CHAPTER 3

LAYING YOUR FOUNDATION

It Starts With Big Ideas, Essential Questions, and Standards

As required by a new district policy, two veteran second-grade teachers, Roberta and Manny, sat down with their school administrative leader to review their students' benchmark assessments. Roberta, who had not yet seen the results, had been nervous all day about this meeting. She knew that Leah, the school principal, supported their work, but the situation was still incredibly nerve-wracking.

Leah pulled up the screen with the results and displayed them. "Let's just take a few minutes to look at them before we discuss."

At first, Roberta's heart sang, but then it plummeted. She looked over at Manny and noticed a confused expression on his face.

Leah said, "Let's begin with the successes. I am noticing that the students performed beautifully on place value concepts. These scores are way up from last year."

Roberta commented, "We really hit the place value hard this year. In fact, I was truly amazed with their conceptual understanding."

Manny added, "Yes, we integrated place value the entire year so the students would continue to build on their understanding. We also integrated it into our number routines and small groups."

Leah said, "I am so glad that all this effort paid off! Now, let's look at what we need to work on."

Roberta said, "My students were completely confused about the representations used for equations."

Manny exclaimed, "Mine were, too! Do you think it has anything to do with the new standards? We always taught equations, but we never used those balances that were on the test. We are going to need to review those new standards more carefully for next year."

Leah replied, "I think you are on to something, Manny. How could we strategically plan for the new standards so that we can create the same kind of success you had with place value concepts?"

Roberta and Manny's surprise about the assessment results may mirror the feelings of many teachers after states and districts implement new standards. In this chapter, we will focus on big ideas, essential questions, and standards as the building blocks of a lesson taught at the K–2 grade levels. We will also address the following questions.

- What are state standards for mathematics?
- What are essential questions?
- What are process standards?

WHAT ARE STATE STANDARDS FOR MATHEMATICS?

For many years, research studies of mathematics education concluded that to improve mathematics achievement in the United States, standards needed to become more focused and coherent. The development of common mathematics **standards** began with research-affirmed **learning progressions** highlighting what is known about how students develop mathematical knowledge, skills, and understanding. The resulting document became known as the *Common Core State Standards for Mathematics* (*CCSS-M*) (National Governors Association and Council of Chief State School Officers, 2010). The landmark document was intended to be a set of shared goals and expectations for the knowledge and skills students need in mathematics at each grade level. The overall goal was college and career readiness.

Currently, the majority of states have adopted the *Common Core State Standards for Mathematics* as their own state standards. However, it is important to note that while many states adopted the *CCSS-M*, others have updated, clarified, or otherwise modified them, adopting the updated set as their new state standards. A few states have written their own standards.

Most standards documents are composed of **content standards** and **process standards** of some kind. It is important to recognize that no state standards describe or recommend what works for all students. Classroom teachers, not the standards, are the key to improving student learning in mathematics. The success of standards depends on teachers knowing how to expertly implement them. It is important as a teacher to be very knowledgeable about your own state standards and what they mean, not only at your grade level but also at the one above and below the one you teach. They are at the heart of planning lessons that are engaging, purposeful, coherent, and rigorous.

Regardless of whether your state has adopted *CCSS-M*, has modified the standards, or has written their own, the **big ideas** of K–2 mathematics are universal. Big ideas are statements that describe concepts that transcend grade levels. Big ideas provide focus on specific content. Here are the big ideas for K–2.

Kindergarten

In kindergarten, students use numbers to represent quantities and to solve quantitative problems, such as counting objects in a set, counting out a given number of objects, comparing sets or numerals, and modeling joining and separating situations with sets of objects and simple equations such as $4 + 3 = 7$ and $7 - 4 = 3$. They study geometric ideas such as shape, orientation, and spatial relations. Kindergartners use basic shapes and spatial reasoning to model objects in their environment. At this grade, students work with measurement to compare measurable attributes and data to classify data and count the number of objects in each category.

First Grade

First graders focus on developing understanding of addition, subtraction, and strategies for addition and subtraction within 20. They study place value, including grouping in tens and ones, and they work with linear measurement to measure lengths as iterating length units. Students at this level learn to tell and write time and represent and interpret data with graphs. In geometry, students compose and decompose shapes.

Second Grade

Second-grade students extend understanding of the base-ten system, including counting in fives, tens, and multiples of hundreds, tens, and ones, as well as number relationships involving these units, including comparing. At this level, students use their understanding of addition to develop fluency with addition and subtraction within 100. They solve problems within 1,000 by applying their understanding of models for addition and subtraction. Second graders work with standard units of measure (centimeter and inch) and with time and money. They represent and interpret data. In geometry, students describe and analyze shapes by examining sides and angles, and they build, draw, and analyze two- and three-dimensional shapes to develop a foundation for understanding area, volume, congruence, similarity, and symmetry in later grades.

While the major topics in K–2 mathematics are the same, states may have a slightly different focus at a grade level. Compare your state standards for your grade level with the summary previously stated. Are there any differences? If so, what are they? Briefly describe them here.

WHAT ARE ESSENTIAL QUESTIONS?

It is estimated that over the course of a career, a teacher can ask more than two million questions (Vogler, 2008). If teachers are already asking so many questions, why should they need to consider essential questions? An **essential question** is a building block for designing a good lesson. It is the thread that unifies all of the lessons on a given topic to bring the coherence and purpose discussed previously. Essential questions are purposefully linked to the big idea to frame student inquiry, promote critical thinking, and assist in learning transfer. (See Chapter 5 for more information on essential questions in transfer lessons.) As a teacher, you will want to revisit your essential question(s) throughout your unit.

Essential questions include some of these characteristics:

- *Open-ended.* These questions usually have multiple acceptable responses.
- *Engaging.* These questions ignite lively discussion and debate and may raise additional questions.
- *High cognitive demand.* These questions require students to infer, evaluate, defend, justify, and/or predict.
- *Recurring.* These questions are revisited throughout the unit, school year, other disciplines, and/or a person's lifetime.
- *Foundational.* These questions can serve as the heart of the content, such a basic question that is required to understand content to follow.

Not all essential questions need to have all of the characteristics. Here are some examples of essential questions that follow from big ideas for K–2.

- When and why do people estimate?
- Outside of school, when do we need to count?
- What patterns do you see when we look at place value?
- Why do we need standard units to measure?
- How many different ways can you represent 345?
- What would life be like if there were no numbers?
- What do mathematicians do when they get stuck on a problem?
- Where can we find two- and three-dimensional shapes in our world?

Look at the list of sample K–2 essential questions. Decide which characteristics describe which question. Note any thoughts or comments below.

WHAT ARE PROCESS STANDARDS?

Up to this point, we have been discussing content standards. However, every state also has a set of standards that define the **habits of mind** students should develop through mathematics. In 1989, the National Council of Teachers of Mathematics (NCTM) introduced these standards as process standards, stating that "what we teach [in mathematics] is as important as how we teach it" (NCTM, 1991), encouraging us to teach mathematics through these processes. Those standards are as follows:

- Communication
- Problem solving
- Reasoning and proof
- Connections
- Representations

The Common Core State Standards include the eight **Standards for Mathematical Practice** (SMPs), which also describe the habits of mind students should develop as they do mathematics (National Governors Association and Council of Chief State School Officers, 2010). The following SMPs are the same across all grade levels.

1. **Make sense of problems and persevere in solving them.** Students learn to understand the information given in a problem and the question that is asked. They use a strategy to find a solution and check to make sure their answer makes sense. If students reach a point where they are "stuck," they should not give up but relook and rethink about the problem in a different way, continuing to solve the problem.
2. **Reason abstractly and quantitatively.** K–2 students make sense of quantities and their relationships in problem situations. They develop operational sense by associating contexts to numbers, such as thinking about 4 + 3 as having four items and adding on three more items to find the total number of items.
3. **Construct viable arguments and critique the reasoning of others.** Students at this level begin to develop mathematical vocabulary and use it to explain their thinking and discuss their ideas. They listen to others and find how their own strategies are similar or different and why they work and/or make sense.
4. **Model with mathematics.** At the primary level, students use representations, models, and symbols to connect conceptual understanding to skills and applications. They may also represent or connect what they are learning to real-world problems.
5. **Use appropriate tools strategically.** K–2 students use a variety of concrete materials and tools, such as counters, tiles, straws, rubber bands, and physical number lines, to represent their thinking when solving problems.
6. **Attend to precision.** Students learn to communicate precisely with each other and explain their thinking using appropriate mathematical vocabulary. K–2 students expand their knowledge of mathematical symbols, which should explicitly connect to vocabulary development.
7. **Look for and make use of structure.** At this level, students discover patterns and structure in their mathematics work. Emphasis is placed on looking for structure through the use of physical models rather than algorithms.
8. **Look for and express regularity in repeated reasoning.** K–2 learners notice repeated calculations and begin to make generalizations. For example, they recognize that ten ones bundled together now represents a new unit, a ten. This helps students extend the understanding to bundling ten tens to make a new unit, a hundred.

The SMPs are not intended to be taught in isolation. Instead, you should integrate them into daily lessons because they are fundamental to thinking and developing mathematical understanding. As you plan lessons, determine how students use the practices in learning and doing mathematics.

Both sets of standards overlap in the habits of mind that mathematics educators need to develop in their students. These processes describe practices that are important when learning mathematics. Not every practice is evident in every lesson. Some lessons/topics lend themselves to certain practices better than others. For instance, you might use **classroom discourse** to teach a content standard through important mathematical practices.

Example: Michael

Michael, a first-grade teacher, uses the content of measurement to have his students engage in constructing viable arguments and critiquing the reasoning of the others.

Michael: What do you think is the best tool to measure the length of your math book?

Billy: I think I would use my yardstick.

Michael: Why did you choose the yardstick?

Billy: Because it has inches on it.

Michael: What does anyone think about measuring your math book with a yardstick? Do you agree that it is the best tool for the job?

LaRhonda: Yardstick is way too long. I think the ruler is better because it is shorter.

Michael: What about Billy's reason that a yardstick is good because it has inches?

Francis: But a ruler has inches, too, and it is shorter.

Through classroom discourse, Michael asked carefully selected questions about measurement to have his students engage in constructing viable arguments and critiquing the reasoning of the others. This is an example of how a content standard can be taught through important mathematical practices.

Think about the process standards/mathematical practices included in your state standards. Select one and reflect on how you weave it into your lessons.

It is important to note that the decision to start with a big idea, essential question, or standard is up to you. Some districts have **pacing guides,** which dictate the order in which the standards must be taught. In that case, you need to do the following:

- Look at your standards and decide which big ideas it covers.
- Identify the common thread or essential question you want to weave through your lessons on this big idea.

If your district does not have a pacing guide, you may first want to select a big idea to teach and then select the state standards you will cover in the lessons.

Building Unit Coherence

One of the best ways to build coherence between and among lessons within your unit is through the big ideas, essential questions, and standards. Keep in mind that connecting individual lessons through these three main elements promotes in-depth conceptual understanding, supports coherence, and unifies individual lessons. In fact, your lessons will share big ideas, essential questions, and shared standards within one unit. A big part of creating a coherent unit is strategically deciding how these three elements will be connected across the unit. Consider mapping the three components for the entire unit as you develop the lesson plan (Figure 3.1).

Figure 3.1

Unit-Planning Template

Unit Topic:		
Unit Standards	**Unit Big Ideas**	**Unit Essential Questions**

online resources Download the Unit-Planning Template from resources.corwin.com/mathlessonplanning/k-2

Kindergarten Snapshot

Big Ideas, Essential Questions, and Standards

Kindergarten teachers know that counting—especially learning how to use numbers to answer the question "How many?"—is a big idea. Three teachers, Marilyn, Eliza, and Rena, want to ensure that their kindergarten students have internalized counting and can use it as a strategy when they need it. To help the children make connections, they decide to hold regular class discussions with their students about when they use counting in their life outside of school. Once they decide on the big idea ("Use numbers to represent quantities") and the essential question ("How can numbers help us in everyday life?"), the standards fall into place for them.

Big Idea(s):

Use numbers to represent quantities.

Essential Question(s):

How can numbers help us in everyday life?

Content Standard(s):

Write numbers from 0 to 20. Represent a number of objects with a written numeral 0 to 20 (with 0 representing a count of no objects).

Mathematical Practice and/or Process Standards:

Construct viable arguments and critique the reasoning of others.

Attend to precision.

See the complete lesson plan in Appendix A on page 178.

What kinds of essential questions can you ask that encompass big ideas in your class? Record some of your responses below.

First-Grade Snapshot

Big Ideas, Essential Questions, and Standards

First-grade team Sarita, Jen, and Karlo are beginning to write their lessons on tens and ones. After discussing the ups and downs of last year's teaching of the topic, they decide they want an essential question that will guide them in keeping children from developing the misconception that there is only one way to decompose a number into tens and ones, a problem they ran into last year. They decide that they will focus the children on answering this question: "How can a number be represented with tens and ones in more than one way?"

Big Idea(s):

Group with tens and ones for place value.

Essential Question(s):

How can a number be represented with tens and ones in more than one way?

Content Standard(s):

Understand that the two digits of a two-digit number represent amounts of tens and ones.

Mathematical Practice or Process Standards:

Construct viable arguments and critique the reasoning of others.

Attend to precision.

See the complete lesson plan in Appendix A on page 183.

What kinds of essential questions can you ask that encompass big ideas in your class? Record some of your responses below.

Second-Grade Snapshot

Big Ideas, Essential Questions, and Standards

Second-grade teachers Aliyah and Dwayne are starting the year with the topic of place value. Aliyah notes that while her students can answer questions about place value, this year she wants students to show a greater understanding of place value concepts with more depth. Dwayne says that he wants to know more about whether his students understand the importance of the role of ten in our number system. Together they decide to use those thoughts to create the essential question that guides all of their lessons on this topic: "How is the number ten used in our system with ones and hundreds?"

Big Idea(s):

Extend the base-ten system to relationship among the unit.

Essential Question(s):

How is the number 10 used in our number system with ones and hundreds?

Content Standard(s):

Demonstrate that each digit of a three-digit number represents amounts of hundreds, tens, and ones (e.g., 387 is 3 hundreds, 8 tens, 7 ones).

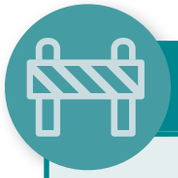
Mathematical Practice and/or Process Standards:

Construct viable arguments and critique the reasoning of others.

Attend to precision.

See the complete lesson plan in Appendix A on page 188.

Are there other topics in your grade level that could be guided by an essential question? Give some examples below.



Under Construction

Now it is your turn! You need to decide what big idea, essential question, and standards you want to build a lesson around. Start with your big idea and then identify the remaining elements.

Big Idea(s):

Essential Question(s):

Content Standard(s):

Mathematical Practice and/or Process Standards:

online resources Download the full Lesson-Planning Template from resources.corwin.com/mathlessonplanning/k-2
Remember that you can use the online version of the lesson plan template to begin compiling each section into the full template as your lesson plan grows.