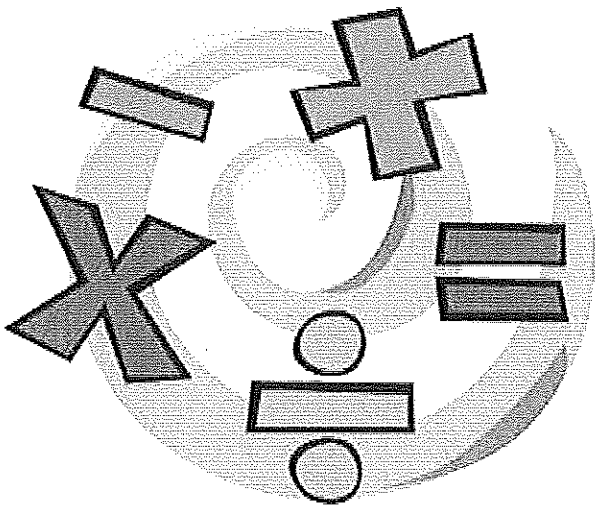
Owen J. Roberts School District

Parents' Guide to

Everyday Mathematics

Primary Grades 1 – 3



Owen J. Roberts School District

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Dear Parents,

The Owen J. Roberts School District is pleased to announce that *Everyday Mathematics* has arrived in Grades K – 6 as the core elementary mathematics program. All classrooms in Grades K – 6 will be using this research-based curriculum, developed as part of the University of Chicago School Mathematics Project (UCSMP). *Everyday Mathematics* reflects the state and national goals for mathematics and includes these features:

- A curriculum that explores mathematical content beyond basic arithmetic
- A problem-solving approach based on everyday situations
- Frequent, varied practice of basic skills
- An instructional approach that revisits concepts regularly
- An emphasis on communication and teamwork
- A commitment to home/school relationships

In the past few decades, there has been a tremendous increase in the importance of mathematics in the workplace and daily life. In order to succeed in this information- and technology-oriented environment, our students need to learn a range of sophisticated mathematical knowledge that extends far beyond basic calculation skills. *Everyday Mathematics* is a program that will prepare students for the future and enable them to achieve at high levels.

If you would like more information about *Everyday Mathematics*, please visit their website at www.everydaymathonline.com. You can become familiar with the math games that are a key component of practice in the program.

We are excited about the implementation of the *Everyday Mathematics* and feel confident that this program will make the study of mathematics an engaging, enriching and successful experience for all students in the Owen J. Roberts School District.

Janet E. Wolff
Supervisor of K-12 Mathematics

How Children Learn in *Everyday Mathematics*

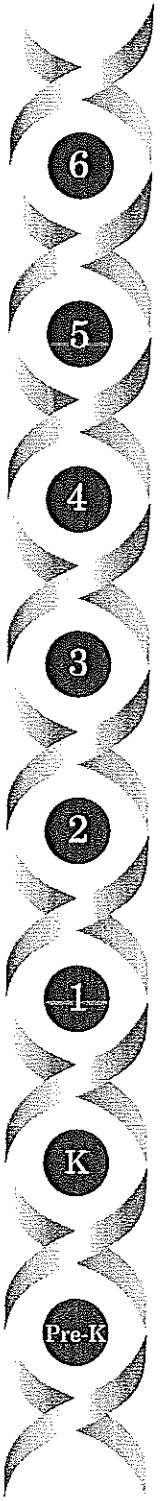
Think about the master chefs you see on television—how do they acquire their knowledge and skills? No one starts out chopping onions at high speed, inventing their own dishes, or running a restaurant! Chefs develop their cooking expertise over time, starting with basic skills and easy recipes. Gradually, they practice these skills, learn important food science concepts, and gain experience by cooking in many different restaurants.

In a similar way, *Everyday Mathematics* is based on the idea that children build understanding and develop skills as a result of many meaningful and connected learning experiences. Mastery of mathematics concepts and skills comes with repeated exposure and practice, not after just one lesson. This enables children to make new connections and build on the mathematical content they already know while gradually learning more difficult and challenging content. Think of this process as climbing a spiral staircase—with each twist of the stairs, the previous steps can be seen, but you are farther and higher.

To help children develop mastery, you may notice the mathematical content in this program is taught in a repeated fashion, first with informal exposure and then through more formal and directed instruction. For example, children will have many different hands-on experiences with subtraction—they will take items away from a set, count backwards on a number line, and make up number stories—before they learn pencil-and-paper procedures for subtraction.

The design of *Everyday Mathematics* allows your child to gain a more genuine understanding of mathematical concepts, a much more solid mathematical foundation, and exposure to the entire scope of mathematics each year.

How can you help? Because homework is one way children revisit concepts, you can support your child by helping with Home Links and playing math games at home when they are assigned.



How will children be assessed in *Everyday Mathematics*?

There are many opportunities to collect information about students' abilities in *Everyday Mathematics*. The purpose of gathering this information is to:

- see how each student's mathematical understanding is developing; and
- provide feedback to the teacher about each student's instructional needs.

The process of collecting information to track each student's progress and make decisions about how and what to teach is known as assessment. An assessment plan is an essential part of every effective educational program. Students show what they know and can do in different ways. For this reason, teachers have a variety of assessment tools and techniques. It is important to gather information not only about students' procedural skills, but also their understanding of concepts.

Ongoing Assessments

This is often called informal assessment because information is collected from the ordinary work that students do every day in mathematics class. Teachers use observation and students' products (work) to look for specific indicators of learning. Observation involves watching what students do and say during the lessons, games and practice. Work samples are often collected and reviewed.

Periodic Assessments

These are formal assessments, such as those that occur at the end of each unit, middle of the year and end of the year in *Everyday Mathematics*. These assessments are cumulative in nature and assess students on concepts several times throughout the year. In addition, district-created learning checks will be used that are aligned to state standards and provide student with additional opportunities to show their mathematical understanding of key concepts and skills. Because students will see mathematical content several times throughout the year, re-tests on unit assessments will not be available.

Benchmark and External Assessments

Many school districts, including OJRSD, use standardized assessments to measure students' progress toward state standards of performance. Students in Grades 3 – 6 will be assessed using 4-sight periodically throughout the year. In addition, students in Grades 1 – 6 will be assessed using Star Math which provides teachers with diagnostic information about each child's strengths and weaknesses in mathematics. Students in Grades 3 – 6 will take the Math PSSA which is the state test which measures student performance in Mathematics.

How to Help Your Child with Mathematics

Create a homework routine.
Familiar routines help work go smoothly at school *and* at home. With your child, decide on a time and place to do homework, along with a few rules. A typical routine might go like this:

Come home, have a snack, clear a space at the table, start math homework. Create a place for homework supplies. Always have a sharp pencil, and circle problems you want help with. Once homework is complete, put it in your book bag.

Read Family Letters and Study Links.
These pages describe what your child is learning so that you can help. They also suggest fun, easy math activities you can do at home. Consider keeping all of these pages in a special folder to refer to later.

Communicate with the teacher.
You are the link between your child and school, and it is your responsibility to share your thoughts and concerns with the teacher. Call or write a note if your child has had trouble with homework, ask questions if you or your child do not understand something, and share good news when you see progress.

Ask your child to explain.
Encourage your child to teach you the day's math lesson by using the problems in the Study Links. Ask questions about the steps your child uses to solve a problem, such as *Why did you put that number there?* or *What does that zero mean?*

Use questions to help.
Although it's tempting to give children answers when they're confused, they learn more if you help them discover the answers for themselves. Try doing this with questions such as these:

- *Have you seen problems like this before? Is there an example anywhere that might help?*
- *What is the problem asking you to do or to find?*
- *What's one idea you have for finding an answer?*
- *Can you draw a picture of the problem? Can you use objects* (like coins, beans, and so on) *to show the problem?*

Be accepting of mistakes.
Let your child know that every mistake is an opportunity to learn. When your child makes a mistake, ask him or her to explain how he or she arrived at the answer, give praise for the correct steps or thinking, and gently point out where the error occurred. Then have your child try a similar problem (you may have to make one up) to practice the new understanding.

Play math games.
Games your child brings home from school or store-bought games that involve mathematical thinking will help your child master skills. Your child's teacher can give you a list of popular commercial games with mathematical content.

Observe a mathematics lesson in your child's classroom, or volunteer to help.
Visit your child's classroom—it's the best way find out more about *Everyday Mathematics*. When you volunteer to help with activities, you also learn a great deal. Do not worry if you're not a math expert—teachers always appreciate an extra hand and will find ways to use your skills.

Read the *Student Reference Book* with your child.
Many schools periodically send home this "math encyclopedia" for families and students to use together. Choose a page or section related to the day's Study Link, and read it together. Try the activities or questions at the end of the section with your child.

Share real-life math situations.
Think about the ways you use math in your everyday life—at work, at the store, at the bank, in the kitchen, and so on. Invite your child to observe or participate in these activities with you. Encourage your child to think mathematically about common activities, such as folding laundry or taking out the garbage—*How many socks are in 12 pairs? About how many pounds does a bag of trash weigh?*

Give gifts that encourage mathematical exploration.
Children love special gadgets and tools, as well as games and activities that challenge their minds. Giving a gift related to math is a good way to reinforce and reward your child's accomplishments. Here are some ideas: a watch, a timer, an hour glass (egg timer), a calendar, a tape measure, a calculator, pattern blocks, books of brainteasers, 3-dimensional building kits, puzzles, maps, and a wide variety of games.

Content Emphasized in Grade 1

In *Everyday Mathematics*, children develop a broad background by learning concepts and skills in all these six content strands. The first-grade program emphasizes the following content.

Number and Numeration
Counting; reading and writing numbers; investigating place value of whole numbers; exploring fractions and money

Operations and Computation
Learning addition and subtraction facts, fact families, and extended facts; beginning informal work with properties of numbers and problem solving

Data and Chance
Collecting, organizing, and displaying data using tables, charts, and graphs

Measurement and Reference Frames
Using tools to measure length, capacity (quarts, liters), and weight; using clocks, calendars, timelines, thermometers, and ordinal numbers such as *fifth* and *tenth*

Geometry
Exploring 2-dimensional shapes (squares, triangles, rectangles) and 3-dimensional shapes (pyramids, cones, prisms)

Patterns, Functions, and Algebra
Exploring attributes, patterns, sequences, relations, and functions; finding missing numbers and rules in problems; studying properties of operations (addition and subtraction)

For a lesson-by-lesson view of the way children learn this content, see the Grade 1 *Content by Strand* Poster.

Do-Anytime Activities for Grade 1

These activities are easy and fun to do with your child at home, and they will reinforce the skills and concepts your child is learning in school.

Unit 1	◆ Have your child help create a number line (0–15) outside with sidewalk chalk. Call out a number and have your child jump on that number. Make up directions such as "Hop to the number that is two less" or "Jump to the number that is four more." Give a few more directions, and then have your child call out directions while you jump. If you don't have chalk, use paper, crayons, and fingers. ◆ Divide a deck of cards evenly between you and your child and put the cards facedown. For each turn, players flip their top card faceup and decide who has the larger number. That player collects both cards. Continue playing until the deck has been used. Play a second round, but have the player with the smaller number take both cards. You may assign points to Aces, Kings, Queens, and Jacks or remove them.
Unit 2	◆ Have your child create tally marks in batches of five until you say "Stop." Then skip count by 5s to see how many marks were written. ◆ Let your child count the dollars and coins in your wallet. Together, brainstorm the items that you can buy.
Unit 3	◆ Count orally by 2s, 5s, and 10s, sometimes starting at numbers other than 0. ◆ Choose a time "on the hour" (7:00, 2:00), and help your child set an analog clock or watch to that time.
Unit 4	◆ Have your child measure various objects in the house using his or her hand spans (outstretched fingers). Before measuring, estimate how many hand spans it will take to cover the object, then compare the estimate with the actual number. ◆ Practice writing numerals with various objects: pens, markers, crayons, paint, sand. Or form numerals using cotton balls, craft sticks, toothpicks, or rocks.
Unit 5	◆ Have your child create and tell you a number story that goes with a given number sentence, such as $4 + 2 = 6$. ◆ Create number stories that involve two or more items. For example, "I want to buy a doughnut for 45 cents and a juice box for 89 cents. How much money do I need?" ($1.34)

Unit 6	◆ Label each cup of an egg carton with the numbers 0–11. Put two pennies in the carton, close the lid, and shake it up. Using the numbers of the two sections the pennies landed in, make up and solve addition and subtraction problems. ◆ Use Fact Triangles to practice addition by covering the sum. Practice subtraction by covering one of the other numbers.
Unit 7	◆ Look for geometric shapes around the house, in the supermarket, on buildings, and on street signs. Help your child use geometric names for the shapes, such as triangle, square, rhombus, hexagon, and so forth. ◆ Help your child use paper and scissors to make various shapes such as rhombus, hexagon, trapezoid, pentagon, square, or circle. Take turns holding up each shape and naming them. After naming all of the shapes, make a design.
Unit 8	◆ Gather a dollar bill, a five dollar bill, and lots of change. Name an amount of money, such as "one dollar and 26 cents," and have your child use the real money to show you that amount. Try a few more and then switch roles. ◆ With your child, cut food, such as pizza, celery, carrots, sandwiches, pies, or green beans into halves, thirds, fourths, fifths, and so on. If you are cutting more than one of the same item, look at the pieces to compare the fractional parts. Ask questions such as "Which is bigger: the halves or the thirds?"
Unit 9	◆ Say a 2- or 3-digit number. Have your child identify the actual value of the digit in each place. For example, in the number 952, the value of the 9 is 900; the value of the 5 is 50; and the value of the 2 is two 1s, or 2. ◆ Take out various measuring cups and line them up. Ask your child, "Which holds more: $\frac{1}{2}$ cup or $\frac{1}{3}$ cup? $\frac{1}{4}$ cup or $\frac{1}{3}$ cup? Which holds less: $\frac{1}{3}$ cup or $\frac{2}{3}$ cup?" If your child can't determine which holds more, fill the measuring cups with water and pour the water into clear glasses to compare the amounts.
Unit 10	◆ Pick three single-digit numbers. Ask your child to write the smallest number and largest number using all three digits. For example, using 4, 2, and 7, the smallest number is 247 and the largest number is 742. ◆ Have your child name a temperature that is hot, cold, and mild. Using a map of the United States, discuss with your child states that are hot, cold, have temperatures in the teens in the winter, have temperatures over 100 degrees in the summer, and so on.

Content Emphasized in Grade 2

In *Everyday Mathematics*, children develop a broad background by learning concepts and skills in all these six content strands. The second-grade program emphasizes the following content.

Number and Numeration
Counting; reading and writing numbers; identifying place value; comparing numbers; working with fractions; using money to develop place value and decimal concepts

Operations and Computation
Recalling addition and subtraction facts; exploring fact families (related addition and subtraction facts, such as $2 + 5 = 7$, $5 + 2 = 7$, $7 - 5 = 2$, and $7 - 2 = 5$); adding and subtracting with tens and hundreds; beginning multiplication and division; exchanging money amounts

Data and Chance
Collecting, organizing, and displaying data using tables, charts, and graphs

Measurement and Reference Frames
Using tools to measure length, weight, capacity, and volume; using U.S. customary and metric measurement units, such as feet, centimeters, ounces, and grams; using clocks, calendars, timelines, thermometers, and number lines

Geometry
Exploring 2-dimensional and 3-dimensional shapes

Patterns, Functions, and Algebra
Exploring number patterns, rules for number sequences, relations between numbers, and attributes

For a lesson-by-lesson view of the way children learn this content, see the Grade 2 *Content by Strand* Poster.

Do-Anytime Activities for Grade 2

These activities are easy and fun to do with your child at home, and they will reinforce the skills and concepts your child is learning in school.

Unit 1	◆ Ask your child to count by certain intervals. For example, "Start at zero and count by 4s." ◆ Use the family calendar to discuss the number of months in a year, weeks in a month, and days in a week. Count how many days, weeks, or months it is until a special event, such as a birthday, holiday, party, or picnic.
Unit 2	◆ Practice turn-around facts with your child such as $6 + 4 = ?$ Then try $4 + 6 = ?$ Take turns creating turn-around facts and quizzing each other. ◆ Roll two dice and practice addition and subtraction by adding or subtracting the two numbers. Alternate turns with your child and have him or her check your answers.
Unit 3	◆ Gather a handful of coins with a value less than $2. Have your child calculate the total value. ◆ Ask the time throughout the day. Encourage alternate ways of naming time, such as *half past two* for 2:30.
Unit 4	◆ Make up number stories involving estimation. For example, pretend that your child has $2.00 and wants to buy a pencil that is marked $0.64, a tablet marked $0.98, and an eraser marked $0.29. Help your child estimate the total cost of the three items (without tax) to determine if there is enough money to buy all three. ◆ Practice addition and subtraction involving multiples of 10 by asking your child "What is $20 + 10$? $40 + 50$? $60 - 20$?"
Unit 5	◆ Look for 2- and 3-dimensional shapes in your home or neighborhood. Name the shapes and discuss their characteristics. ◆ Use household items (toothpicks and marshmallows, straw and twist-ties) to construct and name shapes. Encourage your child to try combining shapes to make other shapes.
Unit 6	◆ Think of two 2-digit numbers and ask your child to estimate the sum. For example $23 + 46 = ?$ (Estimate is $20 + 50 = 70$.) ◆ Think of a theme (such as animals, shopping, or sports). Take turns making up addition and subtraction number stories related to the theme. Share solution strategies.

Unit 7	◆ Try doubling, tripling, and quadrupling small numbers. ◆ Pick three objects in the house that measure less than a foot. Measure them in inches and then in centimeters.
Unit 8	◆ Read a recipe, and discuss the fractions in it. For example, ask "How many $\frac{1}{4}$ cups of sugar would we need to get 1 cup of sugar?" ◆ Have your child compare two fractions and tell which is greater. Ask questions to help your child visualize the fractions, such as "Which would give you more pizza: $\frac{1}{8}$ of a pizza or $\frac{1}{4}$?"
Unit 9	◆ Find containers that hold 1 pint, 1 cup, 1 quart, and 1 gallon. Hold up the pint and ask your child to guess how many cups are in a pint. Fill the pint with water and pour into the cup until it is filled. Check your guess. Now try cups to quart and then quarts to gallon. ◆ Gather a tape measure, yardstick, ruler, cup, gallon container, and scale. Discuss which is the best tool for different measurement situations. For example, ask "What would you use to measure the length of a room?" or "Which would you use to find out how much water the bathtub holds?"
Unit 10	◆ Take out a few dollars and lots of coins. Call out an amount of money, such as $1.45. Ask your child to show you that amount (for example, 1 dollar bill, 1 quarter, and 2 dimes.) Then prompt your child to show several other ways to represent $1.45. Play again with a new amount. ◆ Say a dollar amount to your child, such as "two dollars and thirty cents." Ask your child to key in that number on the calculator. Check for the correct placement of the decimal. Make up a few more and then switch roles. When your child calls out an amount, make sure he or she always says "and" for the decimal point.
Unit 11	◆ Practice multiplying numbers by 2, 5, and 10. ◆ Use Fact Triangles to practice multiplication by covering the product. Practice division by covering one of the other numbers.
Unit 12	◆ Practice telling time to 5 minutes by helping your child set an analog clock or watch. Some times for your child to try might be 1:05, 3:15, 5:45, and 7:30. ◆ Say a 3- or 4-digit number and have your child identify the actual value of the digit in each place. For example, in the number 3,587, the value of the 3 is 3,000; the value of the 5 is 500; and so on.

Content Emphasized in Grade 3

In *Everyday Mathematics*, children develop a broad background by learning concepts and skills in all these six content strands. The third-grade program emphasizes the following content.

Number and Numeration
Counting patterns; place value; reading and writing whole numbers through 1,000,000; fractions, decimals, and integers

Operations and Computation
Practicing multiplication and division facts extended to multidigit problems; working with properties; operations with fractions and money

Data and Chance
Collecting, organizing, and displaying data using tables, charts, and graphs; using basic probability terms

Measurement and Reference Frames
Recording equivalent units of length; recognizing appropriate units of measure for various items; finding the area of rectangles by counting squares; using multiplication arrays, coordinate grids, thermometers, clocks, calendars, and map scales to estimate distances

Geometry
Exploring 2-dimensional and 3-dimensional shapes and other geometric concepts

Patterns, Functions, and Algebra
Finding patterns on the number grid; solving Frames-and-Arrows puzzles having two rules; completing variations of "What's My Rule?" activities; exploring the relationship between multiplication and division; using parentheses in writing number models; naming missing parts of number models

For a lesson-by-lesson view of the way children learn this content, see the Grade 3 *Content by Strand* Poster.

Do-Anytime Activities for Grade 3

These activities are easy and fun to do with your child at home, and they will reinforce the skills and concepts your child is learning in school.

Unit 1	◆ Draw an analog clock face with the hour and minute hands showing 8 o'clock. Ask your child to write the time shown. Repeat with other times such as 3:30, 11:45, and 7:10. If you don't want to draw a clock face each time, use craft sticks or toothpicks for the hour and minute hands. ◆ Make combinations of bills and coins using money from your wallet or a piggy bank. Have your child write the amount shown using a dollar sign and a decimal point. For example, suggest 4 dollar bills, 3 dimes, and 2 pennies. Your child would write $4.32.
Unit 2	◆ Practice addition and subtraction fact extensions, for example, $6 + 7 = 13$; $60 + 70 = 130$; $600 + 700 = 1{,}300$. ◆ Use Fact Triangles to practice multiplication by covering the product. Practice division by covering one of the other numbers. Make this brief and fun.
Unit 3	◆ Measure various items with your child with each of you using personal measures, such as paces or hand spans. Discuss why, for example, the width of your living room is only 15 of your paces but 25 of your child's. Talk about why standard units are useful. ◆ Draw three different polygons such as a square, a rectangle, and a triangle. Ask your child to estimate which has the largest and which one has the smallest perimeter. Then, help your child measure the sides with a ruler and determine the exact perimeter of each polygon. Compare your child's estimate with the actual perimeters.
Unit 4	◆ Ask questions that involve multiples of equal groups. For example, say "Pencils are packaged in boxes of 8. There are 3 boxes. How many pencils are there?" ◆ Ask questions that involve equal sharing. For example, say "Seven children share 49 baseball cards. How many cards does each child get? How many cards are left over?"
Unit 5	◆ Write decimals for your child to read aloud, such as 0.32 (thirty-two hundredths) or 0.9 (nine-tenths). ◆ Write down two 4- or 5-digit numbers. Ask your child to tell which is larger and explain why. Try a few more and then switch roles.

Unit 6	◆ Search for geometric figures with your child. Identify figures by name, if possible, and talk about their characteristics. For example, a stop sign is an octagon, with 8 sides and 8 angles. A brick is a rectangular prism, where all faces are rectangles. ◆ Have your child use a protractor to draw a design using only acute angles (less than 90°). Other designs can be made using obtuse angles (between 90° and 180°) and right angles (90°).
Unit 7	◆ Have your child write three different number sentences using parentheses that equal 16. Some examples are $1 \times (32 - 16)$, $4 + 4 + (8 \div 2) + (2 \times 2)$, and $(16 \div 2 + 2) + (3 \times 2)$. ◆ Provide your child with problems with missing factors for multiplication practice. For example, ask "6 times what number equals 18?"
Unit 8	◆ Help your child find fractions in the everyday world—in advertisements, on measuring tools, in recipes, and so on. ◆ Have your child trace around an object such as a deck of cards, a box, a plate, a cup, a can, and so on. Divide the figure equally into 4 parts. Ask your child to color $\frac{3}{4}$ of the shape. Try a few more using different figures and dividing them into different fractional parts. Instead of tracing around an object, draw figures such as squares, rectangles, and circles.
Unit 9	◆ Ask your child how many 10s are in 30, 50, 100, 1,000 and so on. ◆ Take out different objects such as buttons, counters, pennies, and paperclips. Divide them into 3 equal groups. How many are in each group? How many are left over?
Unit 10	◆ Review equivalent names for measurements. For example, ask "How many cups are in a pint?" To test it out, count how many cups of water a pint container will hold. ◆ Name items around the house that weigh less than 5 pounds, 10 pounds, and 20 pounds. If you have a scale, place the items on the scale to check your guesses.
Unit 11	◆ Use the weather as a springboard to discuss probability. Begin by noting the chance (percentage) for rain, and then ask your child if it seems likely or unlikely that it will rain. ◆ Make a number line from –6 through 6, leaving off some of the numbers. Ask your child to fill in the missing numbers. Try another number line with a different range of numbers and blank spaces. Then switch roles, and have your child create a number line, leaving off some labels for you to fill in.

Literature List for Grades 1–3

Your child will enjoy reading literature related to mathematics at home. Many of these titles can be found at your local library.

Number Patterns and Counting

12 Ways to Get to 11
Eve Merriam
Aladdin Paperbacks, 1996

26 Letters and 99 Cents
Tana Hoban
Greenwillow Books, 1991

Arctic Fives Arrive
Elinor J. Pinczes
Houghton Mifflin, 1996

Can You Count Ten Toes?: Count to 10 in 10 Different Languages
Lezlie Evans
Houghton Mifflin, 2004

City by Numbers
Stephen T. Johnson
Viking, 1999

Each Orange Had 8 Slices
Paul Giganti
HarperTrophy, 1999

Less Than Zero
Stuart J. Murphy
HarperTrophy, 2003

Math for All Seasons
Greg Tang
Scholastic, 2002

Missing Mittens
Stuart J. Murphy
HarperCollins Publishers, 2001

One Hundred Ways to Get to 100
Jerry Pallotta
Scholastic, 2003

Pattern Bugs
Trudy Harris
The Millbrook Press, 2001

Pizza Counting
Christina Dobson
Charlesbridge, 2002

Six Foolish Fishermen
Daniel San Souci
Hyperion, 2000

Twenty Is Too Many
Kate Duke
Dutton Children's Books, 2000

Two Ways to Count to Ten: A Liberian Folktale
Ruby Dee
Henry Holt and Company, 1988

What's a Pair? What's a Dozen?
Stephen R. Swinburne
Boyds Mills Press, 2000

Number Stories and Operations

Amanda Bean's Amazing Dream
Cindy Neuschwander
Scholastic, 1998

Anno's Mysterious Multiplying Jar
Masaichiro Anno
HarperTrophy, 1986

Bats on Parade
Kathi Appelt
HarperCollins Publishers, 1999

The Best of Times
Greg Tang
Scholastic, 2002

The Doorbell Rang
Pat Hutchins
Greenwillow Books, 1986

Equal Shmequal
Virginia Kroll
Charlesbridge, 2005

The Grapes of Math
Greg Tang
Scholastic, 2001

The Great Divide: A Mathematical Marathon
Dayle Ann Dodds
Candlewick, 2005

How Hungry Are You?
Donna Jo Napoli and Richard Tchen
Atheneum Books, 2001

If You Hopped Like a Frog
David Schwartz
Scholastic, 1999

Mission: Addition
Loreen Leedy
Holiday House, 1997

One Hundred Hungry Ants
Elinor J. Pinczes
Houghton Mifflin, 1993

Pizza Counting
Christina Dobson
Charlesbridge, 2002

A Remainder of One
Elinor Pinczes
Houghton Mifflin, 1995

Spaghetti and Meatballs for All
Marilyn Burns
Scholastic, 1999

Two of Everything: A Chinese Folktale
Lily Toy Hong
Albert Whitman & Co., 1993

The Warlord's Beads
Virginia Walton Pilegard
Pelican, 2001

Place Value

Anno's Counting Book
Mitsumasa Anno
HarperTrophy, 1986

Can You Count to a Googol?
Robert E. Wells
Albert Whitman & Co., 2000

Count to a Million
Jerry Pallotta
Scholastic, 2003

A Place for Zero
Angeline Sparagna LoPresti
Charlesbridge, 2003

Estimation

Betcha!
Stuart J. Murphy
HarperTrophy, 1997

How Much, How Many, How Far, How Heavy, How Long, How Tall is 1,000?
Helen Nolan
Kids Can Press, 2001

Fractions

Apple Fractions
Jerry Pallotta
Scholastic, 2002

Fraction Action
Loreen Leedy
Holiday House, 1996

Fraction Fun
David Adler
Holiday House, 1996

Lulu's Lemonade
Barbara deRubertis
The Kane Press, 2000

Data and Chance

Bart's Amazing Charts
Diana Ochiltree
Scholastic, 1996

Cloudy with a Chance of Meatballs
Judi Barrett
Antheneum Books, 1978

Do You Wanna Bet?
Jean Cushman
Clarion, 1991

Probably Pistachio
Stuart J. Murphy
HarperTrophy, 2001

Geometry

The Art of Shapes for Children and Adults
Margaret Steele and Cindy Estes
Moca Store, 1997

A Cloak for the Dreamer
Arlene Friedman
Scholastic, 1995

Cubes, Cones, Cylinders, & Spheres
Tana Hoban
Greenwillow Books, 2000

Grandfather Tang's Story
Ann Tompert
Crown Publishers, 1990

The Greedy Triangle
Marilyn Burns
Scholastic, 1994

If You Look Around You
Fulvio Testa
Dial Books, 1983

The Librarian Who Measured the Earth
Katheryn Lasky
Little, Brown, 1994

Round Is a Mooncake
Roseanne Thong
Chronicle Books, 2000

Shapes, Shapes, Shapes
Tana Hoban
HarperTrophy, 2003

Sir Cumference and the First Round Table (and other *Sir Cumference* titles)
Cindy Neuschwander
Charlesbridge, 1997

When a Line Bends... A Shape Begins
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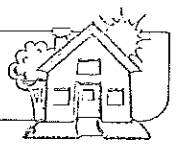
Algorithms in *Everyday Mathematics*



What is an algorithm?

An algorithm is a well-defined procedure or set of rules guaranteed to achieve a certain objective. You use an algorithm every time you follow the directions to put together a new toy, use a recipe to make cookies, or defrost something in the microwave.

In mathematics, an algorithm is a specific series of steps that will give you the correct answer every time. For example, in grade school, you and your classmates probably learned and memorized a certain algorithm for multiplying. Chances are, no one knew why it worked, but it did!

In *Everyday Mathematics*, students first learn to understand the mathematics behind the problems they solve. Then, quite often, they come up with their own unique working algorithms that prove that they "get it." Through this process, they discover that there is more than one algorithm for computing answers to addition, subtraction, multiplication, and division problems. Having students become comfortable with algorithms is essential to their growth and development as problem solvers.

How do students learn to use algorithms for computation?

Ideally, students should develop a variety of computational methods and the flexibility to choose the procedure that is most appropriate in a given situation. *Everyday Mathematics* includes a variety of standard computational algorithms, as well as students' invented procedures. The program leads students through three phases as they learn each mathematical operation (addition, subtraction, multiplication, and division).

Algorithm Invention

In the early phases of learning an operation, students are encouraged to invent their own methods for solving problems. This approach requires students to focus on the meaning of the operation. They learn to think and use their common sense, as well as new skills and knowledge. Students who invent their own procedures:

- learn that their intuitive methods are valid and that mathematics makes sense.
- become more proficient with mental arithmetic.
- are motivated because they understand their own methods, as opposed to learning by rote.
- become skilled at representing ideas with objects, words, pictures, and symbols.
- develop persistence and confidence in dealing with challenging problems.

Alternative Algorithms

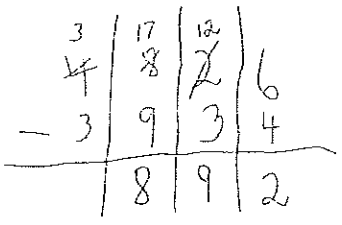
After students have had many opportunities to experiment with their own computational strategies, they are introduced to several algorithms for each operation. Some of these algorithms may be the same or similar to the methods students have already invented on their own. Others are traditional algorithms which have commonly been taught in the U.S. or simplifications of those algorithms. And others are entirely new algorithms that have significant advantages in today's technological world.

Students are encouraged to experiment with various algorithms and to become proficient with at least one.

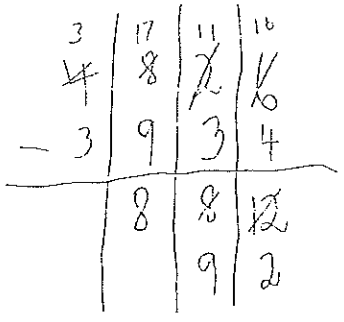
Demonstrating Proficiency

For each operation, the program designates one alternative algorithm as a "focus" algorithm. Focus algorithms are powerful, relatively efficient, and easy to understand and learn. They also provide common and consistent language, terminology, and support across grade levels of the curriculum.

All students are expected to learn and demonstrate proficiency with the focus algorithm. Once they can reliably use the focus algorithm, students may use it or any alternative they prefer when solving problems. The aim of this approach is to promote flexibility while ensuring that all students know at least one reliable method for each operation.



trade-first subtraction with columns



trade-first subtraction with an unnecessary trade

Addition Algorithms

This section presents just a few of the possible algorithms for adding whole numbers.

Focus Algorithm: Partial-Sums Addition

You can add two numbers by calculating partial sums, working one place-value column at a time, and then adding all the sums to find the total.

Example: Partial-Sums Addition

	268
	+ 483
Add the hundreds (200 + 400).	600
Add the tens (60 + 80).	140
Add the ones (8 + 3).	+ 11
Add the partial sums (600 + 140 + 11).	751

Column Addition

To add using the column-addition algorithm, draw vertical lines to separate the ones, tens, hundreds, and so on. Add the digits in each column, and then adjust the results.

Example: Column Addition

Add the digits in each column.

	hundreds	tens	ones
	2	6	8
+	4	8	3
	6	14	11

Since 14 tens is 1 hundred plus 4 tens, add 1 to the hundreds column, and change the number in the tens column to 4.

	hundreds	tens	ones
	2	6	8
+	4	8	3
	7	4	11

Since 11 ones is 1 ten plus 1 one, add 1 to the tens column, and change the number in the ones column to 1.

	hundreds	tens	ones
	2	6	8
+	4	8	3
	7	5	1

For some students, the above process becomes so automatic that they start at the left and write the answer column by column, adjusting as they go without writing any of the intermediate steps. If asked to explain, they might say something like this:

"200 plus 400 is 600. But (looking at the next column) I need to adjust that, so I write 7. 60 and 80 is 140. But that needs adjusting, so I write 5. 8 and 3 is 11. With no more to do, I can just write 1."

Opposite-Change Rule

If you add a number to one part of a sum and subtract the same number from the other part, the result remains the same. For example, consider:

$$8 + 7 = 15$$

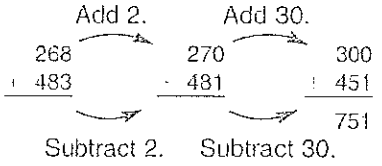
Now add 2 to the 8, and subtract 2 from the 7:

$$(8 + 2) + (7 - 2) = 10 + 5 = 15$$

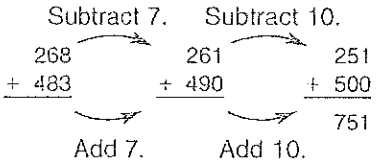
This idea can be used to rename the numbers being added so that one of them ends in zeros.

Example: Opposite-Change Rule

Rename the first number and then the second.



Rename the second number and then the first.



Subtraction Algorithms

There are even more algorithms for subtraction than for addition, probably because subtraction is more difficult. This section presents several subtraction algorithms.

Focus Algorithm: Trade-First Subtraction

This algorithm is similar to the traditional U.S. algorithm except that all the trading is done before the subtraction, allowing children to concentrate on one thing at a time.

Example: Trade-First Subtraction

Examine the columns. You want to make trades so that the top number in each column is as large as or larger than the bottom number.

	hundreds	tens	ones
	9	3	2
−	3	5	6

To make the top number in the ones column larger than the bottom number, borrow 1 ten. The top number in the ones column becomes 12, and the top number in the tens column becomes 2.

	hundreds	tens	ones
		2	12
	9	~~3~~	~~2~~
−	3	5	6

To make the top number in the tens column larger than the bottom number, borrow 1 hundred. The top number in the tens column becomes 12, and the top number in the hundreds column becomes 8.

	hundreds	tens	ones
		12	
	8	~~2~~	12
	~~9~~	~~3~~	~~2~~
−	3	5	6

Now subtract column by column in any order.

	hundreds	tens	ones
		12	
	8	~~2~~	12
	~~9~~	~~3~~	~~2~~
−	3	5	6
	5	7	6

Counting Up

To subtract using the counting-up algorithm, start with the number you are subtracting (the subtrahend), and "count up" to the number you are subtracting from (the minuend) in stages. Keep track of the amounts you count up at each stage. When you are finished, find the sum of the amounts.

Example: Counting Up

To find 932 − 356, start with 356 and count up to 932.

356
Add 4 to count up to the nearest ten.
360
Add 40 to count up to the nearest hundred.
400
Add 500 to count up to the largest possible 100.
900
Add 32 to count up to 932.
932

Now find the sum of the numbers you added.

```
   4
  40
 500
+ 32
 576
```

So, 932 − 356 = 576.

Left-to-Right Subtraction

To use this algorithm, think of the number you are subtracting as a sum of ones, tens, hundreds, and so on. Then subtract one part of the sum at a time.

Example: Left-to-Right Subtraction

To find 932 − 356, think of 356 as the sum 300 − 50 + 6. Then subtract the parts of the sum one at a time, starting from the hundreds.

```
                    932
Subtract the hundreds.  − 300
                    632
Subtract the tens.      −  50
                    582
Subtract the ones.      −   6
                    576
```

Same-Change Rule

If you add or subtract the same number from both parts of a subtraction problem, the results remain the same. Consider, for example:

$$15 - 8 = 7$$

Now add 4 to both the 15 and the 8:

$$(15 - 4) - (8 - 4) = 19 - 12 = 7$$

Or subtract 6 from both the 15 and the 8:

$$(15 - 6) - (8 - 6) = 9 - 2 = 7$$

The same-change rule algorithm uses this idea to rename both numbers so the number being subtracted ends in zeros.

Example: Same-Change Rule

Add the same number.

Add 4.		Add 40.		
932	→	936	→	976
− 356		− 360		− 400
			Subtract.	576

Example: Same-Change Rule

Subtract the same number.

Subtract 6.		Subtract 50.		
932	→	926	→	876
− 356		− 350		− 300
			Subtract.	576

Partial-Differences Subtraction

The partial-differences subtraction algorithm is a fairly unusual method, but one that appeals to some students.

The procedure is fairly simple: Write partial differences for each place, record them, and then add them to find the total difference. A complication is that some of the partial differences may be negative.

Example: Partial-Differences Subtraction

		932
		− 356
Subtract 100s.	900 − 300	600
Subtract 10s.	30 − 50	− 20
Subtract 1s.	2 − 6	− 4
Add the partial differences.		576

Multiplication Algorithms

Students' experiences with addition and subtraction algorithms can help them invent multiplication algorithms. For example, when estimating a product mentally, many students begin to compute partial products: "Ten of these would be. . ., so 30 of them would be. . ., and we need 5 more, so. . ." Beginning in *Third Grade Everyday Mathematics*, this approach is formalized as the partial-products multiplication algorithm. This algorithm and others are discussed in this section.

Focus Algorithm: Partial Products

To use the partial-products algorithm, think of each factor as the sum of ones, tens, hundreds, and so on. Then multiply each part of one sum by each part of the other, and add the results.

Rectangular arrays can be used to demonstrate visually how the partial-products algorithm works. The product 14 * 23 is the number of dots in a 14-by-23 array. The diagram below shows how each of the partial products is represented in the array.

Example: Partial Products

To find 67 * 53, think of 67 as 60 + 7 and 53 as 50 + 3. Then multiply each part of one sum by each part of the other, and add the results.

	67 * 53
Calculate 50 * 60.	3,000
Calculate 50 * 7.	350
Calculate 3 * 60.	180
Calculate 3 * 7.	+ 21
Add the results.	3,551

	20	3
10	10 * 20	10 * 3
4	4 * 20	4 * 3

$$\begin{aligned} 14 \times 23 &= (10 + 4) * (20 - 3) \\ &= (10 * 20) + (10 * 3) + (4 * 20) + (4 * 3) \\ &= 200 + 30 + 80 + 12 \\ &= 322 \end{aligned}$$

Modified Repeated Addition

Many students are taught to think of whole-number multiplication as repeated addition. However, using repeated addition as a computation method is inefficient for anything but small numbers. For example, it would be extremely tedious to add fifty-three 67s in order to compute 67 * 53. Using a modified repeated addition algorithm, in which multiples of 10, 100, and so on, are grouped together, can simplify the process.

Example: Modified Repeated Addition

	67 * 53
Think of 53 * 67 as fifty 67s plus three 67s.	
Since ten 67s is 670, fifty 67s is five 670s.	670 670 670 670 670
So, 53 * 67 is five 670s plus three 67s.	67 67 67
	3,551

Lattice Multiplication

Everyday Mathematics initially included the lattice method for its recreational value and historical interest (it has been used since A.D. 1100 and appeared in the first printed arithmetic book, published in 1478) and because it provided practice with multiplication facts and adding single-digit numbers. This method has become a favorite of many students in *Everyday Mathematics*.

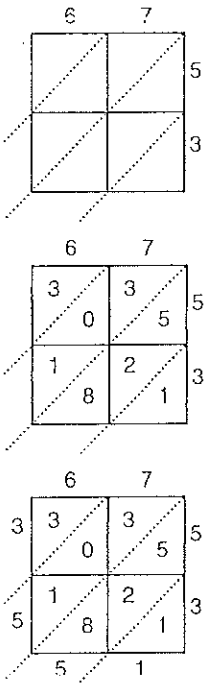
The following example shows how the method is used to find 67 * 53.

Example: Lattice Multiplication

Follow these steps to find 67 * 53.

- Draw a 2-by-2 lattice, and write one factor along the top of the lattice and the other along the right. (Use a larger lattice to multiply numbers with more digits.)
- Draw diagonals from the upper-right corner of each box, extending beyond the lattice.
- Multiply each digit in one factor by each digit in the other. Write each product in the cell where the corresponding row and column meet. Write the tens digit of the product above the diagonal and the ones digit below the diagonal. For example, since 6 * 5 = 30, write 30 in the upper-left box with the 3 above the diagonal and the 0 below.
- Starting with the lower-right diagonal, add the numbers inside the lattice along each diagonal. If the sum along a diagonal is greater than 9, carry the tens digit to the next diagonal.

  The first diagonal contains only 1, so the sum is 1. The sum on the second diagonal is 5 + 2 + 8 = 15. Write only the 5, and carry the 1 to the next column. The sum along the third diagonal is then 1 + 3 + 0 + 1, or 5. The sum on the fourth diagonal is 3.
- Read the product from the upper left to the lower right. The product is 3,551.



Division Algorithms

One type of division situation involves making as many equal-size groups as possible from a collection of objects: How many dozens can you make with 746 eggs? How many 5-passenger cars are needed for 37 people? Such problems ask, "How many of these are in that?" More generally, a / b can be interpreted as "How many bs are in a?" This idea forms the basis for the division algorithms presented in this section.

Focus Algorithm: Partial Quotients

The partial-quotients algorithm uses a series of "at least, but less than" estimates of how many bs are in a.

Example: Partial Quotients

Estimate the number of 12s in 158.

You might begin with multiples of 10 because they are simple to work with. There are at least ten 12s in 158 (10 * 12 = 120), but there are fewer than twenty (20 * 12 = 240). Record 10 as a first estimate, and subtract ten 12s from 158, leaving 38.

Now estimate the number of 12s in 38.

There are more than three (3 * 12 = 36) but fewer than four (4 * 12 = 48). Record 3 as the next estimate, and subtract three 12s from 38, leaving 2.

Since 2 is less than 12, you can stop estimating. The final result is the sum of the estimates (10 + 3 = 13) plus what is left over (the remainder of 2).

12)158	10	first guess
120		
38	3	second guess
36		
2	13	sum of guesses

158 / 12 ⟶ 13 R2

Column Division

Column division is a simplification of the traditional long division algorithm you probably learned in school. but it is easier to learn. To use the method, you draw vertical lines separating the digits of the divisor and work one place-value column at a time.

Example: **Column Division**

To find 683 / 5, imagine sharing $683 among 5 people. Think about having 6 hundred-dollar bills, 8 ten-dollar bills, and 3 one-dollar bills.

First, divide up the hundred-dollar bills. Each person gets one, and there is one left over.

1		
5)6	8	3
− 5		
1		

Trade the leftover hundred-dollar bill for 10 ten-dollar bills. Now you have a total of 18 ten-dollar bills. Each person gets 3, and there are 3 left over.

1	3	
5)6	~~8~~	3
− 5	18	
~~1~~	− 15	
	3	

Trade the 3 leftover ten-dollar bills for 30 one-dollar bills. You now have a total of 33 one-dollar bills. Each person gets 6, and there are 3 left over.

1	3	6
5)6	~~8~~	~~3~~
− 5	18	33
~~1~~	− 15	− 30
	~~3~~	3

So, when you divide $683 among 5 people, each person gets $136, and there are $3 left over. So, 683 / 5 = 136 R3.