in order to teach the concept. After that, students are shown the usual shortcut for the multiplication of fractions.

Simplifying before multiplying is a process that is not absolutely necessary for fifth graders. I have included it here because it prepares students for the same process in future algebra studies and because it makes fraction multiplication easier. I have also tried to include explanations of *why* we are allowed to simplify before multiplying. These explanations are actually *proofs*. I feel it is a great advantage for students to get used to mathematical reasoning and proof methods well before they start high school geometry.

Then, we find the area of a rectangle with fractional side lengths, and show that the area is the same as it would be found by multiplying the side lengths. Students multiply fractional side lengths to find areas of rectangles, and represent fraction products as rectangular areas.

Students also multiply mixed numbers, and study how multiplication can be seen as resizing or scaling. This means, for example, that the multiplication $(2/3) \times 18$ km can be thought of as finding two-thirds of 18 km.

Next, we study division of fractions in special cases. The first one is seeing fractions *as* divisions; in other words recognizing that 5/3 is the same as $5 \div 3$. This of course gives us a means of dividing whole numbers and getting fractional answers (for example, $20 \div 6 = 3 \, 2/6$).

Then students encounter the shortcut or rule for fraction division: each division is actually changed into a *multiplication* by the reciprocal of the divisor. While this rule is presented here in 5th grade, students are not required to master fraction division in all cases (such as with mixed numbers). We focus on divisions where the divisor and dividend are whole numbers unit fractions. However, I have also included some problems with non-unit fractions.

After introducing the shortcut, students study two main contexts and real-life applications for fraction division: sharing divisions and so- called "measurement divisions", where we think how many times the divisor "fits into" the dividend.

The Lessons in Chapter 8

Helpful Resources on the Internet

Fraction Videos 2: Multiplication and Division
My own videos that cover multiplying and dividing fractions.
https://www.mathmammoth.com/videos/fractions_2.php

REDUCING/SIMPLIFYING FRACTIONS

Canceling Demonstration
Watch a movie that uses circles to demonstrate how to rename to lowest terms with canceling.
http://www.visualfractions.com/cancel/

Reduce Fractions Shoot
Reduce the fraction on the screen to the lowest terms by clicking the correct answer.
http://www.sheppardsoftware.com/mathgames/fractions/reduce_fractions_shoot.htm

Fraction Worksheets: Simplifying and Equivalent Fractions
Create custom-made worksheets for fraction simplification and equivalent fractions.
https://www.homeschoolmath.net/worksheets/fraction.php

Speedway Fractions
Add and subtract fractions, simplifying your answer. Power up your race car and win first place!
https://www.mathplayground.com/ASB_Speedway.html

Reducing Fractions to Lowest Terms
Simple worksheet exercise that you can use for extra practice.
http://www.mathgames.com/skill/3.46-reducing-fractions-to-lowest-terms

Fractions America
Turn the United States ablaze in color, then determine what fraction of the states are each color. Choose from 2, 3, 4, 5, 6, 7, or 8 fractions.
https://mrnussbaum.com/fraction-america/

Frosty Fractions
Add together the two fractions given. If the answer is available on the board, place a snowflake token over it. The winner is the first player to get a straight line of three snowflakes, either horizontally, vertically, or diagonally (this game is for two players).
http://www.counton.org/games/map-fractions/frosty/

FRACTION MULTIPLICATION

Multiply Fractions by Whole Numbers
Use this simple online exercise for additional practice as needed.
http://www.mathgames.com/skill/4.67-multiply-fractions-by-whole-numbers

Multiply Fractions and Whole Numbers
Practice multiplying a whole number times a fraction in this online exercise.
https://www.khanacademy.org/math/pre-algebra/fractions-pre-alg/multiplying-fractions-pre-alg/e/multiplying_fractions_by_integers

Interactive Model for the Multiplication of Fractions
In this interactive activity, you will see how to use area models to multiply fractions.
https://www.learner.org/courses/learningmath/number/session9/part_a/try.html

Fraction Multiplication TeacherTool
Students multiply two fractions together and use an area model to represent the product. Scroll down to "Fifth Grade Multiplication and Division" and click on "Fraction Multiplication 2".
http://www.dreambox.com/teachertools

Soccer Math - Multiplying Fractions
Answer the multiple-choice fraction multiplication problems and play soccer in between the questions.
http://www.math-play.com/soccer-math-multiplying-fractions-game/multiplying-fractions-game.html

Snow Sprint Fractions
Practice fraction multiplication while participating in a snowmobile race!
http://www.mathplayground.com/ASB_SnowSprint.html

Multiply Fractions with Models
Use this simple online exercise for additional practice as necessary.
http://www.mathgames.com/skill/5.109-multiply-fractions-with-models

Product Fractions Card Activity (p. 36 of the PDF)
In this activity, players work in pairs to multiply fractions. This is not a "game", as such, but rather an opportunity for students to work collaboratively and manipulate the problems.
http://www.pepnonprofit.org/uploads/2/7/7/2/2772238/acing_math.pdf

Multiply Mixed Numbers Quiz
Practice multiplying mixed numbers. Express the answers as mixed numbers and in lowest terms.
https://www.thatquiz.org/tq-3/?-j304-la-p0

**Sample worksheet from
https://www.mathmammoth.com**

Fraction Multiplication Quiz
Practice multiplying like and unlike fractions in this 10-question interactive quiz.
http://www.thegreatmartinicompany.com/Math-Quick-Quiz/fraction-multiply-quiz.html

Multiplying Fractions Word Problems
Solve and interpret fraction multiplication word problems in this interactive exercise from Khan Academy.
https://www.khanacademy.org/math/arithmetic/fractions/multiplying-fractions-word-probl/e/multiplying-fractions-by-fractions-word-problems

Fraction Multiplication as Scaling
Interpret how multiplying by a fraction greater or less than 1 affects the product in this interactive online exercise.
https://www.khanacademy.org/math/pre-algebra/fractions-pre-alg/multiplying-fractions-pre-alg/e/fraction-multiplication-as-scaling

Top Transfer
Begin at the "Start" with 100 on your calculator. What is the largest and smallest total you can end up with at the "Finish"?
https://www.transum.org/Software/SW/Starter_of_the_day/starter_December7.ASP

Who Wants Pizza?
A tutorial that explains fraction multiplication using a pizza, followed by some interactive exercises.
http://math.rice.edu/~lanius/fractions/

Multiply Fractions Jeopardy
Jeopardy-style game. Choose a question by clicking on the tile that shows the points you will win.
http://www.quia.com/cb/95583.html

Multiplying Fractions
Multiply the fractions shown and reduce to the answer to the lowest terms.
http://www.mathplayground.com/fractions_mult.html

Fraction of a Number
Practice finding fractional parts of various numbers in this interactive online exercise.
https://www.mathplayground.com/fractions_fractionof.html

FRACTION DIVISION

Divide Fractions by Whole Numbers - Word Problems
These are simple word problems which can be used to reinforce the topic of division with fractions.
http://www.mathgames.com/skill/5.94-divide-fractions-by-whole-numbers

Dividing Unit Fractions by Whole Numbers
Use this simple interactive exercise to reinforce fraction division skills.
https://www.khanacademy.org/math/arithmetic/fractions/dividing-fractions-tutorial/e/dividing_fractions_0.5

Dividing Whole Numbers by Unit Fractions
Practice dividing a whole number by a unit fraction in this interactive exercise.
https://www.khanacademy.org/math/arithmetic/fractions/dividing-fractions-tutorial/e/dividing_fractions

Fractions as Divisions
In this educational video, Sal shows how a/b and a÷b are equivalent. That is, the fraction bar and the division symbol mean the same thing.
https://www.khanacademy.org/math/cc-fifth-grade-math/cc-5th-fractions-topic/tcc-5th-fractions-as-division/v/fractions-as-division

Partitive Division of Fractions Tool
This tool provides you with a connection between a story problem (context), paraphrase, model, and procedure where a fractional value is shared equally. Students complete phrases like: 5 4/5 shared equally among 12. They use a double number line or an area model to visualize the answer, and they connect this understanding to the numeric procedure.
https://www.conceptuamath.com/app/tool/divide-partitive

Fractions as Divisions Word Problems
Practice word problems that involve using the fraction bar as division in this interactive exercise.
https://www.khanacademy.org/math/cc-fifth-grade-math/cc-5th-fractions-topic/tcc-5th-fractions-as-division/e/understanding-fractions-as-division--word-problems

Dividing Fractions: Word Problems
Solve word problems by dividing fractions by fractions in this interactive exercise.
https://www.khanacademy.org/math/arithmetic/fractions/div-fractions-fractions/e/dividing-fractions-by-fractions-word-problems

Seven Cookies for Grampy
Make seven whole cookies for Grampy by rearranging the fractional parts of other whole cookies.
http://www.visualfractions.com/sevencookies/

Fraction Worksheets: Addition, Subtraction, Multiplication, and Division
Create custom-made worksheets for fraction addition, subtraction, multiplication, and division.
http://www.homeschoolmath.net/worksheets/fraction.php

Thinking Blocks: Ratio Word Problems
Model and solve word problems with ratios using this interactive bar model tool.
http://www.mathplayground.com/tb_ratios/index.html

GENERAL

Visual Fractions
A great site for studying all aspects of fractions, including: identifying, renaming, comparing, addition, subtraction, multiplication, division.
http://www.visualfractions.com/

Visual Fraction Calculator
This fraction calculator can perform addition, subtraction, multiplication, or division of two fractions. The values for the calculation can be simple or mixed fractions, or consist of only wholes. Input of improper fractions is also allowed.
http://www.dadsworksheets.com/fraction-calculator.html

Conceptua Math Fractions Tools
Free and interactive fraction tools. Each activity uses several models, such as circles, horizontal and vertical bars, number lines, etc. that allow students to develop a conceptual understanding of fractions.
http://www.conceptuamath.com/app/tool-library

Fraction Lessons at MathExpression.com
Tutorials, examples, and videos explaining all the basic fraction topics.
http://www.mathexpression.com/learning-fractions.html

Online Fraction Calculator
Add, subtract, multiply, or divide fractions and mixed numbers.
https://www.homeschoolmath.net/worksheets/fraction_calculator.php

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Multiply Fractions by Fractions 1

We have studied how to find a fractional part of a whole number using multiplication.

For example, $\dfrac{3}{5}$ of 80 is written as the multiplication $\dfrac{3}{5} \times 80 = \dfrac{240}{5} = 48$.

REMEMBER: The word "of" translates here into **multiplication**.

We can use the same idea to find a fractional part of a fraction.

Example 1. One-half of ⬤ is ⬤ .

As a multiplication, $\dfrac{1}{2} \times \dfrac{1}{3} = \dfrac{1}{6}$.

Example 2. One-fourth of ⬤ is ⬤ .

As a multiplication, $\dfrac{1}{4} \times \dfrac{1}{3} = \dfrac{1}{12}$.

1. Find a fractional part of the given fraction. You can think of a leftover pizza piece, which you must share equally with one, two, or three other people. Write a multiplication sentence.

a. Find $\dfrac{1}{2}$ of $\quad \dfrac{1}{2} \times \dfrac{1}{4} =$	**b.** Find $\dfrac{1}{2}$ of $\quad$ □ × □ = □	**c.** Find $\dfrac{1}{2}$ of $\quad$ □ × □ = □
d. Find $\dfrac{1}{3}$ of	**e.** Find $\dfrac{1}{3}$ of	**f.** Find $\dfrac{1}{3}$ of
g. Find $\dfrac{1}{4}$ of	**h.** Find $\dfrac{1}{4}$ of	**i.** Find $\dfrac{1}{4}$ of

Did you notice a shortcut?

| **Shortcut: multiplying fractions of the type 1/n** |
| To multiply fractions of the form 1/*n* where *n* is a whole number, simply multiply the denominators to get the new denominator. $\quad\rightarrow\quad \dfrac{1}{4} \times \dfrac{1}{5} = \dfrac{1}{20}$ or $\dfrac{1}{2} \times \dfrac{1}{6} = \dfrac{1}{12}$ |

2. Multiply.

| **a.** $\dfrac{1}{9} \times \dfrac{1}{2}$ | **b.** $\dfrac{1}{13} \times \dfrac{1}{3}$ | **c.** $\dfrac{1}{5} \times \dfrac{1}{20}$ |

We have now studied how to find 1/2 or 1/3 or 1/5 of some fractions. What about finding some other kind of fractional part? Let's again compare this to finding fractional parts of whole numbers.
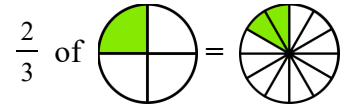
Review: To find $\dfrac{3}{4}$ of 16, or in other words $\dfrac{3}{4} \times 16$, you can first find $\dfrac{1}{4}$ of 16, which is 4.

Then just take that three times, which is 12. In other words, $\dfrac{3}{4} \times 16 = 12$.

We can use the same idea when finding a fractional part of another fraction.

Example 3. Find $\dfrac{2}{3}$ of $\dfrac{1}{4}$. First, we find $\dfrac{1}{3}$ of $\dfrac{1}{4}$, which is $\dfrac{1}{12}$.

Then, $\dfrac{2}{3}$ of $\dfrac{1}{4}$ is double that much, or $\dfrac{2}{12}$.

$\dfrac{2}{3}$ of =

Example 4. Find $\dfrac{4}{5}$ of $\dfrac{1}{7}$.

First, we find $\dfrac{1}{5}$ of $\dfrac{1}{7}$, which is $\dfrac{1}{35}$. Then, $\dfrac{4}{5}$ of $\dfrac{1}{7}$ is four times that much, or $\dfrac{4}{35}$.

Multiplying a fraction by a fraction means taking that fractional part *of* the fraction.
It is just like taking a certain part of the leftovers, when what is left over is a fraction.

3. The pictures show how much pizza is left, and you get a certain part of the leftovers.
   How much will you get? Color in a picture to show the answer.

a. $\dfrac{3}{4} \times$ =	**b.** $\dfrac{2}{3} \times$ =
c. $\dfrac{3}{4} \times$ =	**d.** $\dfrac{2}{3} \times$ =
e. $\dfrac{2}{5} \times$ =	**f.** $\dfrac{4}{5} \times$ =

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Chapter 9: Geometry
Introduction

This chapter includes many problems that involve drawing geometric figures, because drawing is an excellent help towards achieving a conceptual understanding of geometry. Most of those are marked with " ", meaning the exercise is to be done in a notebook or on blank paper.

The chapter starts out with lessons that review topics from previous grades, such as measuring angles, the vocabulary of basic shapes, how to draw a perpendicular line through a given point on a line, and how to draw a triangle with given angle measurements. Some fun is included, too, with star polygons.

In the lesson about circles, we learn the terms circle, radius, and diameter. Students are introduced to a compass, and they draw circles and circle designs using a compass.

Then we go on to classify quadrilaterals and learn the seven different terms used for them. The focus is on understanding the classification, and understanding that attributes defining a certain quadrilateral also belong to all the "children" (subcategories) of that type of quadrilateral. For example, squares are also rhombi, because they have four congruent sides (the defining attribute of a rhombus).

Next, we study and classify different triangles. Students are now able to classify triangles both in terms of their sides and also in terms of their angles. The lesson also includes several drawing problems where students draw triangles that satisfy the given information.

The last focus of this chapter is volume. Students learn that a cube with the side length of 1 unit, called a "unit cube," is said to have "one cubic unit" of volume, and can be used to measure volume. They find the volume of right rectangular prisms by "packing" them with unit cubes and by using formulas. They recognize volume as additive and solve both geometric and real-word problems involving volume of right rectangular prisms.

The Lessons in Chapter 9

Helpful Resources on the Internet

FOR REVIEW OF ANGLES AND POLYGONS

Measuring Angles
Rotate the protractor into position and give your measurement to the nearest whole number.
https://www.mathplayground.com/measuringangles.html

Turtle Pond
Guide a turtle to a pond using commands that include turning him through certain angles and moving him specific distances.
http://illuminations.nctm.org/Activity.aspx?id=3534

Interactive Polygon Crossword Puzzle
Use the clues to help you guess the words that go in the puzzle, and fill it in.
http://www.mathgoodies.com/puzzles/crosswords/ipolygon3.html

Types of Polygons Vocabulary Quiz
In this interactive quiz you have to quickly name different types of polygons based on given clues. For each question you will have only 30 seconds to write your answer!
http://www.math-play.com/types-of-poligons.html

Polygon Matching Game
Many of the polygons included are quadrilaterals.
https://www.mathplayground.com/matching_shapes.html

Free Worksheets for Area and Perimeter
Create worksheets for the area and the perimeter of rectangles/squares with images, word problems, or problems where the student writes an expression for the area using the distributive property. Options also include area and perimeter problems for irregular rectangular areas, and more.
https://www.homeschoolmath.net/worksheets/area_perimeter_rectangles.php

Areas of Compound Shapes
Practice finding the perimeter and area of compound shapes.
https://www.cimt.org.uk/projects/mepres/book7/bk7i9/bk7_9i4.htm

Circle
This page includes a detailed lesson about circles, as well as interactive exercises to practice the topic.
http://www.mathgoodies.com/lessons/vol2/geometry.html

How to use a Compass to Draw a Circle
Simple instructions on how to use a compass.
https://www.youtube.com/watch?v=02XRad7s1Io

QUADRILATERALS

Interactive Quadrilaterals
See all the different kinds of quadrilateral "in action." You can drag the corners, see how the angles change, and observe what properties do not change.
https://www.mathsisfun.com/geometry/quadrilaterals-interactive.html

Properties of Quadrilaterals
Investigate the properties of a kite, a rhombus, a rectangle, a square, a trapezoid, and a parallelogram in this dynamic, online activity.

180

Complete the Quadrilateral
This is a hands-on activity (printable worksheets) where students join the dots to complete
quadrilaterals, which helps students learn about the different types of quadrilaterals.
http://fawnnguyen.com/don-stewards-complete-quadrilateral/

Types of Quadrilaterals Quiz
Identify the quadrilaterals that are shown in the pictures in this interactive multiple-choice quiz.
http://www.softschools.com/math/geometry/quadrilaterals/types_of_quadrilaterals/

Quadrilateral Types Practice at Khan Academy
Identify quadrilaterals based on pictures or attributes in this interactive quiz.
https://www.khanacademy.org/math/basic-geo/basic-geo-shapes/basic-geo-classifying-shapes/e/quadrilateral_types

Classify Quadrilaterals Worksheets
Make free printable worksheets for classifying (identifying, naming) quadrilaterals.
https://www.homeschoolmath.net/worksheets/classify_quadrilaterals.php

TRIANGLES

Triangle Shoot
Practice classifying triangles by their angles or by their sides, or identifying types of angles, with this
"math splat" game.
http://www.sheppardsoftware.com/mathgames/geometry/shapeshoot/triangles_shoot.htm

Rags to Riches: Classify Triangles by Sides and Angles
Answer multiple-choice questions about classifying triangles by their angles and sides and about angle
measures of a triangle in a quest for fame and fortune.
http://www.quia.com/rr/457498.html

Identify Triangles Quiz
A simple multiple-choice quiz about identifying (classifying) triangles either by their sides or angles. You can
modify some of the quiz parameters, such as the number of problems in it.
http://www.thatquiz.org/tq-A/?-j1-l34-p0

Interactive Triangles Activity
Play with different kinds of triangles (scalene, isosceles, equilateral, right, acute, obtuse). Drag the
vertices and see how the triangle's angles and sides change.
https://www.mathsisfun.com/geometry/triangles-interactive.html

Classify Triangles Worksheets
Make free printable worksheets for classifying triangles by their sides, angles, or both.
https://www.homeschoolmath.net/worksheets/classify_triangles.php

Angles and Their Measures Matching Game
Learn to better estimate angles by matching angles to their angle measures.
https://www.mathmammoth.com/practice/angles-matching

VOLUME

Geometric Solids
Rotate various geometric solids by dragging with the mouse. Count the number of faces, edges, and
vertices.
http://illuminations.nctm.org/Activity.aspx?id=3521

Cuboid Exploder and Isometric Shape Exploder
These interactive demonstrations let you see either various cuboids (a.k.a. boxes or rectangular prisms) or various shapes made of unit cubes, and then "explode" them to the unit cubes, illustrating volume.
http://www.teacherled.com/resources/cuboidexplode/cuboidexplodeload.html and
http://www.teacherled.com/resources/isoexplode/isoexplodeload.html

3-D Boxes Activity
Identify how many cubes are in the 3-D shapes in this interactive activity.
http://www.interactivestuff.org/sums4fun/3dboxes.swf

Rectangular Prisms Interactive Activity
Fill a box with cubes, rows of cubes, or layers of cubes. Can you determine a rule for finding the volume of a box if you know its width, depth, and height?
http://illuminations.nctm.org/Activity.aspx?id=4095

Interactivate: Surface Area and Volume
Explore or calculate the surface area and volume of rectangular prisms and triangular prisms. You can change the base, height, and depth interactively.
http://www.shodor.org/interactivate/activities/SurfaceAreaAndVolume/

Decompose Figures To Find Volume - Practice at Khan Academy
Find the volume of irregular 3-D figures by dividing the figures into rectangular prisms and finding the volume of each part.
https://www.khanacademy.org/math/cc-fifth-grade-math/cc-5th-measurement-topic/cc-5th-volume/e/decompose-figures-to-find-volume

Volume Word Problems
Practice solving word problems that involve volume of rectangular prisms.
https://www.khanacademy.org/math/pre-algebra/measurement/volume-introduction-rectangular/e/volume_2

Worksheets for the Volume and Surface Area of Rectangular Prisms
Customizable worksheets for volume or surface area of cubes and rectangular prisms. Includes the option of using fractional edge lengths.
https://www.homeschoolmath.net/worksheets/volume_surface_area.php

FOR FUN

Patch Tool
An online activity where the student designs a pattern using geometric shapes.
http://illuminations.nctm.org/Activity.aspx?id=3577

Shape Guess - Elimination Game
Have fun with shapes while playing this interactive online guessing game!
http://www.learnalberta.ca/content/mejhm/index.html?l=0&ID1=AB.MATH.JR.SHAP&ID2=AB.MATH.JR.SHAP.SHAP&lesson=html/object_interactives/shape_classification/use_it.html

Interactivate! Tessellate
An online, interactive tool for creating your own tessellations. Choose a shape, then edit its corners or edges. The program automatically changes the shape so that it will tessellate (tile) the plane. Then push the tessellate button to see your creation! Requires Java.
http://www.shodor.org/interactivate/activities/Tessellate

**Sample worksheet from
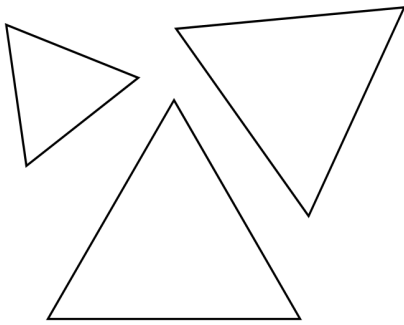https://www.mathmammoth.com**

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Equilateral, Isosceles, and Scalene Triangles

Classification according to sides

If all three sides of a triangle are congruent (the same length), it is called an **equilateral triangle**.
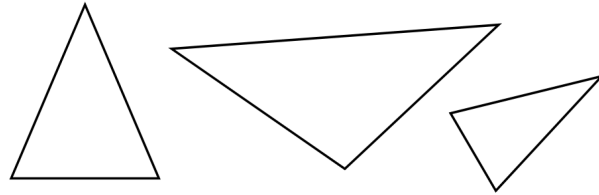
"*Equi-*" refers to things that are the same or equal, and "*lateral*" refers to sides. Think of it as a "same-sided" triangle.

If only *two* of a triangle's sides are congruent, then it is called an **isosceles triangle**.

Think of it as a "same-legged" triangle, the "legs" being the two sides that are the same length.

MARK the two congruent sides of each isosceles triangle:

Lastly, if none of the sides of a triangle are congruent (all are different lengths), it is a **scalene triangle**.
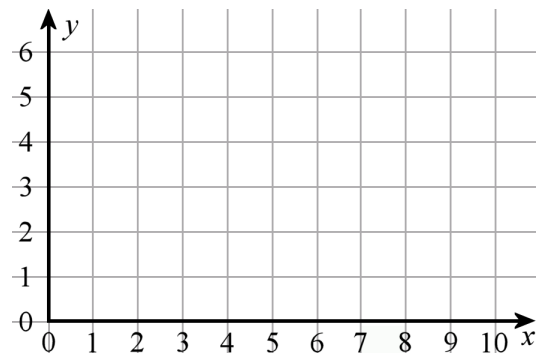
1. Classify the triangles by the lengths of their sides as either equilateral, isosceles, or scalene.

   You can mark each triangle with an "*e*," "*i*," or "*s*" correspondingly.

   a.
   b.
   c.
   d.
   e.
   f.
   g.
   h.
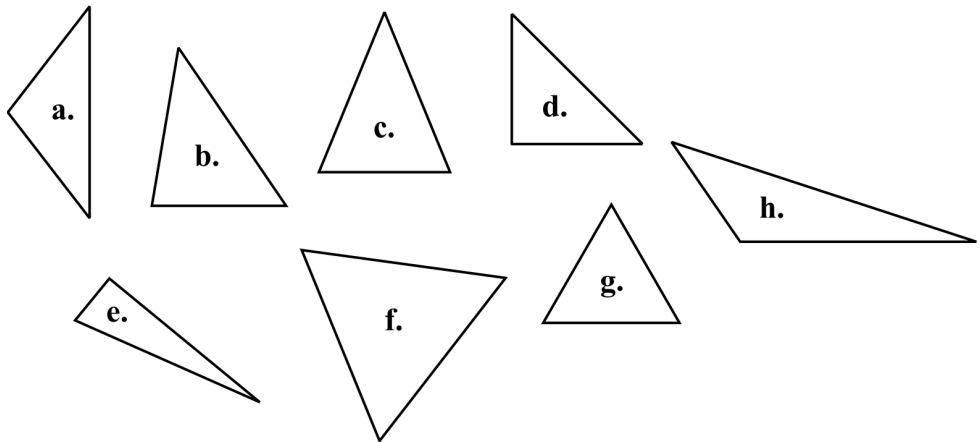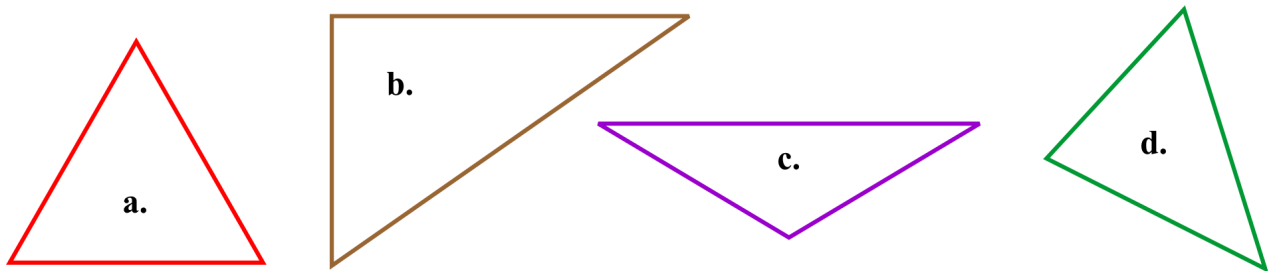
2. Plot the points (0, 0), (3, 5), (0, 5) , and connect them with line segments to form a triangle.

   Classify your triangle by its sides.
   Is it equilateral, isosceles, or scalene?

   _____

Classification according to angles

Remember, we can also classify a triangle according to its <u>angles</u>.

- A **right triangle** has one right angle.
- An **obtuse triangle** has one obtuse angle.
- An **acute triangle** has three acute angles.

---

3. Classify the triangles as "acute," "right," or "obtuse" (by their angles), and also as "equilateral," "isosceles," or "scalene" (by their sides).

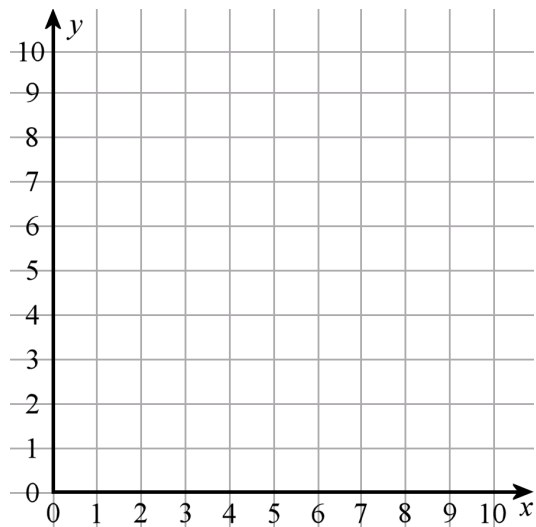| Triangle	Classification by the angles	Classification by the sides
a.		
b.		
c.		
d.		

4. Plot the points, and connect them with line segments to form two triangles. Classify the triangles by their angles <u>and</u> sides.

Triangle 1: (0, 0), (4, 0), (0, 4)

_____ and

_____

Triangle 2: (5, 5), (1, 8), (9, 4)

_____ and

_____

Sample worksheet from
https://www.mathmammoth.com

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Area and Perimeter Problems

Example 1. Find the area of the shaded figure.

The easiest way to do this is:
(1) Find the area of the larger outer rectangle.
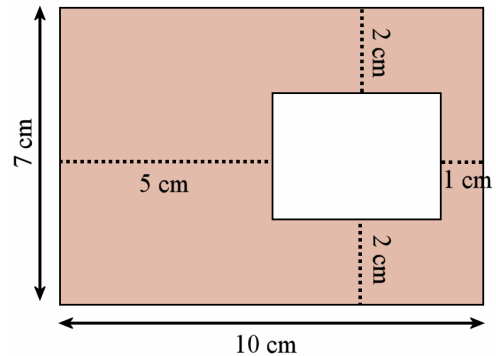(2) Find the area of the white inner rectangle.
(3) Subtract the two.

1. The area of the large rectangle is

$7 \text{ cm} \times 10 \text{ cm} = 70 \text{ cm}^2$.

2. First we find the *sides* of the white rectangle
   by subtracting. The longer side of the white
   rectangle is 10 cm − 5 cm − 1 cm = 4 cm.
   The shorter side is 7 cm − 2 cm − 2 cm = 3 cm.

   So, the area of the white rectangle is $4 \text{ cm} \times 3 \text{ cm} = 12 \text{ cm}^2.$

3. Lastly we subtract the two areas to find the shaded area: $70 \text{ cm}^2 - 12 \text{ cm}^2 = 58 \text{ cm}^2$.

Note: In the following problems, record your work—all the calculations—carefully. That way you
are much less likely to make mistakes! Use a notebook, if necessary, for additional space.

1. **a.** Find the area of the *white* rectangle.
   All lines meet at right angles.
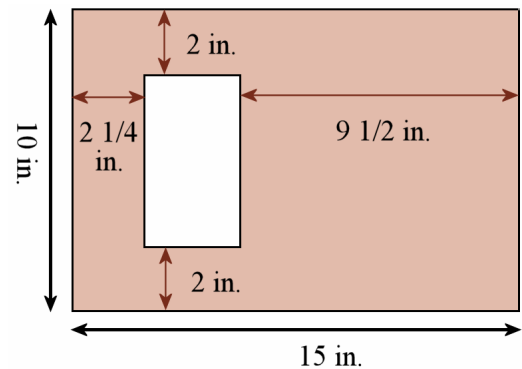
   b. Find the area of the shaded figure.

2. The image on the right shows a picture frame.
   Find the area of the actual frame (that is, of the shaded part).
   Give your answer to the nearest whole square centimeter.
   (All lines meet at right angles.)
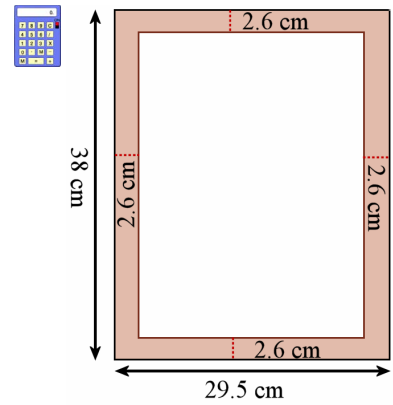
3. The perimeter of a rectangle is 42 cm.
   If the long side of the rectangle is 11 cm,
   how long is the shorter side?

4. The perimeter of a square is ½ mile.

   a. How long is one side of the square, in miles?
   Draw a sketch to help you.

   b. How long is one side of the square, in *feet*?
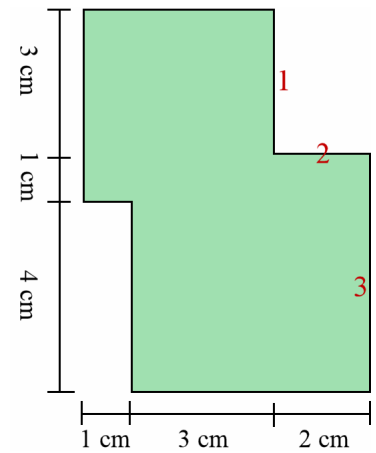   (1 mile = 5,280 ft)

Example 2. Find the perimeter of the figure.

We need to find the length of *each* side and then add the lengths. Start, for example, at the side marked with 1, then go to the side marked with 2, then to side 3, and so on, until you have "traveled" all the way around the figure.

Side 1 is 3 cm. Side 2 is 2 cm. Side 3 is 5 cm. The total perimeter is:

3 cm + 2 cm + 5 cm + 5 cm + 4 cm + 1 cm + 4 cm + 4 cm = 28 cm.
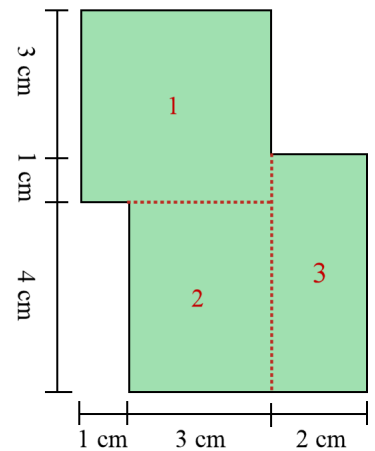
Example 3. Find the area of the figure.

Divide the figure into rectangles by drawing in it some additional lines.

Rectangle 1 has an area of $4 \text{ cm} \times 4 \text{ cm} = 16 \text{ cm}^2$.
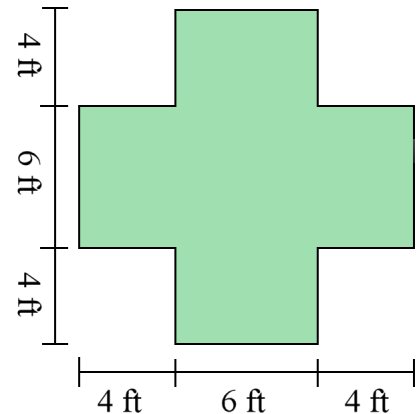
Rectangle 2 has an area of $3 \text{ cm} \times 4 \text{ cm} = 12 \text{ cm}^2$.

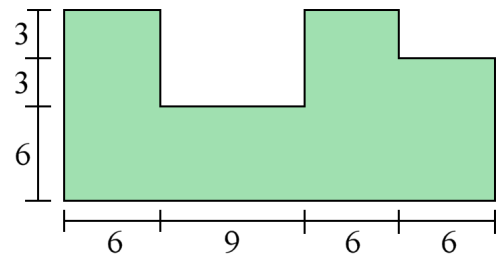Rectangle 3 has an area of $2 \text{ cm} \times 5 \text{ cm} = 10 \text{ cm}^2$.

The total area is: $16 \text{ cm}^2 + 12 \text{ cm}^2 + 10 \text{ cm}^2 = 38 \text{ cm}^2$.

5. Find the area and the perimeter of this figure.
   All lines meet at right angles.

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6. Find the area and the perimeter of this figure.
   All lines meet at right angles.
   The dimensions are given in centimeters.

7. A farmer fenced a rectangular field with 910 ft of fencing.
   One side of that field measures 330 ft.
   How long is the other side of the field?

8. Find the area and the perimeter of this figure.
   All lines meet at right angles.
   The dimensions are given in inches.