The University of Chicago School Mathematics Project

UCSMP Newsletter

No. 40, Spring 2009

Third Edition UCSMP Materials

We are pleased to announce the existence of the entire Third Edition of UCSMP materials, from Pre-Kindergarten through grade 12, all by the same publisher, Wright Group/ McGraw-Hill. The content is enriched, more real-world applications have been added, and the use of available technologies has been increased in the materials to provide a high-quality learning experience for every student.

There are two new texts within the series, Pre-Kindergarten *Everyday Mathematics* and *Pre-Transition Mathematics*. In this issue of the *UCSMP Newsletter*, we describe the features of the Third Edition materials and compare them to our prior editions.

Some Beliefs Underlying the UCSMP Pre-K—12 Curriculum

In UCSMP Newsletters in 1987 and again in 2003, we indicated some of the beliefs that underlie the UCSMP curricula. We summarize a few of these beliefs here.

1. Mathematics is valuable to the average citizen, yet huge numbers of students leave high school mathematically ill-prepared for the activities they will undertake.

2. The traditional K-8 mathematics curriculum wastes time, not taking advantage of what students know when they enter the classroom and needlessly reviewing what students have already learned.

3. The scope of school mathematics should expand at all levels, including number and operation, algebra and functions, geometry and measurement, probability and statistics, and discrete mathematics.

4. The classroom should reflect the real world both in the choices of activities and problems and the choices of methods (paper and pencil, calculator, computer).

5. Students learn best when they are actively involved in their learning, and usually need practice and review over time in order to achieve mastery.

These beliefs are naturally actuated in different ways at the different grade levels.

UCSMP Target Chart Explanation

Grade			
Pre-K	Everyday Mathematics Pre-Kindergarten		
K	Everyday Mathematics Kindergarten		
1	Everyday Mathematics 1		
2	Everyday Mathematics 2		
3	Everyday Mathematics 3		
4	Everyday Mathematics 4		
5	Everyday Mathematics 5		
6	Everyday Mathematics 6	or	Pre-Transition Mathematics
7	Algebra	Transition Mathematics	Pre-Transition Mathematics
8	Geometry	Algebra	Transition Mathematics
9	Advanced Algebra	Geometry	Algebra
10	Functions, Statistics, and Trigonometry	Advanced Algebra	Geometry
11	Precalculus and Discrete Mathematics	Functions, Statistics, and Trigonometry	Advanced Algebra
12	Calculus (Not available through UCSMP)	Precalculus and Discrete Mathematics	Functions, Statistics, and Trigonometry

To interpret the chart, please see the next page.

Inside this issue . . .

EVERYDAY MATHEMATICS OVERVIEW

Everyday Mathematics, Pre-Kindergarten through Grade 6

Everyday Mathematics® is currently used by more than 3 million students in 175,000 classrooms across the United States. The Third Edition of *Everyday Mathematics* was first published in 2006. It includes a completely new Pre-Kindergarten program for children who are ages 3 and 4, a number of new components for grades K-6, and enhancements to help teachers deal with the challenges of today's classrooms.

The new Pre-K program was developed and refined after extensive research and field-testing in preschools ranging from Head Start to private programs. The Pre-K components include a *Program Guide and Masters*, a *Teacher's Guide to Activities*, a *Theme Book* that is a resource for ideas when integrating mathematics into thematic units commonly used in early childhood classrooms, *Pre-K Minute Math* that contains brief activities for transition times and spare moments throughout the day, and a set of *Mathematics at Home* booklets. Unlike most other Pre-K programs, Pre-K *Everyday Mathematics* is fully integrated with Kindergarten *Everyday Mathematics* and, thus, the entire *Everyday Mathematics* program.

UCSMP New Target Chart, cont'd from previous page

The color on the chart for each course has been chosen to be close to the main color of the materials for that course and has no other significance.

At grade 6 the chart begins to show a choice of materials. To simplify any inservice needs, we recommend a K-6 school use *Everyday Mathematics 6*, which has the style of the prior *Everyday Mathematics* courses; and a 6-8 school use *Pre-Transition Mathematics*, which has the style of the later courses.

Diligence and work outside the classroom are traits that we try to foster in UCSMP courses at all grades. However, starting with grades 6 and 7, the importance of these traits increases in significance. A child who, for whatever reason, does not give attention in class to problems that are not immediately accessible and who does not put in the effort outside of school in homework, will lag behind peers in performance and understanding. The choices of UCSMP courses beginning at grade 7 represent that reality. They are not to be interpreted as tracking, but as putting all students on the same track and realizing that they learn at different paces and are ready to learn at different ages.

The Third Edition includes other new components for grades K-6, including: *My First Math Book* (a Kindergarten student book analogous to the *Student Journals* for grades 1-6), *Resources for the Kindergarten Classroom* (including curriculum support materials for teachers), *My Reference Book* (a resource book for students in grades 1-2, analogous to the *Student Reference Books* for grades 3-6), and *5-Minute Math* (for grades 4-6, so that all grades Pre-K- 6 now include appropriate *Minute Math* components).

The Third Edition provides in-depth differentiated instruction to support teachers with diverse groups of learners. This includes support to help teachers make mathematics more accessible to English-language learners, as well as readiness activities to prepare children for the lessons; a variety of extra practice activities, which include games that allow students to enjoy working longer on understanding concepts; and enrichment activities for students who have grasped the concepts quickly. A new *Differentiation Handbook* has been created for each of grades 1-6.

The Third Edition also provides enhanced teacher support by explicitly defining program and grade-level goals and carefully articulating these across each grade. The mathematics in *Everyday Mathematics* is an integration of topics in numeration, arithmetic operations, algebra and functions, geometry, measurement, and data analysis and probability. Proficiency in each of these strands is clearly defined in grade-level goals that are linked to individual lessons and assessments. These goals are actualized when closure is achieved, and detailed expectations for *Everyday Mathematics* users are met far beyond what instructional materials typically provide. Formative assessments are clearly tied to grade-level goals in this latest edition. The program goals for *Everyday Mathematics* are listed below; the program goals are organized by strand and grade-level goals are then defined for each program goal.

Number and Numeration Strand:

- Understand the meanings, uses, and representations of numbers
- Understand equivalent names for numbers
- Understand common numerical relations

EVERYDAY MATHEMATICS OVERVIEW

Operations and Computation Strand:

- Compute accurately
- Make reasonable estimates (Computational Estimation)
- Understand meanings of operations (Models for the Operations)

Data and Chance Strand:

- Select and create appropriate graphical representations of collected or given data
- Analyze and interpret data
- Understand and apply basic concepts of probability

Measurement and Reference Frames Strand:

- Understand the systems and processes of measurement; use appropriate techniques, tools, units, and formulas in making measurements
- Use and understand reference frames

Geometry Strand:

- Investigate characteristics and properties of two- and three-dimensional shapes
- Apply transformations and symmetry in geometric situations

Patterns, Functions, and Algebra Strand:

- Understand patterns and functions
- Use algebraic notation to represent and analyze situations and structures

To gain a better feel for how goals are articulated across the grades, we focus in this Newsletter on two specific program goals within the Operations and Computation Strand — Computational Estimation, and Models for the Operations — and show how these goals are stepped through the grades. In addition, we use the Highlights section for each grade to describe particularly noteworthy content, projects, or activities for those grades.

Everyday Mathematics Pre-Kindergarten and Kindergarten

Computational Estimation: There are no grade-level goals of this type for either grade. Children in grades Pre-Kindergarten and Kindergarten are developing early number sense, an understanding of basic addition and subtraction concepts, and some concrete strategies for solving problems. A solid foundation in these areas leads to an ability to make rough estimates and evaluate the reasonableness of one's answers.

Models for the Operations: In Pre-K *Everyday Mathematics* (EM), children develop their understanding of addition and subtraction informally and experientially by singing such songs as "one-more" and "one-less," and through number stories that they act out with their bodies, puppets, counters, and other concrete objects. In Kindergarten EM, number stories continue to be important for developing children's understanding of the meaning of operations, and as a natural bridge from spoken to symbolic language. Children categorize number stories as addition or subtraction and begin to relate the +, –, and = symbols to the actions in the stories. They use number sentences to model number stories.

Highlight: The Pre-K *Teacher's Guide to Activities* suggests over 150 mathematical activities and games that early childhood teachers can use in their classrooms. It includes a unique section called "Mathematics All Around," that heightens teachers' awareness of the spontaneous mathematics that emerges from children's play and work in all areas of the preschool classroom, and helps teachers set up their classrooms to promote these types of activities.

Kindergarten EM places great emphasis on eight "Ongoing Daily Routines" that help teachers integrate mathematics into the daily life of the classroom and provide continuous, meaningful practice with skills in virtually every mathematical strand. For example, as children construct a growing number line and track the number of days in school as part of the "Number of the Day Routine," they have experiences with rote and rational counting, reading and writing numbers well beyond 100, representing those numbers with manipulatives, exchanging 1s for 10s and 10s for 100s, and recognizing number patterns.

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EVERYDAY MATHEMATICS OVERVIEW

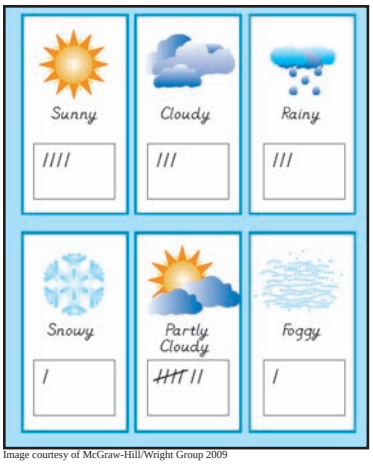


Image courtesy of McGraw-Hill/Wright Group 2009

Daily weather observation is one of the suggested ongoing routines in Kindergarten EM

Everyday Mathematics 1

Computational Estimation: A major first-grade goal is for children to begin to achieve automaticity in recall of addition and subtraction facts. This goal is reached in two ways: through the use of real-life situations to develop an understanding of the meanings of addition and subtraction, and through games that develop facility with the basic facts. Each of these ways includes a focus on estimation as well as on basic facts. For example, when domino combinations are used to practice addition facts, they are also used to practice estimating the sum of the dots, noting whether the sum is more than, less than, or equal to 10. And in the "Domino Top-It" game, where each child selects a domino and compares the total number of dots on his domino to the total number of dots on his partner's domino, children are encouraged to estimate whether there are relatively more or less dots before finding exact totals.

Models for the Operations: In first grade, children are encouraged to solve problems in any way they can: by using counters, by drawing pictures or doodles—by using whichever means can help them model a situation. Along with this intuitive approach, EM begins to lay the foundation for a systematic (diagram) approach to solving number stories that involves change, comparison, and part and total situations. In discussing these problems, teachers are encouraged to display appropriate situation diagrams which visually reinforce the meaning of any addition and subtraction operations in play.

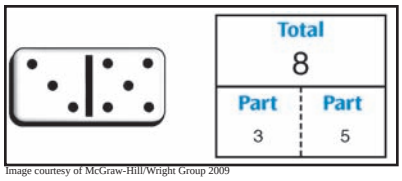
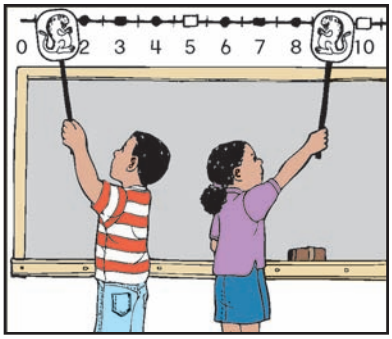


Image courtesy of McGraw-Hill/Wright Group 2009

Parts-and-total diagram for a 3|5 domino

Highlight: Young children need to develop the ability to count by rote, including skip counting and counting backwards, as a prerequisite to rational counting (counting of objects). Number lines and number grids are repeatedly used to provide visual displays for such rote-counting activities. They are also used for comparing pairs of numbers and finding numbers between two numbers. Both number-line and number-grid games offer practice of these activities.



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Children find numbers between two numbers by playing "Monster Squeeze."

Everyday Mathematics 2

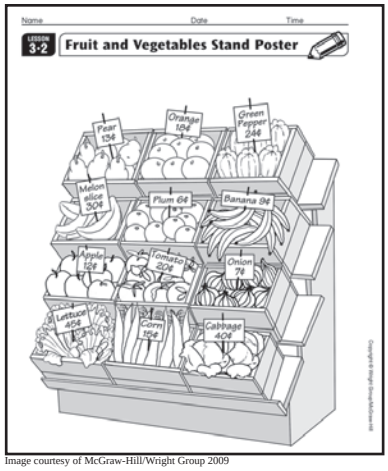
Computational Estimation: Children make ballpark estimates of answers to problems by changing the numbers to "close but easier" numbers before adding or subtracting them. Such estimates are used both to anticipate and to check answers. There are repeated opportunities to practice this skill through mental exercises and written work, and for both raw-number and real-life problems.

Models for the Operations: Children were exposed to situation diagrams informally in first grade. In second grade, children are expected to draw these diagrams themselves: they choose an appropriate diagram, enter the known numbers and identify the unknown, choose the needed operation, and solve the problem.

EVERYDAY MATHEMATICS OVERVIEW

The primary models for multiplication and division in second grade use counters, arrays, pictures, and skip counting. Children are informally exposed to a multiplication/division diagram that can be used to organize problem information and suggest an appropriate operation, but systematic use of this diagram is postponed until third grade.

Highlight: In earlier grades, EM provides experiences that develop children's knowledge about money notation, coin values, and coin exchanges. In second grade, they use the familiar context of money to develop an understanding of fractions and decimals, place value, and strategies for adding and subtracting two-digit numbers. For example, they explore fraction and decimal names for a penny and a dime, and they play exchange games with coins and bills to practice place value. By selecting items to purchase from a variety of shopping posters, they explore strategies for adding and subtracting two-digit numbers.



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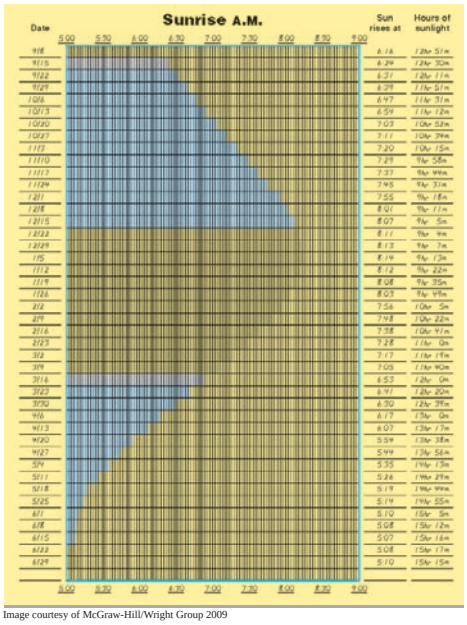
Money problems are used to develop addition and subtraction strategies.

Everyday Mathematics 3

Computational Estimation: While children continue to make ballpark estimates, they are also exposed in third grade to more systematic procedures for adjusting numbers to obtain simpler numbers. These procedures include truncation with replacement by zeros, and rounding. The adjustment methods are explored and compared for real-life problems, which are often money problems.

Models for the Operations: In third grade, children work extensively with equal grouping and equal sharing number stories and arrays. They represent multiples of equal groups with rectangular arrays and find products by counting the number of objects. Arrays are useful in division, not only to represent equal-sharing and equal-grouping situations, but also to emphasize the close link between multiplication and division. Much use is made of the multiplication/division diagram that was informally introduced in second grade. This diagram can help children organize their thinking on paper and assist them in the problem solving process. Children fill in the known numbers, identify the missing number in the diagram, and then act out the problem with counters or draw arrays to solve the problem.

Highlight: Children in third grade undertake a Length-of-Day Project that lasts the entire school year. Once a week they calculate the length of the day using sunrise and sunset data, recording that data on a poster-sized Sunrise/Sunset Chart. The project provides repeated opportunities for collecting data, for calculating elapsed time, for displaying data in a bar graph, and for interpreting the data shown in the bar graph.



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The sunrise half of a sample Sunrise/Sunset Chart

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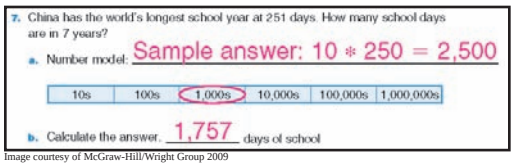
EVERYDAY MATHEMATICS OVERVIEW

Everyday Mathematics 4

Computational Estimation: Fourth-grade students extend their skills at making estimates for whole number addition and subtraction problems to problems with decimals. Ballpark estimates, rounding, and truncation with replacement by zeros are all used. A new routine is introduced that enables order-of-magnitude estimates for whole number multiplication and division problems. In this check-off routine, which is intended to become another matter of "inner speech," students ask "Is the answer I'm looking for in the tens? hundreds? thousands?" and then mark their estimate on a magnitude bar.



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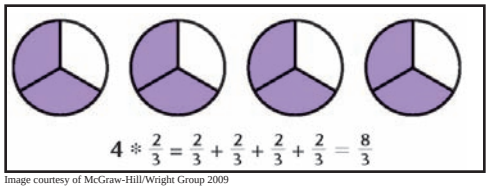
Using a magnitude bar to show an order-of-magnitude estimate

Models for the Operations: The multiplication/division diagram is used extensively to model the connection between multiplication and division, and to introduce the partial-quotients division algorithm. Several new, highly visual models that explore additional meanings of multiplication are given. Repeated addition, used in earlier grades to model whole-number multiplication, is extended to include multiplication of whole numbers by fractions and decimals. The area model for multiplication is explored in the course of developing a formula for rectangle area. The use of multiplication (and division) for scaling is modeled through map and scale-model activities.



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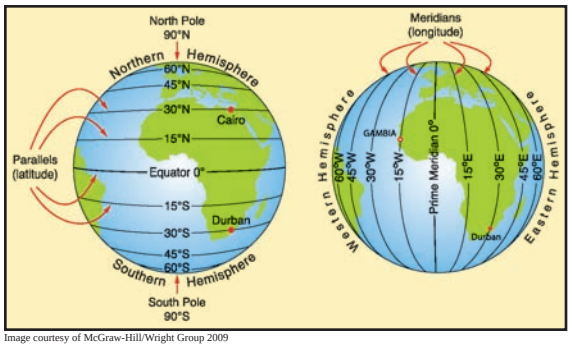
Fraction multiplication as repeated addition

Highlight: Fourth-grade students conduct a yearlong imaginary tour of the world. As they visit various countries, they practice globe and map skills, and learn about the customs and mathematical games of people in other parts of the world. They have many opportunities to apply their knowledge of mathematics as they collect, examine, graph and analyze numerical information. Their *Student Reference Book* includes a 50-page section of relevant maps, charts, tables and descriptions.



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Illustrated globe definitions

Everyday Mathematics 5

Computational Estimation: Order-of-magnitude estimates are used in fourth grade to check answers to whole number multiplication and division problems. In fifth grade, these same estimates are used to anticipate the magnitude of answers to multiplication and division problems that include decimal numbers. The numbers are multiplied or divided as though they were whole numbers, and the magnitude estimate is used as a guide to inserting the decimal point at the correct location in the answer.

Models for the Operations: While rates and ratios are alluded to in prior grades, the first robust discussion of these concepts occurs in the fifth-grade program. Rates and ratios, viewed as comparisons, model the two basic uses of division. Also, situations in which one factor is a rate applied to a second factor model is one of the most common uses of multiplication. Related multiplication and division facts can be reinforced by examples of rates and rate factors. A rate-table diagram is used to record given and derived rate information for a problem.

allowance	$20	$10	$5		?
weeks	4	2	1		1

Image courtesy of McGraw-Hill/Wright Group 2009

Rate table used to find Tim's allowance per week, given that he receives $20 for 4 weeks

Ratio problems often include visual models. Counters are frequently used as models for parts-to-whole ratio problems. And ratio problems concerned with size changes—such as scale models, scale drawings, and map scale—are intrinsically visual.

EVERYDAY MATHEMATICS OVERVIEW

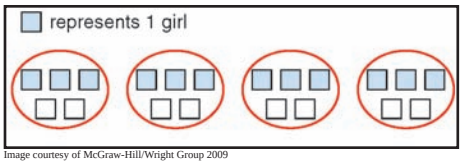


Image courtesy of McGraw-Hill/Wright Group 2009

12 girls out of 20 students

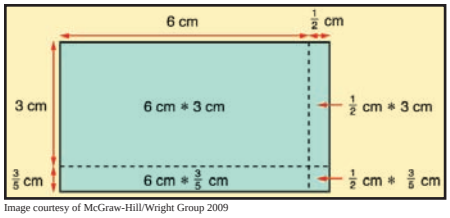
Highlight: The grade-five program begins with a focus on number theory. Students consider and explore the characteristics, patterns, and relationships inherent to numbers and operations. They learn about factors and factorization, prime and composite numbers, prime factorization, tests for divisibility, and square numbers and square roots.

Fifth-grade students conduct a yearlong American tour, on which they visit mathematical aspects of the geography, history, demographics, and politics of the United States. Their *Student Reference Book* includes a 60-page section of relevant maps, graphs, tables and descriptions.

Everyday Mathematics 6

Computational Estimation: The techniques for estimating sums, differences, products, and quotients of whole numbers and decimal numbers have been developed in prior grades. One focus in the sixth-grade program is on estimation when fractions and/or mixed numbers are involved. Students are encouraged to first estimate percent equivalents of fractions, and then apply known procedures for estimating with decimal numbers. To this end, they may find an equivalent fraction whose denominator is about 100 ($\frac{7}{9} = \frac{77}{99} \approx \frac{77}{100} = 70\%$). Or, they may estimate with reference to easy fractions ($\frac{4}{9}$ is between $\frac{4}{8} = 50\%$ and $\frac{4}{10} = 40\%$).

Models for the Operations: While the area model for fraction multiplication was introduced in grade five, it is given full play and used to illustrate multiplication of mixed numbers in the sixth grade.



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An area model for mixed-number multiplication:

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

In previous grades, rate problems were solved either by multiplying the unit rate by a second factor, or by using a rate table to calculate and display equivalent rates. In sixth grade, a third approach—which may be used to solve any rate or ratio problem—is to model the problem with an open proportion and to solve the proportion using the multiplication or division rule for equivalent fractions, or by finding cross products.

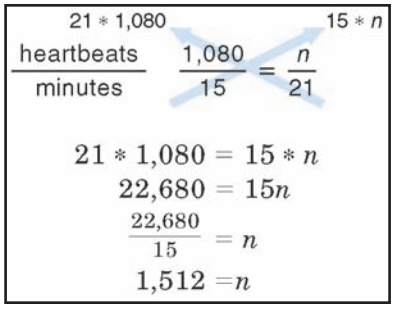
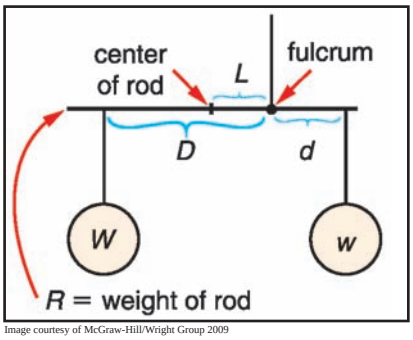


Image courtesy of McGraw-Hill/Wright Group 2009

Solving an open proportion for a human heart-rate example

Highlight: The *Student Reference Book* includes a section of art and design activities with mathematical content that support lesson content and may be used for additional project work. The topics include perspective drawing, tessellations, the golden ratio, Möbius strips, design of paper airplanes, and balancing a mobile.



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The mobile will balance if
*(W * D) + (R * L) = w * d.*

UCSMP GRADES 6-12 OVERVIEW

Broad Features of the Curriculum for Grades 6-12

Wide scope. The UCSMP curriculum for grades 6-12 interweaves five strong strands: arithmetic, algebra, geometry, statistics, and discrete mathematics. This wide scope continues and builds on equivalent strands in the UCSMP *Everyday Mathematics* curriculum. And it reflects national recommendations over the past thirty years in mathematics education, including *A Nation At Risk* (1983), the NCTM *Curriculum and Evaluation Standards* (1989), *Principles and Standards for School Mathematics* (2000), the broad recommendations surrounding the more recent NCTM *Focal Points* (2006) and *Focus in High School Mathematics* (draft, 2008), the GAISE standards of the American Statistical Association (2005), and the recommendations of the College Board (2007) and Achieve (2008).

Real-world orientation. The power of mathematics lies in its abstractness, giving it the ability to be applied in many diverse situations. But we use mathematics because of its many real-world applications, which are important for every individual to learn in order to make wise decisions and to participate in a knowledgeable way in our democracy. Applications are essential because, except for the few students who will have a life in pure mathematics, being able to do mathematics is of little use unless the student can apply that content. We owe it to our students to teach them the applications of mathematics, for if a student does not learn to apply mathematics in a mathematics class, it is doubtful the student will learn applications somewhere else.

Technology use. Preparation for today's workplaces requires that students be familiar with up-to-date technology. For the mathematics classroom, useful technology includes spreadsheets, graphing utilities, computer algebra systems, dynamic geometry drawing programs, statistical software, and applets. Students are gradually introduced to these technologies throughout the program.

Four dimensions of understanding. To understand a mathematical concept means to be able to carry out algorithms related to that concept; to develop and use mathematical properties and relationships involving the concept; to apply the concept in problems, both real-world and theoretical; and to represent or picture the concept. Each dimension allows questions ranging from simple exercises to the invention of new ideas. We call this the SPUR approach: **S**kill, **P**roperties, **U**ses, and **R**epresentations.

Student text organization. Each student book is designed to maximize the acquisition of both skills and concepts. The content of each book is carefully sequenced in 12-14 chapters, split into 6-10 lessons. Each lesson has reading followed by four types of questions, all of which should be covered: Covering the Ideas, Applying the Mathematics, Review, and Exploration. At the end of each chapter, a carefully-focused Self-Test and a Chapter Review, keyed to objectives in all the dimensions of understanding, are used to solidify performance of skills and concepts from the chapters so that they can be applied later with confidence.

Mastery and review. Lesson Masters in the CD with the teacher's editions provide more practice on the objectives for each lesson. Ideas introduced in a lesson, as well as ideas from prior lessons and chapters, and from previous courses are reinforced through the Review questions in the student text. The Self-Test and Review are designed to enable the teacher and student to assess what work still needs to be done before a chapter test.

Reading and active learning. One of the most important goals for any mathematics course is to help a student learn to learn. The third edition has more activities than prior editions. These activities, all within lessons, enable students to be more participatory in their learning and development of concepts. Many examples are guided, with partially-completed solutions to encourage students to read with care and fill in the missing details. Mental mathematics exercises begin each lesson. Stopping points called Quiz Yourself (QY) ask students questions over material just read in order to check their understanding. There are also many more questions requiring writing because writing helps students clarify their thinking and is an important aspect of communicating mathematical ideas to others.

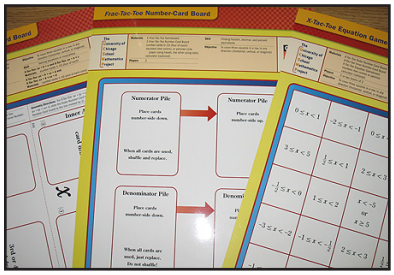
Learning to make choices. All UCSMP courses utilize a variety of tools and technologies in an activity-oriented approach. Students learn through guided activities, examples, and quiz-yourself questions within the text. Lessons present the student with explorations and optional projects to coincide with the material presented. Students are continually asked to make wise choices between mental mathematics, paper-and-pencil skills, and CAS and graphing technology.

UCSMP GRADES 6-12 OVERVIEW

Pre-Transition Mathematics

Goals and intended users: *Pre-Transition Mathematics* is the first book in the UCSMP middle/high school series. Its intended users are students who have already completed a solid fifth-grade curriculum, such as *Everyday Mathematics* 5, and are ready to tackle a sixth-grade curriculum; or students who have completed a sixth-grade course and need more work before proceeding to a pre-algebra/pre-geometry experience such as that in *Transition Mathematics*. The goals of *Pre-Transition Mathematics* are to take an in-depth approach to the arithmetic of rational numbers and the models for operations, to extend the basic ideas of algebra, geometry, probability, and statistics for students from *Everyday Mathematics* or to introduce these basic ideas for students from non-UCSMP programs who may not have been previously exposed to them.

Main theme I: To achieve the understanding of arithmetic of rational numbers, students compute with, apply, and picture decimals, percents, fractions, integers, scientific notation, and powers. Special attention is paid to fractions and negative numbers. Students use the basic applications (models) of the operations to solve real-world problems and to see relationships between operations. *Pre-Transition Mathematics* encourages students to use geometric models in connection with algebraic formulas. Statistical ideas and probability also help students improve their understanding of rational numbers.



Pre-Transition Mathematics Gameboards

Main theme II: Continuing the emphases of *Everyday Mathematics*, students of *Pre-Transition Mathematics* develop the basic ideas of algebra, geometry, probability, and statistics. They continue to use variables in formulas in order to recognize patterns. Students are given the tools they need to solve simple equations and proportions. Using rulers and compasses and dynamic geometry software, students learn to work with the properties of angles, lines, and circles. They use statistics to describe distributions and compare relative frequency with probability. Students also see how to effectively create visual representations to solve mathematical problems using statistical, number line, and coordinate graphs.

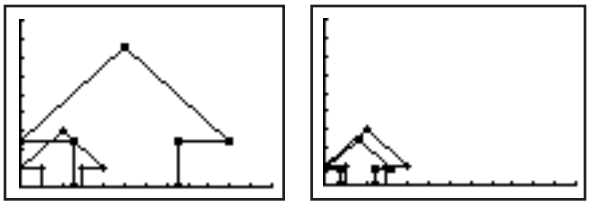
Some distinctive lessons: Solving equations with fact triangles (4-7); Deciding whether a decimal terminates or repeats (7-7); Areas of frames and rings (9-5); Statistics from an experiment: Jumping frogs (13-3). A number of games are incorporated into other lessons; some are advanced versions of games students have seen in *Everyday Mathematics*, others are new.

Comparisons between this and prior editions: This course did not exist in earlier UCSMP editions.

Transition Mathematics

Main goal: The main goal of *Transition Mathematics* is to act as a stepping-stone between the processes learned in *Pre-Transition Mathematics* or *Everyday Mathematics* 6 to the material presented in *UCSMP Algebra* and *UCSMP Geometry*. *Transition Mathematics* incorporates applied arithmetic, algebra, and geometry; and connects all these areas to measurement, probability, and statistics.

Main theme I: Rational number arithmetic skills and concepts continue to be developed through systematic instruction in the uses of the four basic operations of addition, subtraction, multiplication, and division. Basic skills and number sense practice are reinforced by applications and the conversions among decimals, fractions, and percents, with both positive and negative numbers.



Picturing multiplication by 2.5 and by 0.8

Main theme II: The algebra in *Transition Mathematics* includes the uses of variables in formulas, as pattern-generalizers, and as unknowns in solving problems. Graphing lines in the coordinate plane and the solving of linear equations and inequalities are developed.

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Main theme III: The geometry in *Transition Mathematics* includes the use of transformations to demonstrate congruence, similarity, symmetry, and tessellations. Length, perimeter, area, and volume are studied as general concepts and with specific attention to common two- and three-dimensional figures. Drawing and constructions with and without the use of technology are found throughout the text.

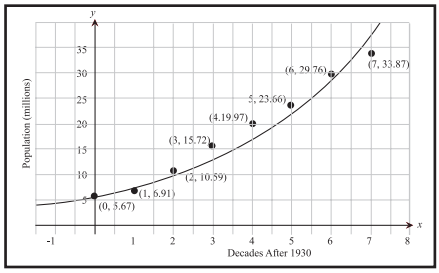
Comparisons between this and earlier editions: The reality orientation of the material and the overall approach of this groundbreaking book remain. Some of the content in the first and second editions of *Transition Mathematics* has been moved to *Pre-Transition Mathematics* due to (1) the existence of *Everyday Mathematics* and the general increase in the performance of students coming into middle school, (2) increased expectations for the performance of all students in both middle and high schools and the concomitant increased levels of testing, and (3) recommendations for more algebra and geometry in middle school courses preceding year-long courses in algebra and geometry. Calculators with graphing and list features are introduced early as pattern-fitting and problem-solving tools. Spreadsheets and dynamic geometry systems are found in activities throughout the materials. Students are engaged and learning is reinforced with the use of games.

Some distinctive lessons: Graphing data on a calculator (1-10); Three little words: always, sometimes, never (4-1); Tessellations (6-4); How changing dimensions affects volume (11-10).

UCSMP Algebra

Main goal: The main goal of *UCSMP Algebra* is to introduce the language of algebra as it is used in mathematics and applied in the real world, while integrating geometry, probability, and statistics with a variety of approaches and uses of contemporary technology.

Main theme I: *UCSMP Algebra* introduces skills, properties, uses, and representations of algebraic concepts and skills. Taking into consideration that not all students learn in the same way, multiple approaches to expressions, equations, and functions are presented. Data are described tabularly, graphically, and symbolically. Graphing calculators are used throughout and numerous CAS activities help students to develop algebraic concepts and algebraic reasoning skills in a systematic way from basic properties. Linear, exponential, and quadratic expressions and functions are studied in detail, applying properties of powers, roots, and polynomials.



Modeling the population of California with an exponential function

Main theme II: Major attention is given to answer the question "Why study algebra?" Almost all concepts are developed through applications. The text explicitly discusses reasons why algebra is so important: to describe, to explain, and to prove. Specifically, algebraic expressions are used to describe patterns and explain properties of numbers, data, and geometric figures. Simple statistics are described algebraically and equations are shown to model data. Functions are presented as a way to describe change. The book culminates with a chapter in which students use algebra to prove number properties.

Main theme III: Geometry is used to assist and complement the learning of algebra. Geometric ideas such as complementary and supplementary angles, the Pythagorean Theorem, and formulas for perimeter, area, and volume are used as contexts for equation-solving and functions. Area models and other pictures are used to represent the Distributive Property and its extensions to the multiplication of polynomials. Fact triangles are employed to help students see algebraic relations between operations. Activities involve dynamic geometry systems.

Comparisons between this and earlier editions: This edition assumes that students have had experience with one-step equation solving and it moves more quickly to the study of linear equations and inequalities. Functions and function notation, found at the end of the course in previous editions, are introduced formally in the middle of the course. Graphing and CAS technology are employed throughout. Matrices are introduced in the solving of systems.

Some distinctive lessons: Explaining number puzzles (2-3); Equivalent expressions with technology (2-6);Comparing linear increase and exponential growth (7-7); Why quadratics are important (9-7); The Chi-square statistic (11-8); Solving equations as proofs (13-3).

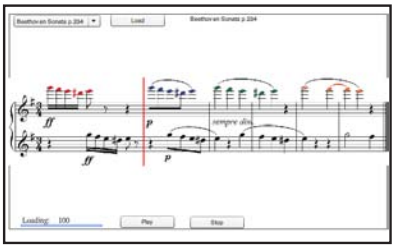
UCSMP GRADES 6-12 OVERVIEW

UCSMP Geometry

Main goal: The main goal of *UCSMP Geometry* is to provide students with a clear understanding of two-dimensional and three-dimensional figures and the relationships among them.

Main theme I: Geometry applies to all figures and all physical objects, not just lines, angles, triangles, other polygons, and circles. Transformations allow general definitions of congruence, similarity, and symmetry and make it easy to connect the abstract notions of geometry with the figures on a page and objects in the real world. Special lessons are devoted to aspects of geometry in art, architecture, sports, and music.

Main theme II: The course operates within a coherent mathematical system. Starting from the assumed properties of points, lines, and angles, the book systematically develops the general properties of congruence and similarity and applies them to deduce specific properties of the common figures. Proofs are gradually introduced as students learn how to write 2-column and paragraph proofs. Indirect proofs and coordinate geometry proofs are also covered.



Music Animations Applet
demonstrating transformations

Main theme III: The study of perimeter, area, surface area, and volume in two-dimensional and three-dimensional figures, both real and abstract, is covered extensively. Special emphasis is given to the study of three-dimensional figures and to showing how area and volume formulas are related to one another.

Main theme IV: The integration of algebra and geometry starts in the first chapter with the introduction of the coordinate geometry of lines. This coincides with the belief that students will have a better grasp on geometric concepts when they are taught in relation to algebraic skills they have already learned. Transformations provide practice with function notation and composites of functions. Students learn to use algebra to derive properties of figures by placing them on a coordinate plane.

Comparison between this and earlier editions: In this edition, activities with dynamic geometry systems run throughout the book. New lessons and problems emphasize connections with the arts. Question sets in most lessons have been revamped.

Some distinctive lessons: The need for definitions (2-1); Transformations and music (4-9); Frieze patterns (6-9); Can there be giants? (12-5); The isoperimetric inequality (14-8).

UCSMP Advanced Algebra

Main goal: The main goal of *UCSMP Advanced Algebra* is to improve and extend the algebra skills of students accumulated during the previous years of study to accommodate the topics traditional to a second algebra course.

Main theme I: Functions provide a unifying theme throughout. Linear, quadratic, exponential, logarithmic, and trigonometric functions are covered, as well as functions of variation, sequences, and transformations. Functions are treated as special kinds of relations and quadratic relations are covered in more detail. The corresponding equations and inequalities are solved symbolically and graphically, with and without CAS technology.

Main theme II: Both the content and the logical approach begun in *UCSMP Geometry* are applied. A review of linear functions and systems utilizes geometric properties of points, lines, and planes. Terms are carefully defined and theorems proved. Formulas and graphs of functions are examined using reflections, translations and scale change transformations. Congruence and symmetry are applied to the study of triangle trigonometry. Geometric applications and representations of all matrix operations are presented.

Main theme III: Mathematical modeling and applications are carefully developed through detailed examination of the basic properties of a situation that cause it to be modeled by each type of function studied in the course. Data abound in the selection of models and provide rationales for the study of each type of function. A wide variety of problems are designed to enhance algebra skills and properties, and quantitative literacy.

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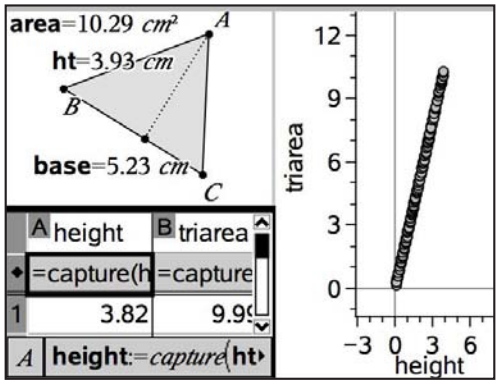


Using a CAS to show the changing height and area of a triangle in a table and graph

Comparison between this and earlier editions: Significantly larger numbers of students now take a second course of algebra than did so when the earlier editions were written. Recognizing this larger population, major changes in this course have been to make the content more accessible to this wider range of students while keeping standards high.

Some distinctive lessons: Fitting a model to data I and II (2-7, 2-8); Rotations and perpendicular lines (4-9); Solving systems using tables, graphs, or a CAS (5-2); Continuous compounding (9-3); Trigonometry, Earth, moon, and stars (10-3); Lotteries (13-8).

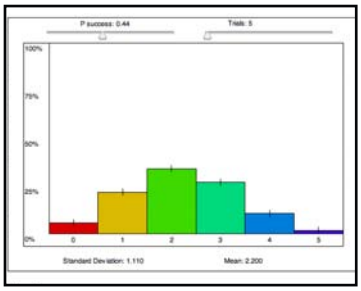
Functions, Statistics, and Trigonometry

Main goal: The goal of *Functions, Statistics, and Trigonometry* is to present topics from these three areas in a unified way to help students prepare for everyday life and future courses in mathematics. Spreadsheet, graphing and CAS technology are employed to enable students to explore and investigate, and to deal with complicated functions and data.

Main theme I: This text extends student knowledge of linear, quadratic, exponential, logarithm, polynomial and trigonometric equations and functions, with a focus on statistical modeling with these functions.

Main theme II: Statistics are introduced in this text in the ways that people who work in a variety of different disciplines use them. Major topics include the selection of statistical displays, the differences between population and sample statistics, statistical distributions with emphasis on binomial and normal distributions, and statistical inference in addition to the statistical modeling mentioned in theme I.

Main theme III: Trigonometry is studied in depth. Trigonometric functions are used in their two main roles: as functions that enable lengths of segments and measures of angles of figures to be determined, and as functions that model periodic phenomena. The work with trigonometry includes strong connections with the geometry, matrices, and complex numbers that students encountered in previous courses.



Binomial Probability Applet

Main theme IV: The themes of statistics and functions are integrated. By viewing statistical distributions as functions, properties of one idea can be applied to the other. A typical example is the transformation of graphs and its conceptual rela-

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tive, the standardization of data. Modeling data by functions enables an examination of the distinguishing characteristics of the various types of functions that make them important.

Comparison between this and earlier editions: The statistical work has been rewritten with more emphasis on decision-making. The work with functions and trigonometry remains about the same as in previous editions.

Some distinctive lessons: Using statistics to solve a mystery: The Federalist papers (1-8); From New York to New Delhi (5-10); Designing simulations (6-7); Polynomial models (7-2); How much does a loan cost? (8-6); Is that coin fair? (10-8); The geometry of complex numbers (13-5).

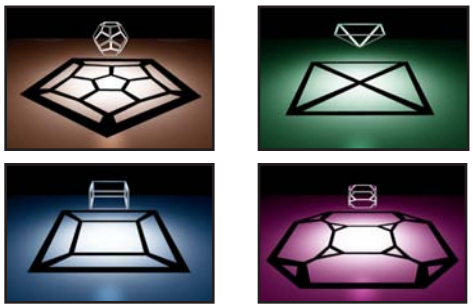
Precalculus and Discrete Mathematics

Main goal: The main goals of *Precalculus and Discrete Mathematics* are to integrate the major ideas of mathematics needed for the future study of calculus, to present the fundamental notions of discrete mathematics, and to provide students with a variety of experiences with proof.

Main theme I: To prepare students for calculus, broad ideas related to all continuous functions and specific ideas related to polynomial, rational and trigonometric functions and sequences and series are discussed. Limits are used in informal introductions to the derivative and the integral. Students are expected to be competent at proofs involving trigonometric identities. Two- and three-dimensional vectors are discussed to prepare students for applications of calculus to the sciences and business.

Main theme II: Discrete mathematics includes logic and mathematical reasoning, mathematical induction and recursion, combinatorics, the analysis of networks, and systematic sorting methods that are important in computer science, business, economics, and the biological sciences. Students are expected to be competent at proofs involving mathematical induction.

Main theme III: The structure of *Precalculus and Discrete Mathematics* enables ideas from discrete mathematics and continuous functions to play off of each other in productive ways. Formal mathematical reasoning, needed for success in college mathematics courses, begins with the study of logic in the first chapter. Logic has direct applications not only to computer games and decision-making, but also to the proof techniques students are expected to employ throughout the book. Analogies are made between the structures of integers (discrete) and polynomials (continuous), between rational numbers and rational functions, and between difference equations and derivatives. Recursion and mathematical induction are intimately related. Discrete rates of change and sums are extended to introduce the ideas of derivatives and integrals.



Finding the two-dimensional graph of a polyhedron by using the shadow a wireframe model of the polyhedron casts on a tabletop

Comparison between this and earlier editions: The content of this course is relatively the same as in prior editions, but there is more work with vectors, parametric equations, polar coordinates, and complex numbers. Some work on trigonometry has been integrated into these lessons and into the study of algebraic fractions. Derivatives are studied earlier. Students use CAS technology to enhance and extend their paper-and-pencil skills.

Some distinctive lessons: Sequences and a limited growth model (2-7); The logic of equation-solving (3-4); Prime numbers and prime polynomials (4-5); Algorithms for sorting lists (6-8); Acceleration and deceleration (7-4); What exactly are you counting (12-1); Walk lengths and minimum paths (13-5). Lessons 4-5, 9-5, and 14-7 discuss the Fundamental Theorems of arithmetic, algebra, and calculus, respectively.

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