math MAMMOTH

Grade 4-A Worktext

A ddition, subtraction, patterns, and graphs

L arge numbers

M ulti-digit multiplication

T ime and measuring

Light Blue Series

By Maria Miller

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Chapter 3: Multi-Digit Multiplication

Chapter 4: Time and Measuring

Foreword

Math Mammoth Grade 4-A and Grade 4-B worktexts comprise a complete math curriculum for the fourth grade mathematics studies, aligned to the Common Core Standards.

In the fourth grade, students focus on multi-digit multiplication and division, learning to use bigger numbers, solving multi-step word problems that involve several operations, and they get started in studying fractions and decimals. This is of course accompanied by studies in geometry and measuring.

The year starts out with a review of addition and subtraction, patterns and graphs. We illustrate word problems with bar diagrams and study finding missing addends, which teaches algebraic thinking. Children also learn addition and subtraction terminology, the order of operations, and statistical graphs.

Next come large numbers—up to millions, and the place value concept. At first the student reviews thousands and some mental math with them. Next are presented numbers up to one million, calculations with them, the concept of place value and comparing. In the end of the chapter we find out more about millions and an introduction to multiples of 10, 100, and 1000.

The third chapter is all about multiplication. After briefly reviewing the concept and the times tables, the focus is on learning multi-digit multiplication (multiplication algorithm). The children also learn why it works when they multiply in parts. We also study the order of operations again, touch on proportional reasoning, and do more money and change related word problems.

The last chapter in part A is about time, temperature, length, weight, and volume. Students will learn to solve more complex problems using various measuring units and to convert between measuring units.

In part B, we first study division. The focus is on learning long division and using division in word problems. In geometry, we first review area and perimeter, and then concentrate on the topic of angles. Students measure and draw angles, solve simple angle problems, and classify triangles according to their angles. They also study parallel and perpendicular lines.

Fractions and decimals are presented last in the school year. These two chapters practice only some of the basic operations with fractions and decimals. The focus is still on conceptual understanding and on building a good foundation towards 5th grade math, where fractions and decimals will be in focus.

When you use these books as your only or main mathematics curriculum, they can be like a “framework”, but you do have some liberty in organizing the study schedule. Chapters 1, 2, and 3 should be studied in this order, but you can be flexible with chapters 4 (Time and Measuring) and 6 (Geometry) and schedule them somewhat earlier or later if you so wish. Chapter 3 (Multiplication) needs to be studied before long division in Chapter 5. Many topics from chapters 7 and 8 (Fractions and Decimals) can also be studied earlier in the school year; however finding parts with division should naturally be studied only after mastering division.

I wish you success in your math teaching!

Maria Miller, the author

Chapter 1: Addition, Subtraction, Patterns, and Graphs

Introduction

The first chapter of *Math Mammoth Grade 4* covers addition and subtraction topics, problem solving, patterns, graphs, and money.

At first, we review the "technical aspects" of adding and subtracting: mental math techniques and adding and subtracting in columns. We also study some patterns. The lesson on Pascal's triangle is intended to be fun and fascinating—after all, Pascal's triangle is full of patterns!

In the next lesson, we study the connection between addition and subtraction and bar models. Bar models help students write addition and subtraction sentences with unknowns, and solve them. This is teaching the students *algebraic thinking*: how to write and solve simple equations.

The lesson on the order of operations contains some review, but we also study connecting the topic with real-life situations (such as shopping). Here, the student writes the mathematical expression (number sentence) for word problems, which again, practices algebraic thinking.

Going towards applications of math, the chapter then contains straightforward lessons on bar graphs, line graphs, rounding, estimating, and money problems.

The Lessons in Chapter 1

Helpful Resources on the Internet

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

ArithmeTiles
Use the four operations and numbers on neighboring tiles to make target numbers.
http://www.primarygames.com/math/arithmetiles/index.htm

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

MathCar Racing
Keep ahead of the computer car by thinking logically, and practice any of the four operations at the same time.
http://www.funbrain.com/osa/index.html

Fill and Pour
Fill and pour liquid with two containers until you get the target amount. A logical thinking puzzle.
http://nlvm.usu.edu/en/nav/frames_asid_273_g_2_t_4.html

Division and Order of operations and
Division and Addition - Order of Operations
Two mystery picture games.
http://www.dositey.com/2008/math/m/mystery2MD.htm and
http://www.dositey.com/2008/math/m/mystery2AD.htm

Order of Operations Quiz
A 10-question online quiz that includes two different operations and possibly parenthesis in each question. You can also modify the quiz parameters yourself.
http://www.thatquiz.org/tq-1/?-j8f-la

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

Exploring Order of Operations (Object Interactive)
The program shows an expression, and you click on the correct operation (either +, —, ×, ÷ or exponent) to be done first. The program then solves that operation, and you click on the *next* operation to be performed, etc., until it is solved. Lastly the resource includes a game where you click on the falling blocks in the order that order of operations would dictate.
http://www.learnalberta.ca/content/mejhm/html/object_interactives/order_of_operations/use_it.htm

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

Quick Calculate
Practice your arithmetic of all four operations plus the order of operations.
http://themathgames.com/arithmetic-games/addition-subtraction-multiplication-division/quick-calculate-game.php

Estimate Addition Quiz
Scroll down the page to find this quiz plus some others. Fast loading.
http://www.quiz-tree.com/Math_Practice_main.html

Shop 'Til You Drop
Get as many items as you can and be left with the least amount of change, and practice your addition skills. The prices are in English pounds and pennies.
http://www.channel4.com/learning/microsites/P/puzzlemaths/shop.shtml

Change Maker
Determine how many of each denomination you need to make the exact change. Good and clear pictures! Playable in US, Canadian, Mexican, UK, or Australian money.
http://www.funbrain.com/cashreg/index.html

Cash Out
Give correct change by clicking on the bills and coins.
http://www.mrnussbaum.com/cashd.htm

Piggy bank
When coins fall from the top of the screen, choose those that add up to the given amount, and the piggy bank fills.
http://fen.com/studentactivities/Piggybank/piggybank.html

Bar Chart Virtual Manipulative
Build your bar chart online using this interactive tool.
http://nlvm.usu.edu/en/nav/frames_asid_190_g_1_t_1.html?from=category_g_1_t_1.html

An Interactive Bar Grapher
Graph data sets in bar graphs. The color, thickness and scale of the graph are adjustable. You can put in your own data, or you can use or alter pre-made data sets.
http://illuminations.nctm.org/ActivityDetail.aspx?ID=63

Create a Graph
A neat online tool for creating a graph from your own data.
http://nces.ed.gov/nceskids/createagraph/

Math Mahjong
A Mahjong game where you need to match tiles with the same value. It uses all four operations and has three levels.
http://www.sheppardsoftware.com/mathgames/mixed_mahjong/mahjongMath_Level_1.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

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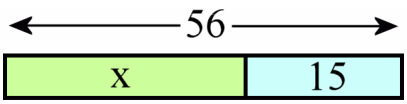
Bar Models in Addition and Subtraction

Think of this **bar model** as a long board, cut into two pieces. It is 56 units long in total (you can think of inches, for example), and the two parts are 15 and *x* units long.

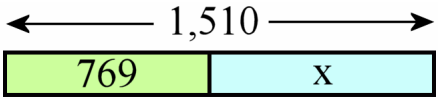


From the bar model, we can write TWO addition and TWO subtraction sentences—a *fact family*.

$x + 15 = 56$	$56 - x = 15$
$15 + x = 56$	$56 - 15 = x$

The *x* stands for a number, too. We just do not know what it is yet. It is an *unknown*.

From this bar model, we can write a **missing addend** problem.



It means that a number to be added is "missing" or unknown.

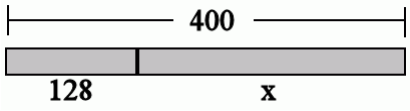
We can solve it by **subtracting** the one part (769) from the total (1,510).

$769 + x = 1{,}510$

$x = 1{,}510 - 769 = 741$

1. Write a missing addend problem that matches the bar model. Then solve it by subtracting.

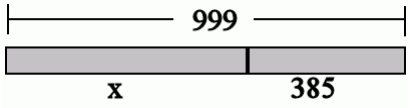
a.



_____ + _____ = _____

x = _____ – _____ = _____

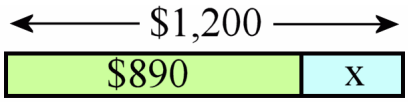
b.



_____ + _____ = _____

x = _____ – _____ = _____

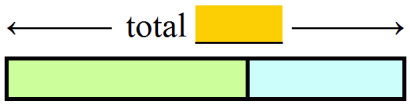
c. A car costs $1,200. Dad has $890. How much more does he need to buy it?



_____ + _____ = _____

x = _____ – _____ = _____

d. The school has 547 students, of which 265 are girls. How many are boys?



_____ + _____ = _____

x = _____ – _____ = _____

2. Write the numbers and *x* to the model. Remember, *x* is the unknown, or what the problem asks for. Write an addition using the numbers and *x*. Lastly solve.

a. Of their 1,200-mile trip, the Jones family traveled 420 miles yesterday and 370 miles today. How many miles do they have left to travel?

Addition:

Solution: *x* = _____

b. The store is expecting a shipment of 4,000 blank CDs. Three boxes of 400 arrived. How many CDs are yet to come?

Addition:

Solution: *x* = _____

c. A 250-cm board is divided into three parts: two 28-cm parts at the ends and a part in the middle. How long is the middle part?

Addition:

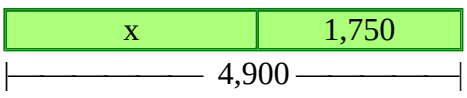
Solution: *x* = _____

d. After traveling 56 miles, Dad said, "Okay, in 9 miles we will be at Kensville, and from there we will have 118 miles left." How many total miles is the trip?

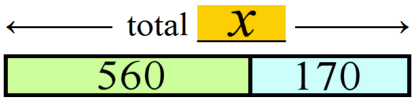
Addition:

Solution: *x* = _____

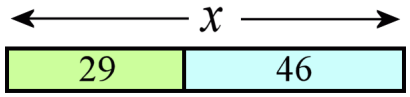
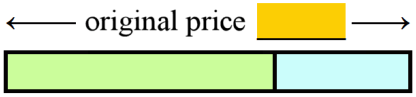
3. Make a word problem that matches the model. Then solve for *x*.



x = _____

In this problem: $x - 170 = 560$, the TOTAL is unknown. Remember, subtraction problems start with the total. Look at the bar model. We can solve x by adding.	 $x - 170 = 560$ $x = 170 + 560 = 730$

4. Write a subtraction problem that matches the bar model. Then solve it by adding.

a.  $x -$ 29 $=$ _____ $x =$ _____ + _____ = _____	**b.**  $x -$ _____ $=$ _____ $x =$ _____ + _____ = _____

5. The number you subtract from is missing! Solve.

a. _____ $- 4 = 20$	**b.** _____ $- 15 = 17$	**c.** _____ $- 22 - 7 = 70$
Still, the number you subtract from is missing. But this time, it is denoted by x, not by an empty line.		
d. $x - 8 = 7$ $x =$ _____	**e.** $x - 24 = 48$ $x =$ _____	**f.** $x - 300 - 50 = 125$ $x =$ _____

6. Here, the number you subtract is the unknown. Write the numbers and x into the bar model. Notice carefully what number is the *total*. Then write another matching subtraction that helps you solve x.

a.  $52 - x = 28$ $x =$ _____ $-$ _____ $=$ _____	**b.**  $97 - x = 54$ $x =$ _____ $-$ _____ $=$ _____

7. The number you subtract is still the unknown. Solve.

a. $20 -$ _____ $= 12$	**b.** $55 -$ _____ $= 34$	**c.** $234 -$ _____ $= 100$
d. $61 - x = 43$ $x =$ _____	**e.** $100 - x = 72$ $x =$ _____	**f.** $899 - x = 342$ $x =$ _____

8. Circle the number sentence that fits the problem. Then solve for x.

a. Jane had \$15. After Dad gave Jane her allowance (x), Jane had \$22. \$15 + x = \$22 OR \$15 + \$22 = x x = _____	**b.** Mike had many drawings. He put 24 of them in the trash. Then he had 125 left. 125 – 24 = x OR x – 24 = 125 x = _____
c. Jill had 120 marbles, but some of them got lost. Now she has 89 left. 120 – x = 89 OR 120 + 89 = x x = _____	**d.** Dave gave 67 of his stickers to a friend and now he has 150 left. 150 – 67 = x OR x – 67 = 150 x = _____

9. Write a number sentence (addition or subtraction) with x. Solve it.

a. A school's teachers and students filled a 450-seat auditorium. If the school had 43 teachers, how many students did it have?	_____ + _____ = _____ x = _____
b. Mom went shopping with \$250 and came back home with \$78. How much did she spend?	originally – spent = left _____ – _____ = _____ x = _____
c. Janet had \$200. She bought an item for \$54 and another for \$78. How much money is left?	_____ – _____ – _____ = _____ x = _____
d. Jean bought one item for \$23 and another for \$29, and she had \$125 left. How much did she have initially?	_____ – _____ – _____ = _____ x = _____

Puzzle Corner Find the missing numbers.

a. 200 − 45 − _____ − 70 = 25	**b.** _____ − 5 − 55 − 120 = 40
c. 23 + 56 + x = 110 x = _____	**d.** x + 15 + 15 + 15 + 15 = 97 x = _____

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Chapter 2: Large Numbers and Place Value

Introduction

The second chapter of *Math Mammoth Grade 4* covers large numbers (up to 1 million) and place value.

The first lessons only deal with thousands, or numbers with a maximum of four digits. These are for review and for deepening the student's understanding of place value. It is crucial that the student understands place value with four-digit numbers before moving on to larger numbers. Then, larger numbers will be very easy to study.

Then we go on to study numbers up to one million, or numbers that have tens or hundreds of thousands. Students write them in expanded form, compare them, add and subtract them, and learn more about rounding.

Lastly we study briefly the multiples of 10, 100, and 1000. This lesson prepares the way for some very important ideas in the next chapter (multi-digit multiplication).

The Lessons in Chapter 2

Helpful Resources on the Internet

Place Value Payoff
Match numbers written in standard form with numbers written in expanded form in this game.
http://www.quia.com/mc/279741.html

Keep My place
Fill in the big numbers in this cross-number puzzle.
http://www.counton.org/magnet/kaleidoscope2/Crossnumber/index.html

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

Megapenny Project
Visualizes big numbers with pictures of pennies.
http://www.kokogiak.com/megapenny/default.asp

Place value puzzler
Place value or rounding game. Click on the asked place value in a number, or type in the rounded version of the number.
http://www.funbrain.com/tens/index.html

Rounding Sharks
You'll be asked to round numbers in the thousands to the nearest hundred. Click on the shark that has the correctly rounded number.
http://www.free-training-tutorial.com/rounding/sharks.html

Rounding Master
A Mathionare-type game where you answer rounding questions, and try to become a Rounding Master Math Millionaire.
http://www.mrnussbaum.com/roundingmaster.htm

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

Maximum Capacity
Drag as many gorillas as you can into the elevator without exceeding the weight capacity. You will have to use your quick addition, estimation, and number sense skills.
http://www.mrnussbaum.com/maximumcapacity.htm

Home Run Derby Math
Estimate answers to math problems. The closer you get, the further your ball will fly at-bat. In addition and subtraction, the numbers are in the thousands. In multiplication, the numbers are in the hundreds.
http://www.mrnussbaum.com/derby.htm

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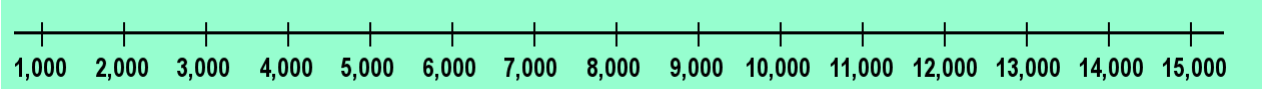
More Thousands



On this number line you see whole thousands from one thousand to fifteen thousand.

The colored digits are the "thousands period" and count as the whole thousands. Read the colored digits as its own number. Say the word "thousand" for the comma.

We continue with whole thousands until reaching *a thousand* thousands.

That number has a new name: *one million.*

78,000	*Read:* 78 thousand
153,000	*Read:* 153 thousand
802,000	*Read:* 802 thousand
990,000	*Read:* 990 thousand
999,000	*Read:* 999 thousand
1,000,000	Thousand thousand = 1 million

The rest of the digits tell us our hundreds, tens, and ones just like you have learned.

17,544	*Read:* 17 thousand five hundred forty four
609,230	*Read:* 609 thousand two hundred thirty
70,080	*Read:* 70 thousand eighty
902,005	*Read:* 902 thousand five

1. Place a comma in the number. Fill in the missing parts.

a. 164000	**b. 92000**	**c. 309000**	**d. 34000**	**e. 780000**
_____ thousand	_____ thousand	_____ thousand	_____ thousand	_____ thousand

2. Place a comma in the number. Fill in missing parts. Read the numbers aloud.

a. 164,453	**b. 92908**	**c. 329033**	**d. 14004**
164 thousand *453*	_____ thousand _____	_____ thousand _____	_____ thousand _____
e. 550053	**f. 72001**	**g. 800004**	**h. 30036**
_____ thousand _____	_____ thousand _____	_____ thousand _____	_____ thousand _____

3. Read these numbers aloud.

a. 456,098 **b.** 950,050 **c.** 23,090 **d.** 560,008

e. 78,304 **f.** 266,894 **g.** 1,000,000 **h.** 306,700

4. Think in whole thousands and add!

a. 30,000 + 5,000 =
think: 30 thousand + 5 thousand

b. 200,000 + 1,000 =

c. 400,000 + 30,000 =

d. 710,000 + 40,000 =

e. 300,000 + 700,000 =

f. 700,000 + 70,000 =

5. Add and subtract, thinking in whole thousands.

a. 35,000 + 5,000 =

b. 711,000 + 10,000 =

c. 420,000 + 30,000 =

d. 700,000 – 70,000 =

e. 300,000 – 60,000 =

f. 1,000,000 – 200,000 =

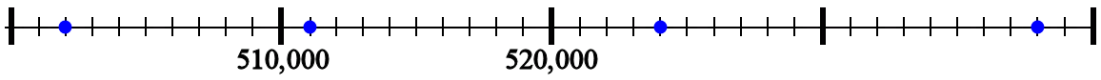
g. 30,000 – 5,000 =

h. 200,000 – 6,000 =

i. 723,000 – 400,000 =

j. 500,000 – 1,000 =

6. On the number line below, 510,000 and 520,000 are marked (at the "posts").
Write the numbers that correspond to the dots.



7. Make a number line from 320,000 to 340,000 with tick-marks at every whole thousand, similar to the one above. Then mark the following numbers on the number line:
323,000 328,000 335,000 329,000 330,000

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Chapter 3: Multi-Digit Multiplication
Introduction

The third chapter of *Math Mammoth Grade 4* covers multi-digit multiplication and some related topics.

The first lessons briefly review the multiplication concept and the times tables. The next lesson, where students solve scales or pan balance problems, is intended to be somewhat fun and motivational. The balance problems are actually equations in disguise.

Then, the focus is on multi-digit multiplication (also called algorithm of multiplication, or multiplying in columns). We start out by multiplying by whole tens and hundreds (such as 20×4 or 500×6). After this is mastered, we study a very important concept of **multiplying in parts** (also called partial products algorithm). It means that 4×63 is done in two parts: 4×60 and 4×3, and the results are added.

This principle underlies all other multiplication algorithms, so it is important to master. We do not want children to learn the multiplication algorithm "blindly", without understanding what is going on with it. Multiplying in parts is also tied in with an area model, which, again, is very important to understand.

Before showing the traditional form of multiplication, the lesson *Multiply in Columns—the Easy Way* shows a simplified form of the same, which is essentially just multiplying in parts. You may skip that lesson at your discretion or skim through it quickly if your child is ready to understand the standard form of the algorithm, which is taught next.

Students also study estimation, the order of operations, and multiplying with money. Many kinds of word problems abound in all of the lessons. Students are supposed to practice writing a number sentence for the word problems—essentially writing down the calculating they are doing.

The lesson "*So Many of the Same Thing*" could be entitled "Proportional Reasoning" but I wanted to avoid scaring parents and children with such a high-sounding phrase. The idea in that lesson is really simple, but it does prepare for proportions as they are taught in 7th grade and in algebra.

After that, we multiply two-digit numbers by two-digit numbers. Again, we first study partial products and tie that in with an area model. The lesson *Multiplying in Parts: Another Way* is optional. After that, the standard algorithm for multiplying a two-digit number by a two-digit number is taught, and the chapter ends.

The Lessons in Chapter 3

Helpful Resources on the Internet

Multiplication Games
A list of times tables games and activities to practice multiplication facts.
http://www.homeschoolmath.net/online/multiplication.php

Math FROG MultipliACTION
Online practice of 2 by 2 digit multiplication. You enter one digit in each box.
http://cemc2.math.uwaterloo.ca/mathfrog/english/kidz/mult5.shtml

Math Playground
Learn how to think algebraically with these clever weighing scales.
http://www.mathplayground.com/algebraic_reasoning.html

Thinking Blocks
Thinking Blocks is an engaging, interactive math tool that helps students learn how to solve multi-step word problems. Scroll down to Multiplication and Division.
http://www.mathplayground.com/thinkingblocks.html

Rectangle Multiplication
An interactive tool that illustrates multiplying in parts using the area model. Choose the "common" option for multiplying in parts.
http://nlvm.usu.edu/en/nav/frames_asid_192_g_2_t_1.html

One-Digit by Two-Digits Multiplication Game
Students will multiply one-digit numbers by two-digit whole numbers, and then get to try shoot a basket.
http://www.math-play.com/one-digit-by-two-digit-multiplication-game.html

Multiplication Jeopardy Game
You get to solve multi-digit multiplication questions of 1-digit by 1-digit, 1-digit by 2-digit, and 1-digit by 3-digit numbers in this game.
http://www.math-play.com/Multiplicaton-Jeopardy/Multiplication-Jeopardy.html

Interactive Pan Balance
Each of the four shapes is assigned a certain weight. Place shapes on either side of the pan balance and figure out their relationships.
http://illuminations.nctm.org/ActivityDetail.aspx?ID=131

Balance Beam Activity
A virtual balance that provides balance puzzles where the student has to find the weights of various figures, practicing algebraic thinking. Includes three levels.
http://mste.illinois.edu/users/pavel/java/balance/

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

Order of Operations Quiz
A 10-question online quiz that includes two different operations and possibly parenthesis in each question. You can also modify the quiz parameters yourself.
http://www.thatquiz.org/tq-1/?-j8f-la

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

Exploring Order of Operations (Object Interactive)
The program shows an expression, and you click on the correct operation (either +, —, ×, ÷ or exponent) to be done first. The program then solves that operation, and you click on the *next* operation to be performed, etc., until it is solved. Lastly the resource includes a game where you click on the falling blocks in the order that order of operations would dictate.
http://www.learnalberta.ca/content/mejhm/html/object_interactives/order_of_operations/use_it.htm

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

Quick Calculate
Practice the arithmetic of all four operations plus order of operations.
http://themathgames.com/arithmetic-games/addition-subtraction-multiplication-division/quick-calculate-game.php

Multiplication Tool
This online tool lets you illustrate and/or practice multi-digit multiplication using the standard algorithm, partial products algorithm, or the lattice method.
http://www.multiplicationtool.org

Mental Math Tricks for Multiplication
Includes some very basic common-sense ones such as multiplying by 9 or multiplying by doubling and halving.
http://wildaboutmath.com/2007/11/11/impress-your-friends-with-mental-math-tricks

Mental math multiplication guide
Rules of thumb and other "tricks" for mental multiplication of two-digit or bigger numbers, conveniently in one place. (This is not about single-digit multiplication; you are supposed to know those by heart of course.)
http://arscalcula.com/mental_math_multiplication_guide.shtml

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Multiplying by Whole Tens and Hundreds

We have studied the SHORTCUTS for multiplying any number by 10, 100, or 1,000:

To multiply any number **by 10**, just **tag ONE zero** on the end.

To multiply any number **by 100**, just **tag TWO zeros** on the end.

To multiply any number **by 1,000**, just **tag THREE zeros** on the end.

1**0** × 481 = 4,81**0**	1**00** × 47 = 4,7**00**	1**000** × 578 = 578**,000**

Note especially what happens when the number you multiply already ends in a zero or zeros. The rule works the same; you still have to tag the zero or zeros.

1**0** × 800 = 800**0**	1**00** × 6,600 = 660,0**00**	1**000** × 40 = 40**,000**

1. Multiply.

a. 10 × 315 = _____	**b.** 100 × 6,200 = _____	**c.** 1,000 × 250 = _____
3,560 × 10 = _____	10 × 1,200 = _____	38 × 1,000 = _____
35 × 100 = _____	100 × 130 = _____	10 × 5,000 = _____

SHORTCUT for multiplying by 20 or 200 (You can probably guess this one!)

What is 20 × 14?

Imagine the problem without the zero. Then it becomes 2 × 14 = 28. Then, just tag a zero to the 28 you got, so it becomes 280. So, 20 × 14 = 280.

What is 200 × 31?

Imagine the problem without the zeros. Then it becomes 2 × 31 = 62. Then, just tag *two* zeros to the result you got, so you get 6,200. In other words, 200 × 31 = 6,200.

2. Now try it! Multiply by 20 and 200.

a.	**b.**	**c.**	**d.**
20 × 8 = _____	200 × 7 = _____	20 × 12 = _____	20 × 16 = _____
4 × 20 =_____	5 × 200 = _____	35 × 20 = _____	42 × 200 = _____
20 × 5 = _____	11 × 200 = _____	200 × 9 = _____	54 × 20 = _____

Why does the shortcut work? It is based on the fact that you can multiply in any order.

When multiplying by 20, we can change the 20 into 10 × 2. For example:

$$20 \times 14 = 10 \times 2 \times 14$$

In that problem, first multiply 2 × 14 = 28. Then the problem becomes 10 × 28, which we know is 280.

$$20 \times 14 = 10 \times 2 \times 14$$

$$= 10 \times 28$$

$$= 280$$

That's it!

Let's try the same with 200. For example,

$$200 \times 31 = 100 \times 2 \times 31$$

In that problem, first multiply 2 × 31 = 62. The problem now becomes 100 × 62, which is 6,200:

$$100 \times 2 \times 31$$

$$= 100 \times 62$$

$$= 6{,}200$$

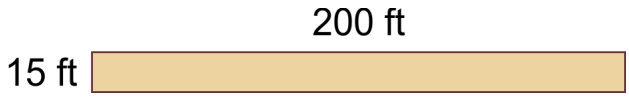
3. Try it yourself! Fill in.

a. 20 × 7	**b.** 20 × 5	**c.** 200 × 8	**d.** 200 × 25
= _____ × 2 × 7	= _____ × 2 × 5	= _____ × 2 × 8	= _____ × 2 × 25
= 10 × _____	= 10 × _____	= 100 × _____	= 100 × _____
= _____	= _____	= _____	= _____

4. Mark's shed measures 20 ft by 15 ft. What is its area? Write a number sentence. A means area.

A = _____

5. Write a number sentence, and find the area of Mark's driveway.



A = _____

6. Mark was told he needed four truckloads of gravel to cover his driveway. One truckload costs 5 × $20 plus $30 for the delivery. How much will it cost him to cover the driveway with gravel?

SHORTCUT for multiplying by whole tens and whole hundreds			
The same principle works if you multiply by whole tens (30, 40, 50, 60, 70, 80, or 90): simply multiply by 3, 4, 5, 6, 7, 8, or 9, and then tag a zero to the end result. Similarly, if you multiply by some whole hundred, FIRST multiply without those two zeros, and then tag the two zeros to the end result.			
50 × 8 = 400	90 × 11 = 990	300 × 8 = 2,400	12 × 800 = 9,600

7. Multiply.

a. 40 × 3 = _____ 8 × 20 = _____	**b.** 70 × 6 = _____ 50 × 11 = _____	**c.** 80 × 9 = _____ 30 × 15 = _____
d. 60 × 11 = _____ 12 × 40 = _____	**e.** 200 × 9 = _____ 7 × 400 = _____	**f.** 700 × 6 = _____ 600 × 11 = _____
g. 200 × 12 = _____ 15 × 300 = _____	**h.** 3 × 1100 = _____ 8 × 900 = _____	**i.** 11 × 120 = _____ 8 × 300 = _____

It even works this way:		
To multiply 40 × 70, simply multiply 4 × 7, and tag two zeros to the result: 40 × 70 = 2,800	To multiply 600 × 40, simply multiply 6 × 4, and tag three zeros to the result: 600 × 40 = 24,000	To multiply 700 × 800, simply multiply 7 × 8, and tag four zeros to the result. 700 × 800 = 560,000

8. Multiply.

a. 20 × 90 = _____ 70 × 300 = _____	**b.** 60 × 80 = _____ 30 × 900 = _____	**c.** 400 × 50 = _____ 200 × 200 = _____
d. 80 × 800 = _____ 200 × 500 = _____	**e.** 100 × 100 = _____ 40 × 30 = _____	**f.** 800 × 300 = _____ 90 × 1100 = _____

Write a number sentence for each question.

9. One hour has _____ minutes.
How many minutes are in 12 hours? _____

How many minutes are in 24 hours? _____

10. One hour has _____ minutes, and one minute has _____ seconds.

How many seconds are there in one hour? _____

11. Ed earns $30 per hour.

a. How much will he earn in a 8-hour workday? _____

b. How much will he earn in a 40-hour workweek? _____

c. How many days will he need to work in order to earn more than $1,000?

_____

12. Find the missing factor. Think "backwards"! How many zeros do you need?

a. _____ × 3 = 360 _____ × 50 = 450	**b.** 40 × _____ = 320 5 × _____= 600	**c.** _____ × 40 = 400 _____ × 2 = 180
d. _____ × 30 = 4,800 _____ × 200 = 1,800	**e.** 40 × _____ = 2,000 6 × _____= 4,200	**f.** _____ × 800 = 56,000 _____ × 20 = 12,000

Puzzle Corner

John wanted to prove that 40 × 70 is indeed 2,800 by breaking the multiplication into smaller parts. He wrote 40 as 4 × 10 and 70 as 7 × 10, and then multiplied in a different order:

$$40 \times 70 = 4 \times 10 \times 7 \times 10$$

$$= 10 \times 10 \times (4 \times 7) = 100 \times 28 = 2{,}800.$$

You do the same, and prove that 600 × 50 is indeed 30,000.

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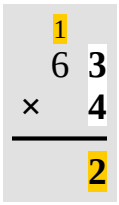
Multiplying in Columns, the Standard Way

The standard algorithm of multiplication is based on the principle that you already know: **multiplying in parts** (partial products): simply multiply ones and tens separately, and add.

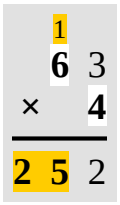
However, in the standard way the *adding* is done at the same time as multiplying. The calculation looks more compact and takes less space than the "easy way to multiply" you have learned.

The standard way to multiply



Multiply the ones: 4 × 3 = 12

Place 2 in the ones place, but write the tens digit (1) above the tens column as a little memory note. You are *regrouping* (or carrying).



Then multiply the tens, ***adding*** the 1 ten that was regrouped.

4 × 6 + 1 = 25

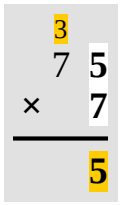
Write 25 in front of the 2. **Note** that 25 tens means 250!

"The easy way"

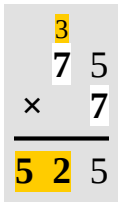
$$\begin{array}{r} 63 \\ \times\ \ 4 \\ \hline 12 \\ +\ 240 \\ \hline 252 \end{array}$$

In the "easy way," we multiply in parts, and the adding is done separately.

The standard way to multiply



Multiply the ones: 7 × 5 = 35
Regroup the 3 tens.



Multiply & add the tens:
7 × 7 + 3 = 52

"The easy way"

$$\begin{array}{r} 75 \\ \times\ \ 7 \\ \hline 35 \\ +\ 490 \\ \hline 525 \end{array}$$

1. Multiply using both methods: the standard one and the easy one.

a.

$$\begin{array}{r} 53 \\ \times\ \ 8 \\ \hline \end{array}$$

$$\begin{array}{r} 53 \\ \times\ \ 8 \\ \hline \end{array}$$

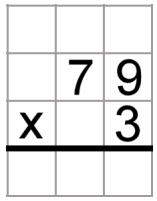
b.

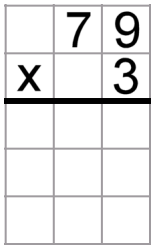
$$\begin{array}{r} 88 \\ \times\ \ 3 \\ \hline \end{array}$$

$$\begin{array}{r} 88 \\ \times\ \ 3 \\ \hline \end{array}$$

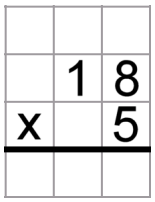
2. Multiply using both methods: the standard one and the easy one.

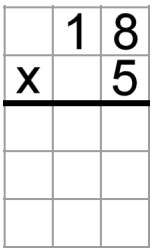
a.



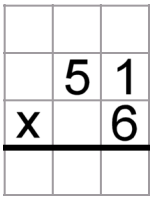
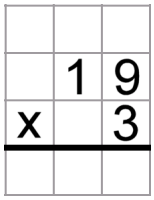
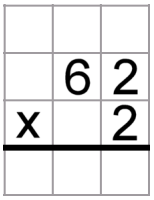
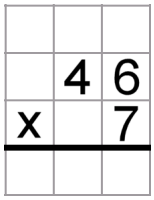
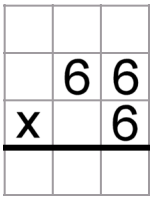
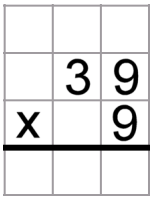
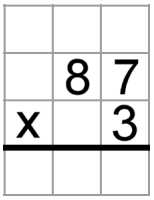
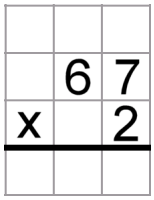
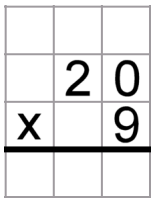
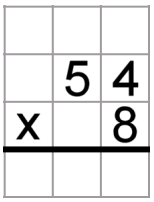
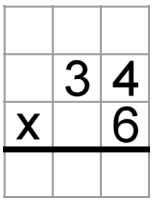
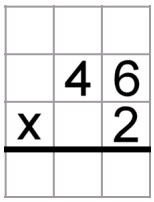


b.





3. Multiply. Be careful with the regrouping.

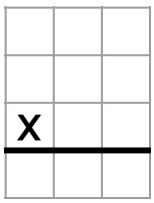
a. 	**b.** 	**c.** 	**d.** 
e. 	**f.** 	**g.** 	**h.** 
i. 	**j.** 	**k.** 	**l.** 

4. Solve. Also, write number sentences (additions, subtractions, multiplications) on the empty lines.

a. What is the cost of buying three chairs for $48 each?

_____

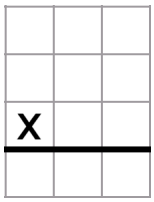
And the cost for six chairs? _____



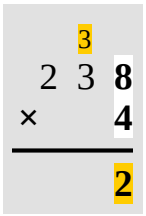
b. You earn $77 a day. How many days do you need to work in order to have $600 or more? Guess and check.

_____

_____



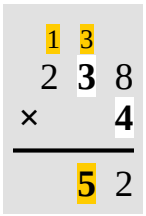
With a 3- or 4-digit number you have to regroup many times.



Multiply the ones first.

$4 \times 8 = 32$

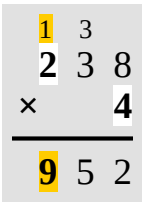
Write 2 in the ones place and regroup the 3 tens to the tens column.



Then multiply the tens, adding the 3 regrouped tens.

$4 \times 3 + 3 = 15$

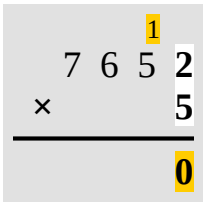
Write 5 in the tens place and regroup the 1 hundred.



Then multiply the hundreds, adding the regrouped hundred.

$4 \times 2 + 1 = 9$

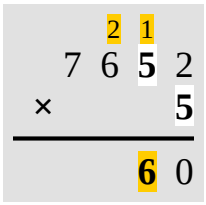
Write 9 in the hundreds place.



Multiply the ones:

$5 \times 2 = 10$

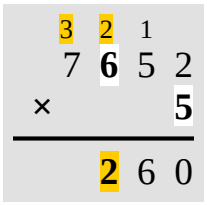
Write 0 in the ones place and regroup the 1 ten.



Then the tens. Add the regrouped ten:

$5 \times 5 + 1 = 26$

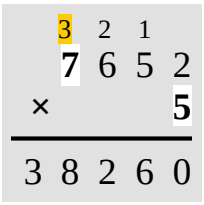
Write 6 in the tens place and regroup the 2 hundreds.



Multiply the hundreds.

$5 \times 6 + 2 = 32$

Write 2 in the hundreds place, and regroup the 3 thousands.



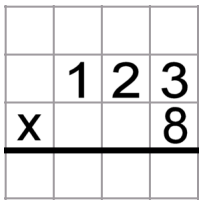
Multiply the thousands:

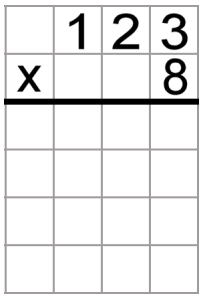
$5 \times 7 + 3 = 38$

Write 38 in front of the 260.

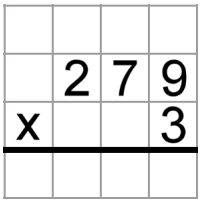
5. Multiply using both methods: the standard one and the easy one.

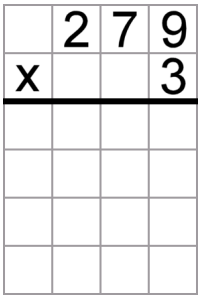
a.



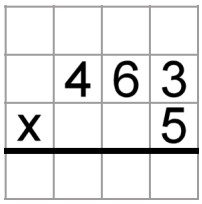


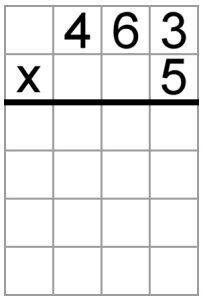
b.





c.





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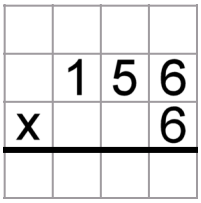

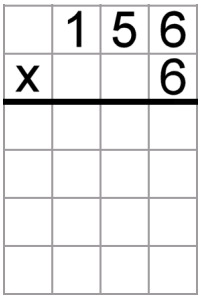

6. Multiply using the standard method.

a. 462 × 2	**b.** 506 × 7	**c.** 278 × 5	**d.** 319 × 7
e. 288 × 3	**f.** 809 × 9	**g.** 287 × 3	**h.** 367 × 2
i. 1208 × 9	**j.** 2514 × 3	**k.** 6177 × 4	**l.** 5330 × 9

7. Solve the word problems. Also, write number sentences (additions, subtractions, multiplications) on the empty lines to show what you calculate.

a. The school has 304 students. To go to the museum, they hired buses which can each seat 43 passengers. How many buses did they need?

Hint: Guess and check.

_____

_____

_____

b. The school also has 24 teachers. How many seats were left empty in those buses when all the students and all the teachers joined the trip?

_____

_____

_____

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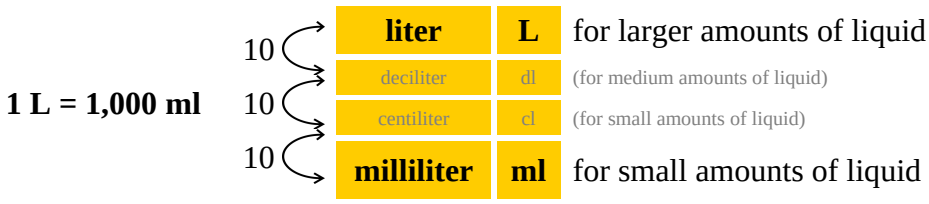
Chapter 4: Time and Measuring
Introduction

The fourth chapter of *Math Mammoth Grade 4* includes lessons on time, temperature, length, weight, and volume. The focus is no longer the actual act of measuring, but on conversions between the units and on word problems that involve conversions.

Students may have difficulty with the conversions, and that is why they will also be studied in 5th grade. At this point, students should be able to easily convert from a bigger unit to a smaller unit (such as converting 3 feet into 36 inches, or 2 kg into 2,000 grams).

And while the Common Core standards do not include them for 4th grade, I have also included some problems where we convert from a smaller unit to a bigger unit (such as 4,500 ml into 4 L 500 ml or 12 feet into 4 yards), because I feel most children are capable of doing these in 4th grade. If you feel your child has difficulty with these types of conversions (from a smaller unit to a bigger unit), feel free to omit those particular exercises. They are intermixed though, and not marked in any special way.

There are separate lessons for customary units and for metric units. These lessons include a table that lists the units and the conversion factors. For metric units, those tables always include all the units, even when they are not in common usage. For example, for metric units of volume, the chart looks like this:



The lesson only deals with milliliters and liters. However, the chart *also* shows the two other units (deciliters and centiliters) in order to help familiarize the students with these two basic ideas of the metric system:

1. The units always differ by a factor of ten;
2. The units are *named* consistently with the same prefixes (milli-, centi-, deci-, deka-, hecto-, and kilo-). These prefixes and their meanings are not yet studied in detail in fourth grade. You may, of course, at your discretion, explain them to the student.

The Lessons in Chapter 4

Helpful Resources on the Internet

The Ruler Game
Choose between whole inches, half-inches, quarters, eighths, or sixteenth parts of an inch to measure. Click on the given measurement on a ruler. Timed or not timed versions available.
http://www.rickyspears.com/rulergame

Measure It!
Practice measuring lines with either centimeters or inches. Multiple choice questions.
http://www.funbrain.com/measure

Sal's Sub Shop
Customers order subs, and you need to cut them to the given measurements - sometimes in metric units, sometimes in inches.
http://www.mrnussbaum.com/sal.htm

Reading a Tape Measure Worksheets
Worksheet generator - you can choose to which accuracy to measure, in inches, or inches and feet.
http://themathworksheetsite.com/read_tape.html

Measurement Game for Kids
Measure the length and weight of various parcels using the interactive scales and ruler so you can give them a stamp with the correct postage rate. Uses grams and centimeters.
http://www.kidsmathgamesonline.com/geometry/measurement.html

Reading Scales
You can illustrate a variety of measuring devices, such as scales, measuring cup, thermometer, and speedometer, and how to read them. Generate examples using different scales on different devices at the press of a button.
http://www.teacherled.com/2008/01/28/reading-scales

Reading Scales
Weigh objects on this virtual balance scale, using weights of 10 g, 50 g, 250 g, and 500 g.
http://www.teacherled.com/resources/oldscales/oldscalesload.html

Measures
An online activity about metric measuring units and how to read scales, a measuring cup, and a ruler. Uses British spelling.
http://www.bgfl.org/bgfl/custom/resources_ftp/client_ftp/ks2/maths/measures

Hours vs Minutes Game BBC SkillsWise
An online quiz to practice minutes versus hours. You have to tell whether, for example, 76 minutes or 1 hour is more.
http://www.bbc.co.uk/skillswise/game/ma25time-game-hours-vs-minutes

24 hour snap game
Two times are given, one using the 24-hour clock, and another using the am/pm system. Snap or don't snap the two times together.
http://www.bbc.co.uk/skillswise/game/ma25time-game-24-hour-snap

A Dictionary of Units of Measurement
Explains the common measuring systems and has lots of background information on their history.
http://www.unc.edu/~rowlett/units/

Bitesize Measures
Facts, problems, and quizzes about measuring length, mass, and capacity (in metric units).
http://www.bbc.co.uk/bitesize/ks2/maths/shape_space/measures/read/1/

Measurements
Online lessons with interactive exercises on metric prefixes, symbols, number values, metric mass, length, volume, US length and volume, and temperature conversions.
http://www.aaamath.com/B/mea.htm

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Metric Units for Measuring Length

The **basic unit** for measuring length in the metric system is **the meter**. All the other units for measuring length have the word "meter" in them.

Each unit is 10 times the smaller unit. For example, 1 kilometer is 10 hectometers. But we do not commonly use hectometers, dekameters, or decimeters. You only need to learn the bolded units in the chart.

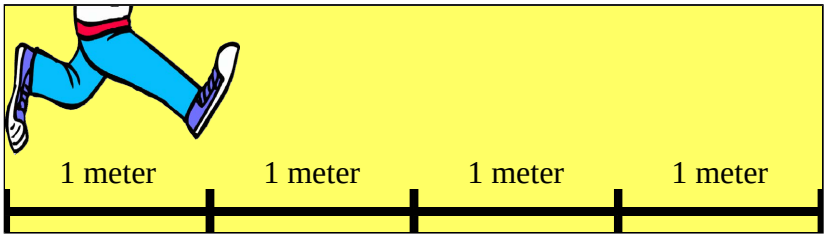
Units of length in the metric system

10 ↷	**kilometer**	**km**	"Kilo" means 1,000.
10 ↷	hectometer	hm	(not used)
10 ↷	dekameter	dam	(not used)
10 ↷	**meter**	**m**	the basic unit
10 ↷	decimeter	dm	(not used much)
10 ↷	**centimeter**	**cm**	100 of these make a meter.
10 ↷	**millimeter**	**mm**	This is 1/10 of a centimeter.

Remember also that 1 meter is very close to 1 yard. One meter is a tiny bit longer than 1 yard.

1. Outside, or in a long corridor or room, draw two lines that start at the same place.

a. Using a measuring tape, mark on the one line 1 m, 2 m, 3 m, and 4 m. Can you take "hops" 1 meter long?



b. Mark on the second line marks from 1 foot to 13 feet. Make 1-yard hops. Compare: do the two kinds of hops feel about the same?

2. Measure how tall you and other people are in centimeters. Write it also using whole meters and centimeters.

Name	How tall
	_____ *cm* = _*1*_ *m* _____ *cm.*

Conversions between units

Remember what millimeters look like on your ruler. 10 millimeters make 1 cm.

And 100 centimeters is 1 meter. "Centi" actually means a hundred (from the Latin word *centum*).

Lastly, 1 kilometer means one thousand meters, because "kilo" means 1,000!

1 km = 1,000 m	1 m = 100 cm	1 cm = 10 mm

3. One meter is 100 cm. Convert between meters and centimeters.

a. 5 m = _____ cm	**b.** 4 m 6 cm = _____ cm	**c.** 800 cm = _____ m
8 m = _____ cm	9 m 19 cm = _____ cm	239 cm = ____ m _____ cm
12 m = _____ cm	10 m 80 cm = _____ cm	407 cm = ____ m _____ cm

4. One centimeter is 10 mm. Convert between centimeters and millimeters.

a. 5 cm = _____ mm	**b.** 2 cm 8 mm = _____ mm	**c.** 50 mm = ____ cm _____ mm
8 cm = _____ mm	7 cm 5 mm = _____ mm	72 mm = ____ cm _____ mm
14 cm = _____ mm	10 cm 4 mm = _____ mm	145 mm = ____ cm _____ mm

5. One kilometer is 1,000 m. Convert between kilometers and meters.

a. 5 km = _____ m	**b.** 2 km 800 m = _____ m	**c.** 2,000 m = _____ km
23 km = _____ m	6 km 50 m = _____ m	4,300 m = ____ km _____ m
1 km 200 m = _____ m	13 km 579 m = _____ m	18,700 m = ____ km _____ m

6. Calculate. Give your answer using whole kilometers and meters.

a. 5 km 200 m + 8 km 900 m

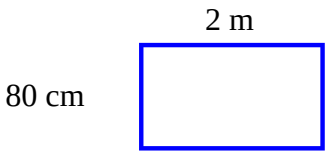
b. 3 km 600 m + 2 km 800 m

c. 1,500 m + 2 km 600 m

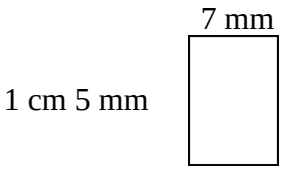
d. 6 × 700 m

7. Solve.

a. Find the perimeter of this rectangle.



b. Find the perimeter of this rectangle.



c. One side of a square measures 5 cm 6 mm. What is its perimeter?

d. *A challenge.* A square has a perimeter of 6 cm. How long is its side?

8. Solve the problems.

a. How many millimeters are in a *meter*?

b. John jogs around a track 1 km 800 m long twice a day, five days a week.
How long a distance does he jog in a day?

In a week?

c. Gary is 1 m 34 cm tall and Jared is 142 cm tall.
How much taller is Jared?

d. Kathy's wallpaper has butterflies that are 8 cm wide. She will put the wallpaper in her room. How many complete butterflies can she have on a wall that is 1 meter long?

How about if the wall is 3 meters long?