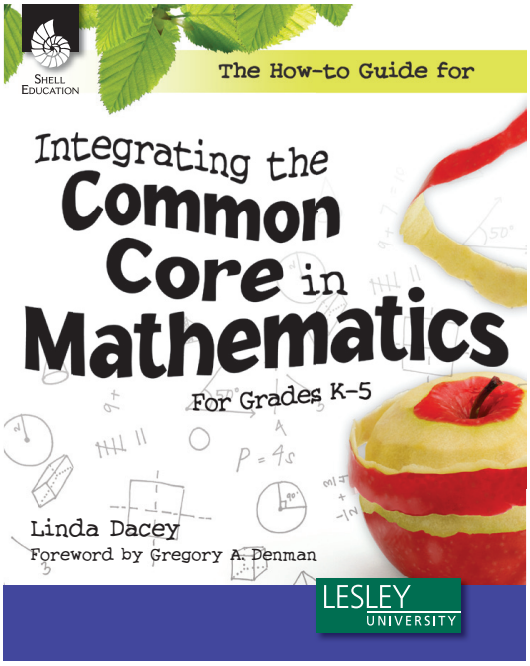
SHELL EDUCATION

Sample Pages from

Integrating the Common Core in Mathematics, K-5



The following sample pages are included in this download:

- Table of Contents
- Introduction excerpt
- sample chapter selection

Shell Education

The How-to Guide for

Integrating the Common Core in Mathematics

For Grades K–5

Linda Dacey

Foreword by Gregory A. Denman

LESLEY UNIVERSITY

Integrating the Common Core in Mathematics

For Grades K–5

Table of Contents

Chapter 1

Opportunities and Challenges

Voice from the Classroom

I first heard about these new standards from my principal. When he announced them, I found myself doing a wonderful imitation of my young daughter's new eye-rolling habit. I figured this meant there would be lots of meetings and paperwork, but no real changes to my teaching. I mean, it wasn't as if I were going to suddenly stop teaching addition and subtraction.

We started with crosswalks, looking to see how what we were teaching now mapped on to these new standards. It was challenging to understand some of the standards and I don't think this matching process helped us. We tended to see things as the same, if they seemed similar, and walked away with only a few things to change—things we would no longer teach, such as writing multiplication equations to match pictures of equal groups or repeated addition sentences. What we didn't understand was how what we saw as the same was actually different. It wasn't until the following summer when I had the opportunity to go to a local conference and learn more about these standards that I began to see them differently. I now understand that teachers need help understanding what these mean, why they are important, and how their teaching will be different.

—Second-Grade Teacher

This teacher's voice expresses what I have heard many teachers say. It's challenging to figure out what these standards mean to our teaching when they are presented to us as a list. We need time to work with others about what they mean and how we can implement them. We need to understand their purpose and to be able to make sound choices among the myriad of resources that seem to pop up online daily. Most important, we need to invest in our own learning—to take the time to read, to listen, and to talk with others about mathematics, these standards, our students, and our teaching practices.

Each of us is on our own learning trajectory about these standards. Some of us have attended numerous workshops and conferences and have coaches to help us explore ideas. Others may only have limited familiarity with the math standards, having spent time focusing on language arts. Regardless of where you are starting from, it is not a journey that ends quickly. I have been able to teach and write about these standards since they first were published, and I continue to deepen my understanding of them and what they mean to teachers and classrooms. So let's begin with a general overview of these standards.

Overview of the Standards

Demand for mathematical knowledge has increased as student performance on worldwide standardized tests continues to disappoint. In response, the National Governors Association Center for Best Practices (NGA) and the Council of Chief State School Officers (CCSSO) cooperated on the development of the Common Core State Standards, standards that were designed with the goal of creating common K–12 learning goals that would prepare students to meet expectations for career or college. In mathematics, the standards identify *Standards for Mathematical Practice* as well as content standards. As of this writing, these standards have been adopted by 45 states, something that has never happened before in the history of the United States.

These standards are intended as a set of learning outcomes, not a national curriculum. The implementation stage is where teachers' knowledge of both their craft and their students is most important. Support for these standards clearly varies at local, state, and national levels, but one thing is clear to me and hopefully to you: It is time for educators to take the lead, as we will ultimately be the key to the success of this reform effort.

We all need to:

- ✏ understand the standards clearly,
- ✏ gain insight into how these standards could be met within classrooms,
- ✏ develop assessment strategies to support student success, and
- ✏ recognize ways in which working with others and using available resources can help us to meet our goals.

This book is designed with these needs in mind. It also is written with the beliefs that all teachers want their students to succeed; that given the right circumstances, all students can succeed; and that any change comes with opportunities and challenges. To support the success of our students, we need to embrace the opportunities and find ways to address the challenges in manageable ways.

Teachers know change. No other profession has a complete change of clients every year. Every September teachers meet their new students with excitement. Yet those early days can be more tiring, too, as we establish routines and classroom expectations with a new group. The routines do get established, though, and the excitement begins to come not from the newness, but from the progress our new students are making. Just as our task is to get to know our new students and learn how to best support them, our first task here is to get to know these new standards and how to best implement them for student success.

Discussion of these standards often centers on the extent to which they provide focus, coherence, rigor, and clarity. Each attribute is considered here and returned to throughout the book.

Focus

The phrase "a mile wide and an inch deep" has often been used to describe the mathematics curriculum in the United States. Many teachers complain about the range of topics they have to *cover,* and clearly strong instruction involves much more than coverage. The Common Core provides focus on key ideas and understandings, as you cannot gain deep understanding of a great number of topics. Also, *critical areas* have been identified for each pre-secondary grade level, which provide further focus to the documents.

Coherence

Mathematical ideas need to be learned as a series of related ideas that progress across the grades, rather than through exposure in ways that do not connect one topic to the next. Too often students don't realize, for example, that the concept of division is the same, whether it is applied to whole numbers, rational numbers, or integers. Similarly, many students do not recognize that properties, such as the commutative property of addition, also apply to all types of numbers. Such generalizations are necessary to avoid students learning isolated concepts or skills that are likely to be forgotten. The Common Core provides coherence by providing standards that progress across the grade levels and that connect to one another in clear, recognizable ways.

Rigor

Teachers often feel as if education reform is just a pendulum swinging back and forth between conceptual development and skill acquisition. Similarly, curricular resources may emphasize one end of the continuum considerably more than the other. Conceptual understanding and skill development are *both* expected outcomes of the Common Core. For example, students are expected to understand the four operations and strategies used to find sums, differences, products, and quotients; reach arithmetic fluency; and apply their understandings and skills to solve problems. The Common Core also defines mathematical habits of mind (Standards for Mathematical Practices) that include rigorous terms such as persevere, precision, abstractly, and viable argument, among others.

Clarity

When learning expectations are given for grade-level spans such as 3–5, or if the language used to describe standards is imprecise, teachers remain unsure of expected outcomes. The Common Core provides specific single-grade-level standards that indicate what is to be learned when. As teachers, we need to develop a common understanding of what students need to know and how they can demonstrate that they know it. Figuring this out is often referred to as *unpacking the standards*. The standards may at first glance appear dense and challenging to comprehend as they are viewed both within and across grade levels. The progressive nature of the standards will become clear.

The Expectations Are for All Students

Before looking at specific standards, it is important to emphasize the *common* expectation of the standards. Too often we have discovered that schools in lower socio-economic areas have less rigorous standards than others with greater financial resources. This educational disparity leads to increased differences and does not match our democratic values. All students must have access to learning goals that allow for success. This is also true of students with learning challenges who are often restricted to skill development through rote procedures. "Emerging literature suggests that students with moderate and severe disabilities can learn content aligned with grade-level standards while continuing to work on basic numeracy" (Saunders et al. 2013, 24). As we think about implementing the standards, we need to address how we will meet the needs of our diverse students.

Standards for Mathematical Practice

The Standards for Mathematical Practice describe a set of proficiencies, or habits of mind, that students should develop over time. Built on the five process standards developed by the National Council of Teachers of Mathematics (NCTM 2000) and the five strands of mathematical proficiency identified in *Adding It Up* (National Research Council 2001), these eight standards (listed in Figure 1.1) have the potential to transform mathematics education in ways that would be even more significant than the content standards, as they indicate ways in which students should learn and demonstrate their knowledge of mathematics (Hull, Harbin Mills, and Balka 2012).

Chapter 4

Counting and Cardinality

Snapshot

A kindergarten teacher likes to use menus that organize choices for students. It is December and the students are familiar with this instructional format. The students are somewhat familiar with the individual activities, but this is the first time they have been combined within a menu. There are six choices on the menu that the teacher displays on chart paper to the whole class:

- A picture of a book informs the students that they may choose to stay in the rug area and choose a book to read from the milk crate the teacher has filled with counting books.
- A picture of a number cube and a game sheet let the students know that they may choose to play Roll and Build, where they roll a number cube and build a tower that high until they have a tower for each of the numbers 1–6.
- A picture of two 10 frames showing the number six tells them that they may choose to play 10-Frame Match.

- A picture of a bag with the written numeral 8 on it lets students know that they can go to the math center to get the clear container filled with similar bags and counters. Their task is to randomly choose two bags to fill according to their numeral labels and then order the bags from least to greatest based on the number of counters they hold.
- A picture of a number sheet with numbers written in dotted lines shows them that they may choose to practice writing numbers.
- A picture of the teacher shows them that they can choose to work on one of these activities with the help of their teacher.

The teacher reviews the choices with the students. Then she says, "Those of you who would like to use the number cube, please raise your hand." She then chooses six students, in pairs, so they each have a partner and tells them to go to the table at the back of the room where they will find the materials they need. She proceeds until each group is identified and all of the students are involved in activities that relate to this domain.

Counting as well as representing and comparing numbers gets considerable attention in this kindergarten classroom throughout the year. As adults, counting is so automatic we may not recognize all the concepts and skills needed to count successfully (Dacey and Collins 2010). In fact, simple mathematical tasks are often more complex than we realize (Ginsberg and Ertle 2008).

Big Picture

The counting and cardinality domain is unique to the kindergarten level. Cardinality may be a new word to many teachers. It refers to the quantity of a set and requires the counter to recognize that the last number said while counting objects indicates the quantity of the group; that it is the answer to the question "How many are there?" It is exciting to see important developmental milestones associated with counting, such as counting on from a number other than one, getting their own focus within the Common Core State Standards. This attention to counting and cardinality gives us the opportunity to relook at this area of students' thinking in closer detail, in ways that will help ensure that each student begins with the foundation he or she needs for later success. Such a goal is significant as research suggests that kindergarten students' counting and number knowledge are predictors of calculation skills at the second-grade level (Locuniak and Jordan 2008).

This domain is organized around three clusters:

- Know number names and the count sequence
- Count to tell the number of objects
- Compare objects

Each cluster and their associated standards work together to form what we mean by counting and cardinality. Figure 4.1 summarizes what this domain specifies that kindergarten students are expected to accomplish at this level. We will consider these specific goals within the next three sections of the chapter that focus on each cluster.

Figure 4.1 Expectations within Counting and Cardinality

Task	Number Goal
Count rotely by ones and tens	1–100
Count rotely by ones from a number other than 1	2–100
Write numerals to represent a number of objects	0–20
Assign exactly one number to each object when counting	1–20
Recognize the last number in the count as the quantity	1–20
Know that counting numbers increase by 1	1–20
Count objects arranged in a row, array, or circle	1–20
Recognize that the arrangement does not change the cardinality	1–20
Produce a set with a given number of objects	1–20
Compare number of objects in two groups	1–20
Compare two written numerals	1–10

Know Number Names and the Count Sequence

In some cases, students enter kindergarten with the ability to say the number names in order, or mostly in order, to 10. This skill develops further throughout the kindergarten year, until the student can count to 100 by both ones and tens (K.CC.1). Listening to young children count to 100 tells us much about our number system. You will often hear a child drag out the number at the end of a decade, such as twenty-*niiiiiiiiine,* as the learner tries to remember the name of the next decade. Then, usually in a much faster cadence, the child will say the numbers 31–38, like an engine building up momentum, followed by another drawn out thirty-*niiiiiiiiine*. Listen to your students count aloud individually so that you can determine if and when they experience difficulty transitioning from one decade to another. Then, target further practice accordingly.

What makes this counting sequence so challenging, even for those students who are successful counting by tens? To older students and adults, it is clear that the familiar 0–9 pattern in the ones place applies to the tens place as well (though we don't record the 0 for natural numbers less than ten), but that is not the case at this level. Many Asian languages are consistent with their number names (Uy 2003). For instance, their name for thirteen would translate to one ten, three and fifty-seven to five tens, seven. Unfortunately, our names for two-digit numbers can obscure patterns within our counting sequence. Counting to 100, rather than perhaps 30, helps to make the counting patterns more prominent. While saying the number names in order to 100 is a rote skill, the students likely to be the first to succeed are those who recognize the structure and regularity within our number system. Our two-digit number names hide the counting patterns in the following ways:

MP7 Structure

MP8 Regularity

- Eleven and twelve do not follow the regular pattern of saying something for both the tens and ones to indicate that two places are involved.
- When we say the teen numbers we identify the ones first, such as in eighteen. This never happens again after the teens.
- Unlike forty, sixty, seventy, eighty, and ninety our decade names teen, twenty, thirty, and fifty are not identical to the sound of the corresponding ones digit. If you only learned to count to 59, only the forties would sound like a familiar one-digit number.

Remember that counting to 100 by ones and tens is a standard that students must meet by the end of the kindergarten year. Much of their mathematical instruction will focus on smaller numbers. That said, students are proud of their abilities to count to what they call *really big numbers*; this is one of the reasons they often enjoy learning to count by tens. Note that when students first learn to count by tens, they may confuse counting by ones with counting by tens. That is, they may begin counting by ones, but when they reach a particular new decade, for instance, thirty, they may switch to counting by tens and say, "forty, fifty, sixty," and so forth. Saying numbers in an incorrect order is common when children are first introduced to greater numbers. Continuous exposure to rote counting throughout the year makes sense.

Over time, increase the final number until 100 is reached. Some classroom ideas include:

- **Use counting songs** that you can find on the Internet. When students repeatedly sing a song, they increase the likelihood that they will remember what they learned (Rinne et al. 2001).
- **Look for opportunities to repeat the counting sequence**, for example, while transitioning from one activity to another, waiting to enter the school building, or taking a walk.
- **Involve movement** as students practice the counting sequence. For example, have them copy you as you swing your arms as everyone counts from one to ten, as you wiggle your fingers as the count goes from 11 to 20, and tap your foot as everyone counts from 21 to 30.
- **Use games.** For example, chose a number such as 10 and have the students stand in a circle. Have students say the number names in order in a round-robin fashion. The student that says *ten* sits down, though continues to count orally with the group. The next student starts again at one and the counting continues until only one student remains standing.

While students need to master these rote counting skills, most instructional time should be spent on their integration in a contextualized task or activity. Rote practice should be a small component of students' learning and conducted in an engaging manner. Also note that students often recognize when they need practice and enjoy it when it feels like just the right time to do it. Giving students options allows them to decide what skills they want to improve.

In one kindergarten classroom, Catalia and Daniel have chosen a practice activity with a mixed up deck of 20 cards, labeled 1–20. The cards are placed face down between the two students. Catalia turns over the top card and enthusiastically announces, "It's five!" It is Daniel's job to count on from five. Not quite able to count on, he discreetly whispers, "One, two, three, four, five," and then speaks more loudly as he continues the count. Daniel turns over the next card and tells Catalia to count from nine. She repeats the nine and then continues. These students are practicing counting from a number other than one, a more sophisticated skill than counting from one (K.CC.2). Note that they are also recognizing written numerals; it is rare that counting skills are isolated (K.CC.3). You can, however, also use the activity with students who have not mastered recognition of symbols by pairing such students with those who have, or leading the class in the activity with you announcing the start numbers.

Honoring Individual Differences

Like learning how to write the letters of the alphabet and associating them with particular phonetic sounds, associating symbols with the number of objects is complex and takes time to develop. To increase the likelihood of success among diverse learners, a variety of practice opportunities should be available. Here, we limit our focus to ways to practice writing numerals, leaving the connection to collections of objects for consideration when we investigate the next cluster. Some ideas include:

- **Begin without pencils and paper**. Have students write numbers in the air or in sand, form them with dough, paint them with a brush, or make them with chenille sticks.

- **Support students when they first move to paper and pencil** by providing written numerals to trace, with arrows that indicate the direction of their strokes. Over time, transition to dotted lines or only part of the symbol until scaffolding is removed.

As a formative assessment task, one teacher asks students to write the numbers that they know. Note that the student represents 20 and 100 as well as the first 10 counting numbers. Several of the numerals are reversed, which is not uncommon at this early age, but is something the teacher will keep in mind when working with this student.

Count to Tell the Number of Objects

It is this cluster that focuses on counting with meaning as students make connections between numbers and quantities (K.CC.4). This connection includes the following abilities.

- One-to-one correspondence or the ability to say *exactly* one number name for each object being counted (K.CC.4a) is essential. Initially, children may omit objects or count objects more than once. Some students may repeatedly count the objects until they have said all of the number names they know.
- Stable order of our numbers, that is, the numbers are said in the same order when counting (K.CC.4a).
- Cardinality that requires the understanding that the last number said indicates the number of objects counted (K.CC.4b). Without this concept, students may think that the counting process is the answer.

Counting and Cardinality Record Sheet

Student Name:	Date	Number(s)	Comments
Rote counting by ones			
Rote counting by tens			
Rote count by ones from a number other than 1 Write numbers/write numbers to represent a number of objects			
Assign exactly one number name to each object in a set Know that the last number in the count tells the quantity			
Say the number names in the correct order Recognize that the counting numbers increase by one			
Count objects arranged in a row, array, or circle Recognize changing the arrangement does not change the quantity			
Produce a set with a given number of objects Match or count to compare two groups			
Compare two written numerals			