Tier 2 Interventions for Mathematics

Denver Public Schools

August 2009

Overview of Morning

- Process to identify recommended interventions

- Support DPS core mathematics with Tier 2 interventions

- Preview DPS recommended interventions
  - *Mathematics Navigator:* Grades 2–10
  - *ALEKS:* Grades 3–12
  - *ORIGOmath:* Grades 1–2

Screen of Intervention Programs

- Clear directions for guided and independent practice

- Instructional materials with adequate practice (concepts, procedures) and sufficient review (distributed, cumulative, varied)

- Additional ELL support

- Identification of common misconceptions with suggestions to address them

- Mathematically correct content

- Multiple assessments (diagnostic, progress monitoring, summative) with clear guidelines for use and instructional interpretation

Research-Based Recommendations for Mathematics Interventions

- Screen all students to identify those at risk.

- Focus intensely on in-depth treatment of whole numbers in K–grade 5 and rational numbers in grades 4–8.

- Provide explicit and systematic instruction (models of proficient problem solving, verbalization of thought processes, guided practice, corrective feedback, frequent cumulative review).

- Include instruction on solving word problems.

- Include opportunities for students to work with visual representations of mathematical ideas.

- Devote about 10 minutes per session to building fluent retrieval of basic arithmetic facts.
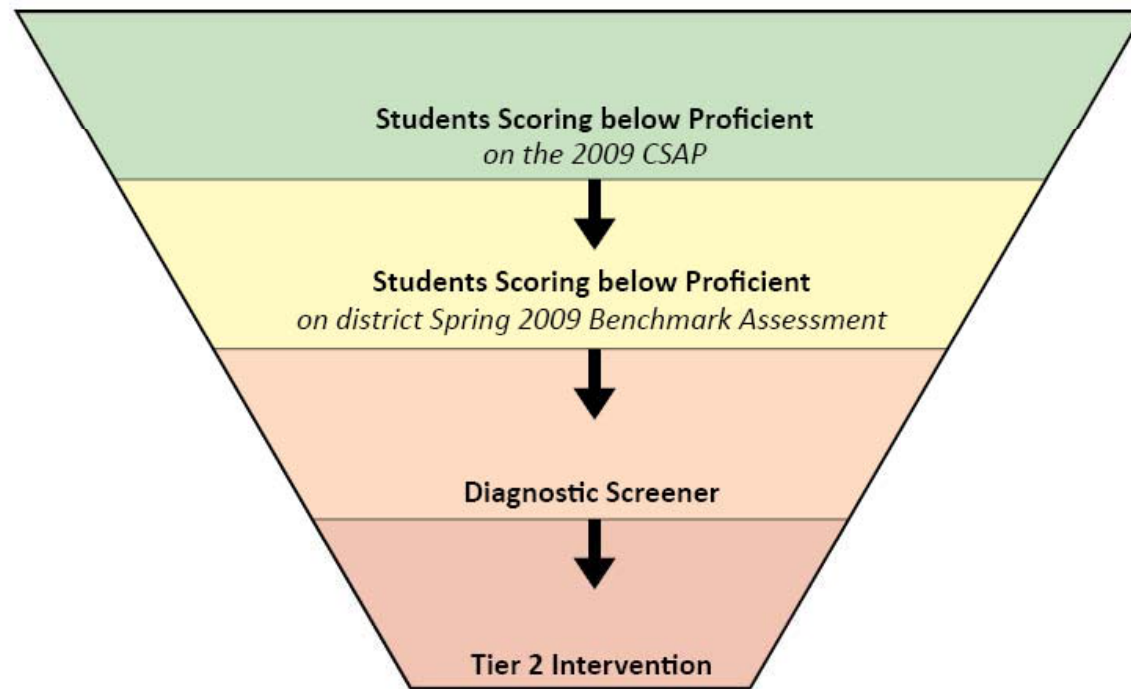
Assisting Students Struggling with Mathematics: Response to Instruction

Begin with high-quality instruction and universal screening for all students.

- Core program (*Everyday Mathematics*, *Connected Mathematics*, or *Discovering Mathematics*)

- Instructional time as described in Best Practice documents

- Differentiated instruction within core program to support students

- Periodic assessment using tools within core program

Universal Screening in Mathematics

Students Scoring below Proficient
on the 2009 CSAP

Students Scoring below Proficient
on district Spring 2009 Benchmark Assessment

Diagnostic Screener

Tier 2 Intervention

Universal Screening: Grade 3

- Current third graders
  - *Spring 2009 DPS benchmark results*
  - *Standards-based progress reports with a focus on Number Sense and Computation*
  - *Diagnostic screener*

Standard Protocol for Progress Monitoring Mathematics: Grades 1–5

Denver Public Schools • Response to Instruction

Universal Level

- Core program of *Everyday Mathematics* (2007): Getting Started, Part 1, Part 2, Part 3
- Instructional time: 75 minutes per day
- Differentiated instruction as needed
- Daily ongoing assessment using Recognizing Student Achievement (RSA) to monitor progress
- Periodic assessment using each unit's Progress Check, Part A

Lack of progress:

Universal Level + additional instructional time at Targeted Level

Gap analysis based on:

- CSAP or early numeracy assessment
- District Benchmarks
- Math intervention program screener

Targeted Level

- *Everyday Mathematics* (2007)
  - Revisit Explorations (skill specific) found in grades 1–3
  - Core with differentiation: Extra Practice, Readiness, Games
- Increased small-group time (15–40 minutes/3–5 days a week) using a short-duration intervention (e.g., one unit or module for 4–6 weeks)

Continued lack of progress:

Universal Level + additional instructional time at Intensive Level

Intensive Level

- Math intervention program (from approved list) implemented as designed
- Small-group sessions: 30–40 minutes, longer duration, based on need
- Progress monitoring using tools within intervention program
- Curriculum-based Measurement (CBM)—TBD

- Individual misconceptions in mathematical understanding addressed to facilitate root-cause analysis
- Students grouped by mathematical needs

Implementing Tier 2 Interventions

- Select an intervention program.

- Identify students to be served, create an order, and send order electronically to Maggie Wolfe in ERS.

- Create an intervention schedule.

- Teachers delivering intervention attend central professional development.

Program Preview

- *Mathematics Navigator*

  from America's Choice

- *ORIGOmath*

  from ORIGOeducation

- *ALEKS*—an online system

Mathematics Navigator

Introduction to *Mathematics Navigator*

- Does not repeat initial teaching
- Focuses on revising misconceptions
- Encourages students to approach the mathematics from several angles
- Provides learning opportunities beyond solving problems—analyze work for errors, test validity of their work against others' work, try multiple strategies to determine if prior knowledge holds true, and modify or invent similar problems

Mathematics Navigator
Program Design

- Targeted Concepts

- Algebraic Structure of Arithmetic

- Prior Knowledge and Misconceptions

- Language-Rich Environment

- Better Learners of Mathematics
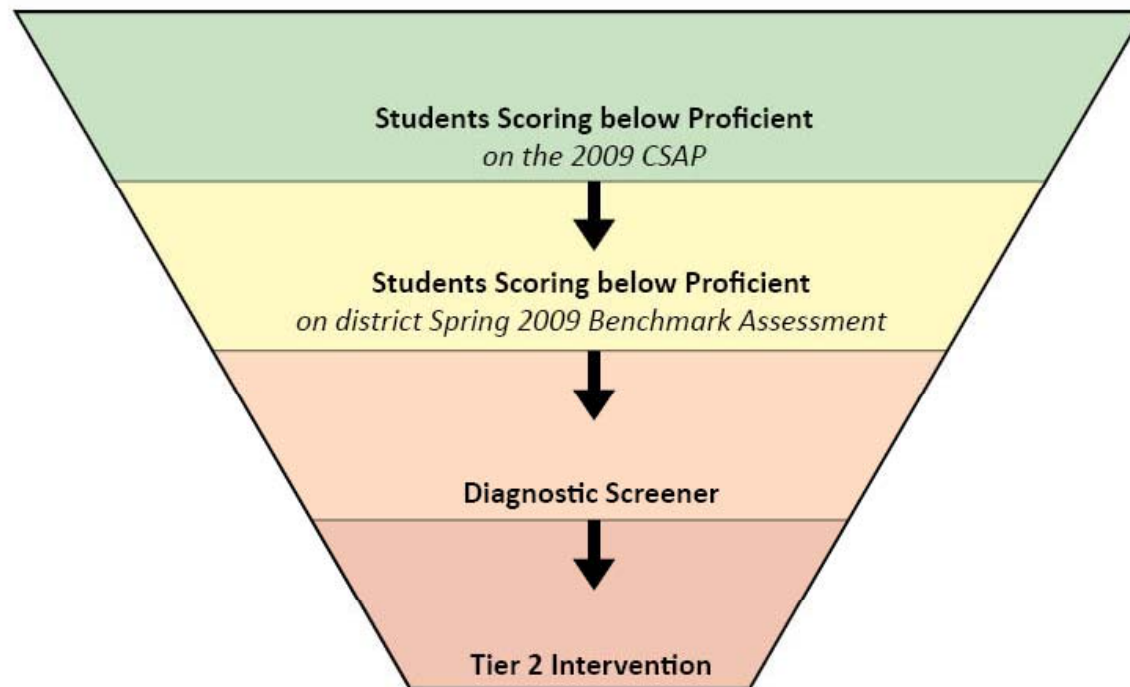
- Instructional Support

Module Design

- 20 days for each module
  - ➢ *Module design in elementary units includes two checkpoints*
  - ➢ *Module design in secondary units includes a checkpoint every five days*

- Recommended instructional time: 35–45 minutes a minimum of 3 days per week in addition to core instruction

- Group size
  - ➢ *Elementary: up to 10 students*
  - ➢ *Secondary: up to 30 students*

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Instructional Support Overview

- Instructional guidance

- ELL support

- Formal and informal assessments
  - *Diagnostic screeners*
  - *Pre- and post-tests*
  - *Checkpoints*

Universal Screening: Grades 4–10

Students Scoring below Proficient
on the 2009 CSAP

Students Scoring below Proficient
on district Spring 2009 Benchmark Assessment

Diagnostic Screener

Tier 2 Intervention

Universal Screening: Grade 3

- Current third graders
  - ➢ *Spring 2009 DPS benchmark results*
  - ➢ *Standards-based progress reports with a focus on Number Sense and Computation*
  - ➢ *Diagnostic screener*

Getting Started with Year

- Administer Screener.

- Analyze assessment data and determine modules to implement and place order.

Getting Started with a Module

Day One

- Administer and score pre-test.

- Record pre-test data on Pre-Test/Post-Test Profile.

- Consider pre-test results for individual students and class.

Getting Started with a Session

- Skill Cards (using quick response boards)
- Skill Practice (in student book)

- Solo Work: Problem 1
- Partner Work: Problem 1
- Probing for Understanding

- Solo Work: Problem 2
- Partner Work: Problem 2
- Probing for Understanding

- Closing the Lesson

Instructional Support within Modules

- Instructor Edition
  - *Purpose of Module*
  - *Goals for the Module*
  - *Day-by-Day Overview*
  - *English Language Learner Considerations*
  - *Types of Assessment and Record Keeping*

- Chart of Rituals

- Study Cards

- Materials List

- Checkpoints

- Checkpoint Profile

- Class Profile

Mathematics Navigator in DPS

	N	Pretest Mean	Posttest Mean	Change	Effect Size (d)
Grade 01	202	32.4%	55.6%	23.2% **	1.25
Grade 02	465	45.9%	69.3%	23.4% **	1.15
Grade 03	323	67.9%	77.1%	9.1% **	0.55
Grade 04	94	52.3%	66.6%	14.3% **	0.61

ALEKS

What is ALEKS?

- **A**ssessment and **LE**arning in **K**nowledge **S**paces

- Only online intervention DPS recommends for mathematics intervention

Features of ALEKS

- Assessment and learning with standards-based content for grades 3–12

- Monitors student, class, school, and district progress toward state standards

- Fully bilingual—English and Spanish for grades 3–9

- Unlimited online access for PCs and Macs

How Does ALEKS Work?

- Initial assessment determines students' topic mastery

- Multi-colored chart generated for each student

- Student works in learning mode to master new topics

- Continual assessment aids students' retention of new learning

ALEKS in Action

- http://www.aleks.com/video/quick_tour

ALEKS Course Products

- Mathematics—LV 3 (with Quick Tables) for Tier 2 Grades 3–4

- Mathematics—LV 4 (with Quick Tables) for Tier 2 Grade 5

- Mathematics—LV 5 (with Quick Tables) for Tier 2 Grade 6

- Essential Mathematics (with Quick Tables) for Tier 2 Grades 8–10

- High School Preparation for Algebra 1 for Tier 2 Grades 10–12

Quick Tables Demonstration

- http://www.aleks.com/video/qt_quick_tour

Assessment within ALEKS

- Initial Assessment

- Automatic Assessments

- Comprehensive Assessments

- Quizzes

Instructional Time

- Recommend minimum of 2½ hours per week in addition to core instruction

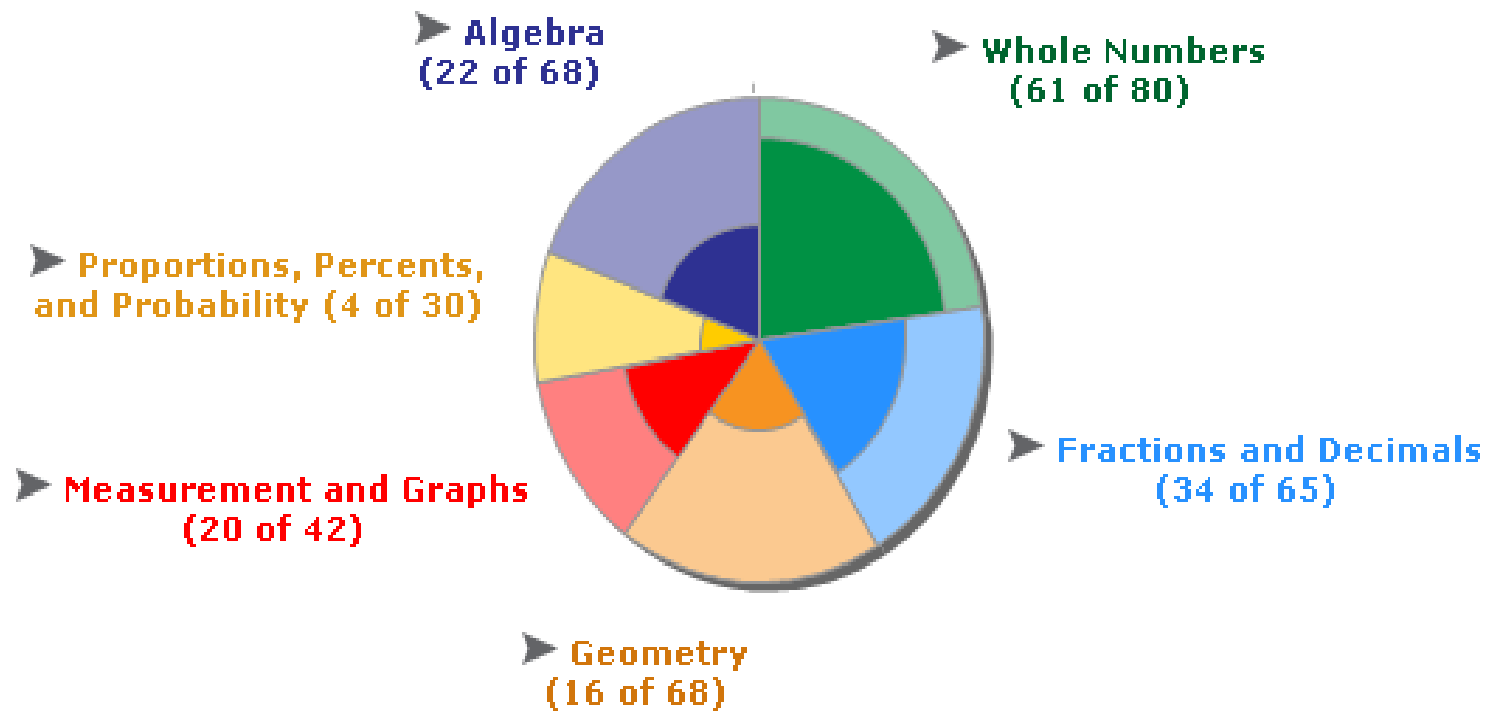- Group size limited only by computer availability and teacher supervision

Sample Student Report

				WEEK

School) _____   44 %

Initial Assessment   04/14/2009   36 +9 %
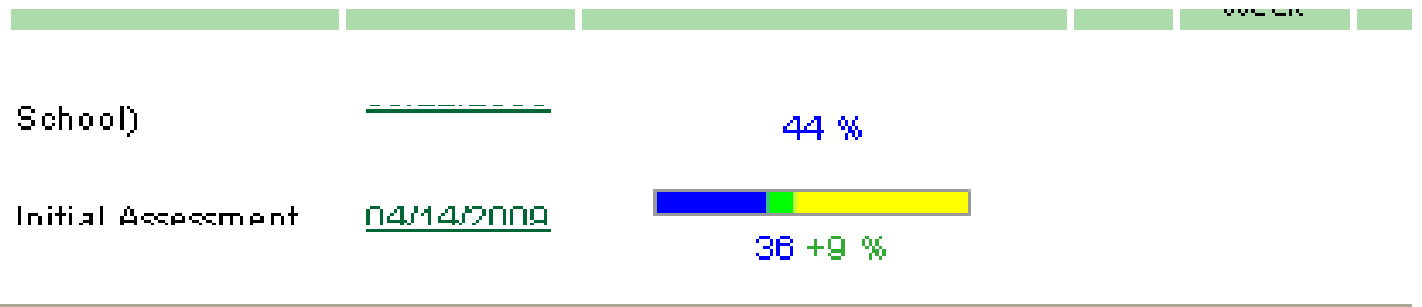
Legend: Assessment (🟦),   progress in learning mode (🟩),   still to learn (🟨),

Sample Student Pie Chart

Course Mastery
(157 of 353 Topics)

Algebra
(22 of 68)

Whole Numbers
(61 of 80)

Proportions, Percents,
and Probability (4 of 30)

Fractions and Decimals
(34 of 65)

Measurement and Graphs
(20 of 42)

Geometry
(16 of 68)

Other Important Information

- ALEKS can be used with either Windows or Mac with modifications.

- Pricing will be determined by number of DPS students registered.

- Professional development will be offered beginning in September.

ORIGOmath

Universal Screening for Primary Grades

- Current second graders
  - *Standards-based progress reports with a focus on Number Sense and Computation*
  - *Diagnostic screener from ORIGOmath: pre-test*

- Current first graders
  - *Standards-based progress reports with a focus on Number Sense and Computation*
  - *Diagnostic screener from ORIGOmath: prerequisite check list*

ORIGOmath

Grades 1 – 6

A Step-by-Step Approach to Computation
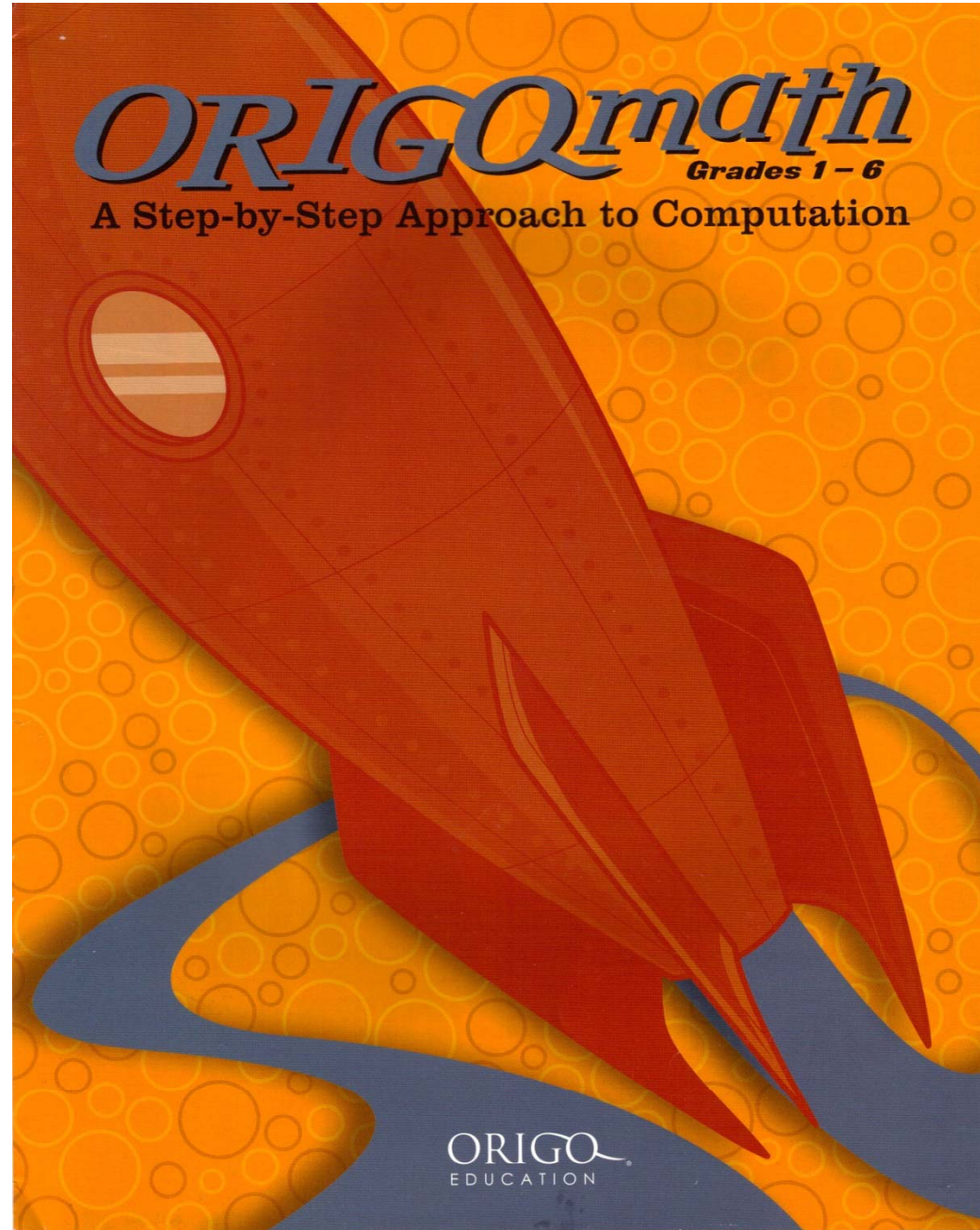
ORIGO
EDUCATION

ORIGOmath

- Encourages students to justify and share their thinking

- Provides real-life contexts to explore mathematical ideas

- Provides carefully developed sequence of learning experiences

- Emphasizes students' critical thinking and reasoning

- Provides students opportunities to practice computation facts in addition to problem solving

Teacher Sourcebook
and Student Journals

Scope and Sequence

	Grade 1	Grade 2	Grade 3
Number	• Use a number track to assist with counting and ordering. • Represent 2-digit numbers using numerals, words, concrete materials, and pictures. • Combine materials and finger groupings into tens and ones to represent 2-digit numbers. • Read and write 2-digit numbers with pictures and a numeral expander. • Use coins to represent 2-digit amounts (multiples of 5 cents). • Count forward and back by tens on and off the decade. • Count forward and back by 2 and 5. • Use number tracks and hundred charts to assist with counting and ordering. • Count forward and back by ones from a given 2-digit number. • Identify the number before and after a given 2-digit number. • Read and write 2-digit numbers. • Use place value to build 2-digit numbers.	• Read and write hundreds. • Use pictures to write 3-digit numbers (easy examples, then numbers with tens and zeros). • Read and write 3-digit numbers without pictures. • Use a number line to develop relative position for 2- then 3-digit numbers. • Use place value to build numbers. • Read and write amounts in dollars and cents. • Use a number line to locate nearby hundreds.	• Read and write 4-digit numbers without pictures. • Locate 3- then 4-digit numbers on a number line. • Use a range of representations to analyze whole numbers and fractions. • Develop relative position for 3- then 4-digit numbers. • Use place value to build numbers. • Read and write amounts in dollars and cents. • Use a number line to locate nearby hundreds then thousands.
Addition and Subtraction	• Solve active and static addition problems. • Use the "+" and "−" symbols. • Establish the turnaround concept. • Record take-away situations with subtraction number sentences. • Relate part-part-total to subtraction. • Use a count-on strategy to add. • Use a doubling strategy to add. • Use a bridge-to-10 strategy to add. • Relate missing addend and comparison situations to subtraction. • Write fact families (count-on/back). • Extend the count-on strategy beyond facts (1 or 2 and then 10 or 20). • Extend the count-back strategy beyond facts (1 or 2 and then 10 or 20). • Extend the addition doubling strategies to multiples of 5 and then teen numbers. • Add and subtract 2-digit numbers on the hundred chart. • Use the count-on/back strategy to add/subtract 10 or 20 cents.	• Relate operations. • Write related facts (use-doubles, then bridge-to-10 facts). • Use extended count-on strategy. • Use extended count-back strategy. • Extend use-doubles strategy to 2-digit numbers. • Use place value to add 2-digit numbers (without, then with bridging). • Use a nearby ten to add 2-digit numbers. • Write fact families. • Use an empty number line to model strategies for addition and subtraction. • Use reference points to add/subtract.	• Extend the count-on/back strategies with 2- and 3-digit numbers. • Write related facts (use-doubles, then bridge-to-10 facts). • Reinforce and extend use-doubles strategy to add 2-digit numbers. • Use addition (count-on strategy) to subtract 2-digit numbers. • Use place value to add/subtract 2- and 3-digit numbers. • Use a nearby ten to add numbers. • Use a known subtraction fact to subtract 3-digit multiples of 10. • Use reference points to add/subtract 3-digit numbers. • Adjust numbers to add/subtract. • Use the count-on/back strategy to subtract 3-digit numbers (with and without bridging). • Use the round-and-adjust strategy to subtract. • Use magic squares to motivate the use of mental strategies. • Use the algorithm for addition and subtraction when mental computation is too difficult.
Multiplication and Division	No content in Grade 1.	• Use language of equal groups and arrays. • Relate the "×" and "÷" symbols to equal groups and arrays. • Use the turnaround concept to write related facts. • Count by 2s, 5s, and 10s. • Use tens to multiply by 5. • Use the turnaround concept to help learn facts. • Use doubling to multiply by 2. • Use the double-double strategy to multiply by 4. • Use materials to divide by 2, 4, or 5. • Interpret remainders. • Relate division to fractions. • Relate division to multiplication. • Write related facts.	• Relate the "×" symbol to equal groups, an array, and the set model. • Write related turnaround facts. • Extend the doubling strategy to 2-digit numbers. • Multiply 2-digit numbers by 10 then 5. • Use the double-double then the double-double-double strategies to multiply by 4 and 8. • Use the build-down strategy (9s facts) and then the build-up strategy (6s facts). • Extend the build-down and build-up strategies to 2-digit numbers. • Use the doubling-and-halving strategy to multiply. • Use place value to multiply. • Solve division problems. • Relate halves and quarters to divide by 2 and 4. • Work with remainders. • Relate division to fractions. • Relate division to multiplication. • Find a missing factor. • Write fact families (2s and 5s facts).
Algebra	• Explore relationship rules. • Express addition or subtraction in equation form. • Use the "=" symbol. • Work with the concepts of "less than," "greater than," and "not equal." • Record relationship rules for addition and subtraction. • Write related addition/subtraction facts. • Use a balance situation to relate addition and subtraction and write equations.	• Develop relationship rules. • Record input-output data (addition and subtraction). • Use equations to record addition/subtraction situations. • Write related addition and subtraction facts. • Use addition to reverse subtraction. • Use a balance situation to relate addition and subtraction and write equations. • Use addition to subtract 2-digit numbers.	• Multiply by 1 then 0. • Investigate multiplication patterns (9s facts). • Record input-output data (addition and subtraction). • Develop relationship rules for multiplication and division. • Record input-output data (multiplication and division). • Use equations to record operations. • Write related multiplication and division facts. • Use addition to reverse subtraction. • Extend relationship rules for multiplication and division. • Use a balance situation to relate addition and subtraction and write equations. • Use addition to subtract 2- and/or 3-digit numbers.

Everyday Mathematics-Like Models

One Unit for Two Weeks

- Each unit has five sessions.

- Combine with Fundamentals game practice.

- Two-week interval are recommended per unit.

- Units include Grade 2 pre- and post-assessments.

- Units include Grade 1 pre-requisite checklist and post-assessment.

Assessment Tools

Grade 1 Prerequisite Checklist

Grade 2 Pre-Test, Page 4

Grade 3 Pre-Test, Page 3

Individual Record of Expectations: Units 1–6

Unit		Expectation	Not yet	Sometimes	Consistently	Observations
		Student Name				
1	A	write related addition and subtraction sentences				
	B	use a count-on strategy to add 1, 2, 10, or 20 to any two-digit number				
	C	use a count-back strategy to subtract 1, 2, 10, or 20 from any two-digit number				
2	A	write related addition and subtraction use-doubles facts given a pictorial representation of the total and one addend				
	B	use a use-doubles addition fact to help figure out a related subtraction fact				
3	A	double multiples of 10 and 5, e.g. 30 + 30 and 45 + 45				
	B	double tens and ones, e.g. 32 + 32				
	C	add near doubles less than 50, e.g. 32 + 33				
4	A	write related addition and subtraction bridge-to-10 facts given a pictorial representation of the total and one addend				
	B	use a bridge-to-10 addition fact to help figure out a related subtraction fact				
5	A	represent and solve multiplication problems involving arrays and equal groups				
	B	use the multiplication symbol to describe and solve problems				
	C	write/draw related number facts to match an array and vice versa				
6	A	write related addition and subtraction number sentences				
	B	apply and reverse a rule involving addition or subtraction to determine the input/output number				
	C	identify the rule from given input and output numbers				