Wright Group

Everyday Mathematics

How Everyday Mathematics Teaches Computational Fluency

Automatically knowing basic number facts is as important to learning mathematics as knowing words by sight is to reading. Educational researchers understand this, and *Everyday Mathematics* co-creator Max Bell has long emphasized the importance of number-fact reflexes. Children are often told that habits, good and bad, come from doing something over and over until they do it without thinking. Developing good number-fact reflexes can be likened to developing good habits.

Everyday Mathematics, a comprehensive Pre-K-6 mathematics curriculum that embraces many of the traditional goals of school mathematics, including automatic recall of number facts, as well as two ambitious goals of the 21st century:

- To substantially raise expectations regarding the amount and range of mathematics children can learn.
- To support teachers and children with the materials necessary to enable children to meet these high expectations.

The program was built on the philosophy that children need a mathematics curriculum that is rigorous and balanced, and this philosophy has proven to work in schools across the country.

In 2006, the What Works Clearinghouse (WWC) stated that a handful of rigorously conducted experiments demonstrated that *Everyday Mathematics* had "potentially positive effects" on achievement compared with more traditional math programs. All other elementary mathematics programs reviewed by WWC as of this writing have been found to have "no discernible effects on mathematics achievement."

Basic Facts and Fact Power

In *Everyday Mathematics*, good fact habits are called *fact power.* In Grades 1 through 3, children keep fact power tables of the facts they know. The grades in which *Everyday Mathematics* activities help children gain fact power for each of the basic arithmetic operations are shown in the following table. For each operation, easier facts are introduced, explored using a variety of strategies, and practiced before harder facts are introduced, usually in the next grade.

Grade-Level Development of Children's Fact Power					
	K	1	2	3	4
Addition					
Easy facts					
Hard facts					
Subtraction					
Easy facts					
Hard facts					
Multiplication					
Easy facts					
Hard facts					
Division					
Easy facts					
Hard facts					

Each bar in this table represents the *Everyday Mathematics* grade levels during which children continuously gain a higher degree of fact power, from introduction and exploration of new facts with manipulatives to automatic recall (automaticity) in which facts are easily recalled from long-term memory. In the middle of this process, children develop their own strategies to learn new strategies for calculating mentally. The goal is to increase children's proficiency using favorite strategies that can help them gain automaticity. For example, easier facts are made more automatic through their application to learning the hard facts; that is, 8 + 7 may be seen as 1 less than the easier double 8 + 8.

Children practice their strategies during mental math activities, through games, in Math Boxes (daily ongoing review and practice in Everyday *Mathematics)*, and within the context of solving number stories and other problems. The next two sections explain ways that *Everyday Mathematics* helps children gain proficiency through continual practice.

By the end of the school year, most Grade 2 students should know the basic addition and subtraction facts automatically. In Grades 3 and 4, the emphasis shifts to learning multiplication and division facts. Although some children may not know all these facts, they should be well on their way to achieving this goal by the end of Grade 4.

Fact Practice

Traditional paper-pencil practice of math facts is included in *Everyday Mathematics.* However, an over reliance on this type of practice alone can be tedious and can lead children to dislike mathematics. Teachers of *Everyday Mathematics* have reported great success using these alternative approaches.

Fact Families and Fact Triangles

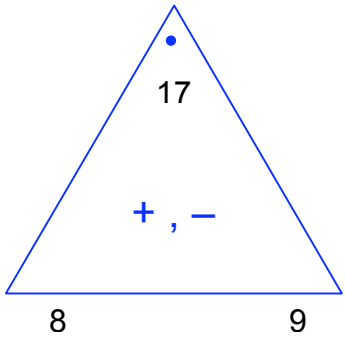
A *fact family* is a collection of four related facts linking two inverse operations. For example, the following four equations symbolize the fact family relating 8, 9, and 17 by addition and subtraction.

8 + 9 = 17	9 + 8 = 17
17 – 9 = 8	17 – 8 = 9

The two addition facts in this family taken together are an instance of the Commutative Property of Addition. Children are taught that these addition facts illustrate the *turn around rule for addition* – a student-friendly term used to describe the Commutative Property of Addition.

Everyday Mathematics calls properties of arithmetic *shortcuts*, and the four facts in a fact family are all related by shortcuts. A major reason for teaching fact families is to give children different options when solving problems that are new or difficult. By recalling a shortcut, a child can reword or rewrite the problem in a more meaningful way. For example, when faced with 7 – 3 = ?, a first grader may think, *Hmm, let me think. What plus 3 is 7? That's easy, it's 4.*

Fact Triangles are the *Everyday Mathematics* version of flash cards. Fact Triangles are more effective than traditional flash cards because they emphasize fact families. An addition/subtraction Fact Triangle has two addends and a sum; a multiplication/division Fact Triangle has two factors and a product. A Fact Triangle for the 8 + 9 = 17 fact family looks like this:



Fact Triangles are best employed in a cooperative-learning situation. One play covers a corner with a finger and the other player gives a fact that has the hidden number as the answer. For example, one play might cover up the 8. The other play might say "17 – 9 = 8." Fact Triangles also can be sorted into known/unknown facts or by a strategy such as doubles, near doubles, + 1, and + 2 to make for efficient practice. Because these activities are easy to do at home, Fact Triangles are strongly recommended as Home Links, which

are homework activities intended to be extensions of the lessons and ongoing review problems.

Everyday Mathematics Grade 1 uses Fact Triangles to establish and emphasize addition/subtraction fact families through 9 + 9. In Grade 2, the addition/subtraction fact families are developed and multiplication/division Fact Triangles are introduced. In Grade 3, children get both addition/subtraction and multiplication/division Fact Triangles. In Kindergarten through Grade 3, a useful long-term project is to have students write the four number models in the fact family on the back of each Fact Triangle. Also, in all grades, new facts are usually introduced through concrete manipulations, drawings, games, and connections to previously known facts.

Choral Drills

Beginning in Grade 1, children participate in many short drills that review small groups of facts written on the board. To hold everyone's interest, teachers can vary the drill over a period of several days by playing with the numbers, formats, and speed. For example, teachers who want to work with doubles, such as 3 + 3 and 5 + 5 for several days, can advance to near doubles such as 3 + 4 and 5 + 6. A good time to do the drills is just after a break such as lunch or recess.

Double-9 Dominoes

Double-9 dominoes are wonderful concrete models of the addition/subtraction facts through 9 + 9 and 18 – 9. Dominoes help children visualize the facts as well as develop an understanding of the meanings of addition and subtraction and the relationship between the two operations. Many suggestions for using dominoes for basic facts work are included in the *Everyday Mathematics Teacher's Lesson Guide.*

Labels

Because numbers in real life nearly always occur in some context, *Everyday Mathematics* recommends that teachers and their students select *labels for the day* to use with fact practice. The kinds and numbers of labels needed depend on the operations being used. In addition and subtraction, only one label is needed. For example, on one day a teacher may choose the label *pencils* and read the problem 7 + 9 = ? as 7 pencils + 9 pencils = ? pencils.

In multiplication and division, two or three related labels are needed. For example, one day a teacher might use *cartons, pounds per carton,* and *pounds* so that the problem 5 X 8 = __ becomes 5 cartons X 8 pounds per carton = __ pounds. Sometimes it makes sense for the two factors in multiplication to have the same label. For example, when finding an area, 5 feet X 8 feet = 40 square feet.

Teachers should post the labels and refer to them occasionally as children practice the facts. The labels of the day reinforce the idea that numbers refer to something real and useful.

Everyday Mathematics authors recommend that teachers keep the labels simple. They can be true-to-life or fanciful, serious or silly. They can be units of measure such as centimeters, minutes, and pounds or countable objects such as cats, hats, and ribbons. Although the main purpose for using labels is to keep numbers from becoming too abstract, labels are also important to other curriculum areas, especially reading, the sciences, and language arts.

Fact Extensions

Fact extensions are powerful mental-arithmetic strategies for all operations with larger numbers. For example:

- If children know 3 + 4 = 7, they also know
  30 + 40 = 70, 70 – 30 = 40, and 300 + 400 = 700.
- If children know 6 X 5 = 30, they also know
  60 X 5 = 300, 600 X 5 = 3000, and 3000 / 600 = 5.

Fact extensions are introduced in Grade 1 and extended throughout the program.

Games for Fact Practice

Frequent practice is necessary in order for children to build and maintain strong mental-arithmetic skills and reflexes. Although drill has its place, much of the practice in *Everyday Mathematics* is in game format. Games are not merely attractive add-ons but essential parts of the complete *Everyday Mathematics* program.

In "Playing games and real mathematics," Ainley (1988) writes, "The most effective mathematical games are those in which the structure and rules of the game are based on mathematical ideas, and where winning the game is directly related to understanding this mathematics. (p. 241)

All grades of *Everyday Mathematics* include games that have been developed to help children learn specific arithmetic and other skills at an appropriate developmental level. Some, in fact, are so targeted to the development of certain skills that once a child becomes proficient, the game is no longer necessary.

Drill and games should not be viewed as competitors for class time, nor should games be thought of as time-killers or rewards. In fact, games satisfy many, if not most, standard drill objectives with many built-in options. Drill tends to become tedious and, therefore, gradually loses its effectiveness. Games relieve the tedium because children enjoy them. Indeed, children often wish to continue to play games during their free time, lunch, and even recess.

Arithmetic practice through games is also recommended to help teachers deal with individual differences in children's motivations and abilities. Seckinger, Mitchel, and Lemire (1989) found that games improve children's attitudes about mathematics as well as improve achievement among low achievers. Alternatively, Johnson (2000) advocates using mathematical games with gifted children, who tend to invent new rules or increase

difficulty of games on their own. Researchers such as Wolpert (1996) also support games or other play to encourage automaticity of arithmetic skills by learning-disabled children.

Drill exercises aim primarily at building fact and operation skills. Practice through games shares these objectives, but at the same time, games often reinforce calculator skills, logical thinking, geometric intuition, and intuition about probability and chance because many games involve randomly generated numbers.

Using games to practice number skills also greatly reduced the need for worksheets. Because the numbers in most games are generated randomly, the games can be played over and over without repeating the same problems. Many of the *Everyday Mathematics* games come with variations that allow players to progress from easy to more challenging versions. Games, therefore, offer an almost unlimited source of practice material.

Note: Cognitive and educational psychologists have long supported children's playing games in school. For a concise summary, see *Theories of Childhood: An Introduction to Dewey, Montessori, Erickson, Piaget and Vygotsky* by C.G. Mooney.

Note: The federal and some state education departments advocate children playing mathematics games in school and at home. The U.S. Department of Education (2004) places high value in *Helping Your Child Learn Mathematics.*

Number Sense and Mathematical Connections

It is perhaps the single greatest goal of *Everyday Mathematics* that children completing the program acquire number sense. People with number sense:

- Have good mental-arithmetic skills as well as reliable algorithms and procedures for finding results they can't produce mentally.
- Are flexible in thinking about numbers and arithmetic and will look for shortcuts to make their efforts as efficient as possible.
- Can use their number and arithmetic skills to solve problems in everyday situations.
- Are familiar with a variety of ways to communicate their strategies and results.
- Can recognize unreasonable results when they see them in their own work, in everyday situations, or in the media.

Number sense develops only with wide mathematical experience, including instruction and practice in specific techniques. But good number sense also depends on attitudes and beliefs, especially the belief their mathematical knowledge to connect with the rest of what they know, including their common sense thus depends on making connections between various kinds of mathematical knowledge and between mathematics and other subjects.

Everyday Mathematics helps children develop number sense in the contexts of data analysis, geometry, and elementary explorations of functions and sequences. In *Everyday Mathematics*, children make connections across mathematical topics and come to view

mathematics as a coherent, consistent discipline rather than a hodgepodge of disconnected procedures and skills.

Number sense also involves making connections between mathematics and other subjects in the curriculum. Many activities in *Everyday Mathematics* are designed to show how number sense applies to science, social studies, and geography. Throughout *Everyday Mathematics* there are connections between mathematics and history, including both the history of mathematics and how mathematics has shaped human endeavors.

Everyday Mathematics also connects mathematics to the community through efforts to share the authors' commitment to number sense with children's families and other caregivers. Family Letters explain how *Everyday Mathematics* introduces children not only to the traditional mathematics people expect but also to a richer mathematics curriculum that older family members may not have experienced. The homework in *Everyday Mathematics* enable parents or guardians to see the kinds of mathematics their children do in school and pass along some interesting ideas for family involvement as well.

Watch Success Multiply!

Everyday Mathematics is based on decades of research and was refined during extensive field-testing. It has been proven to work. The program meets standards set by the National Council of Teachers of Mathematics in *Principles & Standards for School Mathematics*, and more than 3 million students across the country learn with *Everyday Mathematics.*

To learn more about *Everyday Mathematics*, visit www.WrightGroup.com or call 1-800-382-7670.