Chapter 1

BEFORE THE CHILDREN ARRIVE

The week or two before the start of school is often full of both anticipation and anxiety. This time period can feel like a vacuum because you don’t yet know your students. To be ready for the anticipated event, and to allay some anxiety, you can:

- prepare the classroom physically to receive children
- ground yourself in the basics of developing number sense in your students
- think through how you’re going to schedule math each day
- give some thought to what your role will be as a teacher in a problem-solving-oriented math program
Preparing the classroom before the children’s arrival has many benefits. It puts the room in order so that students have easy access to the materials and space they will need to be successful problem solvers. It can also help you settle into the new school year. The sense of order that you create is an important reminder that you are in charge and responsible for much of what goes on within the confines of your classroom. Teachers have many outside pressures—but when the students arrive and the classroom door is closed, you are in charge.

Manipulatives: The Basic Materials

Ideally, your classroom should be stocked with:

- Interlocking cubes can be used throughout the year for number work—gather at least 1 set of 1,000 cubes.
- Pattern blocks are extremely useful for geometry activities and draw children into mathematics with their bright colors and interrelated shapes—have at least 2 buckets of 250.
- Rulers, balance scales, and a clock with a second hand are necessary for measurement activities.
- Beans, bread tags, buttons, small ceramic tiles, color tiles, or any other small discrete material can be used as counters. These will provide variety and help your students understand that numeric concepts are not dependent on the size or shape of any one material.
- You’ll need dice or cubes with the faces labeled 1 through 6 (and the corresponding number of dots on each face).
- You’ll also want regular playing cards with the face cards removed. One deck of cards for every two students and a deck for yourself are needed.
- Geo blocks are nice for three-dimensional geometry activities.
- Multicolored, graduated-length Cuisenaire rods have an inherently mathematical nature. No formal lesson in this book requires Cuisenaire rods, but opportunities to build structures using the rods can help students explore important numeric relationships. They’re a good material to have available during project time, which is described in the “Scheduling Math—Every Day” section of this chapter.

Making Materials Accessible

Place manipulative materials in containers (e.g., gallon plastic bags that you then store in a tub, or clear plastic boxes with stacking lids) in quan-
ties adequate for a table of four students. Affix labels to the shelves indicating where each material is stored, to encourage students to be responsible for keeping the classroom organized.

If possible, store materials in low book shelves that are readily accessible to the children. Above the cabinet, tack large envelopes to hold copies of game/activity instructions. You can then use the shelf top to hold any unique materials needed for a specific game or activity. (See Figure 1–1.)

**Room Arrangement**

**Rug Area**

If possible, set aside an area of your room that is large enough for all of your students to sit around its perimeter. A chalkboard (or easel with a large pad of writing paper) should be visible to everyone. You’ll use this arrangement when you want your students to listen to one another as they share their problem-solving strategies with the whole class. You’ll also find this arrangement useful when you teach a new game or lead group discussions. The rug area creates a feeling of closeness that seems
to help young children listen to one another, and it focuses their visual attention. It also gives them a break from sitting in the same chair all day long.

**Partner Seating**

Throughout the year, each student will often work with one other student, playing games or solving problems together. Rectangular tables that accommodate two students side by side are ideal. Also consider forming larger squares by pushing two tables together and then arranging these squares into a loose U-shape around the rug. With this arrangement, you have easy access to all students. Moreover, you can use this setting for those times when you want to conduct a group discussion with all the children at their tables. (See Figure 1–2.)

**Wall Display for Daily Jobs**

You may decide to have your students do the Daily Jobs described in Chapter 2. To be ready for the first day of school, set aside a large bulletin-board area, readily visible from both the children’s seats and the rug area. In this area, you’ll display calendar information, daily graphs and schedules, and a job chart. The wall display should include:
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- calendars—Use a monthly pocket-chart calendar (available commercially) that will be reorganized each month as the year progresses. Also post a commercial or small hand-made calendar for the current month (see Blackline Masters for one that may be enlarged). You’ll use this calendar to post special days and to model crossing off each day as it passes by.

- pocket charts for today’s date and number—Post the following frame sentences, written on sentence-strip paper, on a pocket chart:

  Today is ____________. (Have cards with the days of the week nearby on a long, narrow pocket chart.)

  September XX, 200X. (Have cards with the months and the numbers 1–31 to rotate through these spaces.)

  Today’s Number is ___. (Have cards with the numbers 1–180, or higher if you have a longer school year. You’ll also need a space elsewhere in the room to create a growing number line using these number cards.)

- days-of-the-year chart—Include a large, blank grid, ten boxes across with as many rows as needed to provide one box for every day of the school year.
- weather graph—Each month, post a new 8½-by-11-inch graph with blank boxes next to the weather choices that are appropriate for your geographic area. (See Blackline Masters for a graph that may be enlarged.)

- daily schedule—Write out the day’s schedule with times on the chalkboard or on cards that fit in another pocket chart.

- daily jobs chart—List the following four jobs and have a space for children’s names to be rotated through the jobs: Today’s Date, Weather Graph, Today’s Number, Today’s Calendar Page. (See Figure 1–3.)

Math Folders or Journals

You’ll also want to plan a way for students to keep track of their math papers. Here are some ideas:

- pocket folders—You can buy folders with two interior pockets at very reasonable prices at office-supply stores. Students can keep them in their desks and store both finished and ongoing work. Early in the year, show students where you want them to put names and
dates on each piece of work if you use a loose-leaf system such as this. Pocket folders have the advantage of flexibility, including making it easy for you to collect work from every child on a particular assignment. But you and your students will need to put some effort into keeping the papers organized and to clean out the folders periodically, possibly for a portfolio presentation.

**FIGURE 1-3**
Wall display for daily jobs.
blank books—You can use commercially available composition books or books you staple together yourself by folding 12-by-18-inch newsprint to form 9-by-12-inch books covered with a piece of construction paper. Students can glue worksheets into these books when appropriate and should date each new piece of work. Blank books have the advantage of keeping work in chronological order and making blank paper readily available to each student. However, they don’t have the flexibility inherent in a pocket-folder system and can be unwieldy if you want to check each child’s work on a particular assignment.

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Students’ Developing Number Sense

One way to decide whether you are providing your students with a useful mathematical program is to ask yourself if you are giving them enough opportunities to develop a strong sense of number. This somewhat elusive notion can be defined as the ability to think about numbers efficiently, accurately, flexibly, and with confidence. Having number sense includes:

- being able to take numbers apart and put them back together again—decomposing or partitioning numbers.
- understanding how numbers compare to one another in terms of their relative magnitude.
- having a *conceptual* understanding of the basic mathematical operations of addition, subtraction, multiplication, and division and opportunities to develop algorithms for performing those operations.
- knowing about number relationships.
- being able to make accurate estimates.

It’s important to understand how these ideas relate to second grade mathematical concepts.

Composing and Decomposing Numbers

Being able to decompose or partition numbers is what much of primary-number work has focused on. It includes knowing that 7 can be partitioned as 3 + 4, 1 + 6, or 2 + 5. Over time, second graders need to develop confidence that the quantity of the whole has not changed even though they have decomposed the number in many different ways. Once they feel
comfortable decomposing smaller numbers, they can apply this thinking toward understanding the structure of larger numbers—knowing, for instance, that 28 can be decomposed into 20 and 8. It is immensely important to give children many opportunities to decompose numbers, both through using concrete models and performing the exercise mentally.

**Relative Magnitude of Numbers**

Second graders should begin to know whether a number is close to or far from a given referent. For example, 24 is almost 25, about half of 50, and small compared to 100. Children develop these understandings by having many opportunities to count quantities of concrete things and to think about the concepts of more and less through games, measuring, number line, and graphing experiences.

**Understanding Operations**

Second graders need to know that addition involves combining quantities and that subtraction may involve taking something away, or looking at the difference between two quantities. Understanding operations includes knowing when to apply each operation. This ability develops in children when they have many opportunities to solve appropriate word problems. Second graders need frequent occasions to construct their own procedures for applying operations, with chances to develop increasingly efficient methods that make sense to them.

**Number Relationships**

Understanding number relationships involves grasping the relative magnitude of numbers, as well as operations. For second graders, it includes knowing that if $5 + 5 = 10$, then $5 + 6 = 11$. It also includes such concepts as knowing what happens when you add 10 to any number. Children frequently draw on their understanding of pattern when noticing and analyzing number relationships.

**Estimation**

Estimating helps children develop number sense because it makes them focus on numbers and how they relate to one another. Estimation also helps children develop that all-important notion of the reasonableness of answers. To develop your second graders’ sense of number, ask them often to estimate in terms of a given referent. For example, when posing a ques-
tion about how many cubes it might take to fill a particular container, you might ask, “Do you think it will take more than a hundred, or fewer than a hundred cubes?”

If children have opportunities to develop these understandings in ways that match their developmental level, they’ll become engaged in activities that will help them grow mathematically. The world is filled with experiences that can encourage this growth. In the remaining chapters of this book, you’ll find many specific suggestions for activities that develop number sense.

### Scheduling Math—Every Day

You’ll need to find time in your daily schedule for:

- a morning routine of set activities
- a 45–50-minute block of time sometime later in the day
- unscheduled opportunities throughout the day—whenever you can capitalize on mathematical possibilities that arise within other subject areas

#### Morning Routines

The morning-routine period lasts for about 20–30 minutes each day. It can work well as an opening activity for the day. It begins with three calendar-related activities (see page 21) and is followed by the activity *Today’s Number* (see page 28). Although small variations happen during this time period as the year progresses, these are fairly unchanging routines.

#### Math Block, Including Menu

Later in the day, but preferably in the morning—when children are most alert—you’ll schedule the main math period of the day. This period generally consists of a 15–20-minute discussion period and about a half-hour of time to work on math activities.

The discussion period might consist of introduction of a new activity at the beginning of the session or a follow-up discussion at the end of the period.
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The activity period might be a time when all students are working on the same activity, alone or with a partner, or children might be choosing from a menu of activities.

You’ll have to see whether these time blocks are a good match for your students. Shorter amounts of time might be better earlier in the year, as students learn to be active listeners and independent problem solvers.

Menu

A menu offers children a choice of two to ten activities that you have slowly introduced over time. You can find an example of a menu and ways to introduce it in Chapter 2.

A big advantage of having a menu set-up is that it accommodates children who are working at different rates. Even on a day when you have assigned a particular problem to solve or activity that you want every child to do, youngsters who finish early can be directed to the menu as others finish up. Menus also offer children opportunities to repeat an activity several times, so that they get beyond the procedure of the activity and more deeply into the mathematics. In addition, menus encourage children to take more responsibility for their own learning and to be more self-directed. Finally, once children are working responsibly on a menu, you have more time to observe and assess as you move from table to table during the work period.

Exploration Throughout the Day

Mathematical exploration should not be confined to scheduled math times. In fact, some of the most exciting mathematical moments that happen in classrooms are often unscheduled and even unexpected. It’s all a matter of staying open and alert to possibilities.

For example, brief mathematical side trips can occur during the reading of literature. Second-grade teachers often use the wonderful My Father’s Dragon series by Ruth Stiles Gannet as a read-aloud. In addition to recounting adventures suited to the interests of second graders, this series is filled with potential mathematical side trips. For instance, you may want to keep a running record of just how many tangerines Elmer has left after each of his snacks, as he slowly consumes the thirty-one tangerines that he picked before heading over to Wild Island. When Elmer finds himself surprised by “the fourteen green eyes coming out of the jungle” in the book’s Chapter 5, you can have children share their thoughts about how many creatures have surrounded the quick-thinking Elmer Elevator.

The big idea? Stay alert to situations in other curricular areas that offer fun, intriguing mathematical inquiry. Also keep your ears open for situations based on your students’ interests that could lead to a longer
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mathematical inquiry. The example below can’t be duplicated elsewhere, but I’ve included it because it illustrates how a student’s question can lead to a rich mathematical project in the classroom.

One year, because of a school construction project, my second graders had to walk to and from the playground via a set of stairs commonly known in the community as the ninety-nine steps. Iliana wondered if there really were ninety-nine steps, or if the name was based on the fact that there were a lot of stairs. I asked her how we could find out, and the obvious answer—count the steps—came up. I suggested that at the next recess she make a point of counting them as she ascended them and then check her count on the return trip. She did so, and discovered that she had gotten a different count each time. I gave her two sticky notes and suggested that she record her two counts and show the date that she did them. We found a place on the wall where she could post these two slips of paper under the heading “How Many Steps Did You Count?” We then invited the rest of the class to participate in this data-collection activity by doing their own counting and posting. For the next few weeks, many children counted and posted—none more often than Iliana and her close friend Katy.

One day, as a class, we examined the data. With the children’s help, I rearranged the randomly posted notes into a bar graph that let us note the range of counts and the numbers that had come up most often. [The graph looked like the one in Figure 1–4.]

The children easily understood that the counts were inconsistent because the numbers were large and hard to keep track of. Yet we were impressed that the range was fairly small. Because so many pieces of data hovered around ninety-nine, we began to feel fairly certain that an accurate count might very well prove that the steps were aptly named.

Now the problem became how to come up with a definitive count. We finally decided to put one Snap Cube on each step. Iliana and Katy took care of this job and later snapped the cubes into groups of ten. We were thrilled to find out that there were exactly nine groups of ten and nine single cubes left over—ninety-nine steps indeed! Iliana and Katy later wrote up their findings, then posted them in the hallway for other classes to see. What began as a simple question by a curious child had become a full-fledged data-collection-and-analysis exploration that involved many children.

Project Time

Project time is a name for scheduled spontaneity and creativity in the classroom. Three to five times a week, for at least a half-hour to, preferably, forty-five minutes, children get to work on projects of their own choosing. It may help to think of project time as preparation for college, another time in life when students will be asked to devise and develop projects on their own. Your role is to provide materials—crayons; paper; other art materials; and access to building materials such as
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Jan. 10
99
Iliana

Jan. 5
88
Katy

FIGURE 1–4

Ninety-nine steps data
blocks, Legos, and all the basic math materials you have on hand. You also need to be available to enjoy and respond to your students’ creations. Project time is a great way to get to know your students and their interests and to let them know how interested you are in their work. Children love project time. You can help them to understand the importance of being responsible for their own learning through brief discussions at the end of the period. Keep these discussions short and get the kids started by asking volunteers to tell a few things about what they chose to do that day.

Mathematical situations are almost sure to arise once the children have settled into their chosen projects. For example, one day Sonya and Raj were snapping cubes together on the floor, hoping to make a train long enough to go from one side of the room to the other. When they were about halfway across the room, I asked them how many cubes they thought it would take to accomplish the task. They had no firm idea how to estimate the number of cubes needed but were interested in finding the answer. They decided to try counting how many cubes they had used so far. But they found it frustrating to count by ones—they kept getting off track. I asked if there were any other way of counting that might be easier, and they came up with the idea of creating mini-trains of ten cubes each. Their work proceeded over several days, during which they found they could easily store the trains of ten on a tray each day at cleanup time. Eventually, they decided that if they made the last cube of each train blue (they had been using all red cubes), they could tell where each group of ten ended and a new one began. As they worked, many other children became interested in their work. They put aside their pattern-block creations or coloring projects to make estimates of their own about the total cubes needed after learning how many cubes it took to go halfway across the room.

The mathematical richness of the activity developed because Sonya and Raj were working on a project of their own choosing and because they were confronted with an interesting question that they wanted to pursue. So, as teacher, you’ll want to stay alert to such possibilities. But also be willing to step back and let the children make final decisions about their own projects.

Thinking About Your Role as Teacher

Perhaps the most important preparation you’ll do to get ready for the school year will take place in your own mind. When making choices about your math program, you’ll want to remind yourself that your job is to ensure that your students have many opportunities to develop a strong understanding of the world of number. The number of pages you
get through in a math workbook won’t be the best way to judge your program. Your most important job is to give students a strong conceptual understanding of our number system and a positive attitude about mathematics. One way to judge your program is to continually ask yourself questions such as these: “Am I giving my students many opportunities to compose and decompose numbers? Are my students having experiences that develop their understanding of relative magnitude and number relationships? Have my students had the time to firmly grasp basic mathematical operations?” You’ll also want to plan to give some attention to geometry—the mathematical world of shape.

Your students will need to know that you (and their fellow classmates) value their thinking. After providing an appropriate problem to solve, plan to pay close attention to students’ reasoning. Be prepared to listen actively and respectfully. When you pay careful attention to your students’ ideas, you are more likely to notice and understand how they are thinking. You need this information to know which questions to ask and which problems to pose next. You’ll also send the message to your students that you care about and respect their thought process—a powerful message indeed. And you’ll model active listening for your students so that they themselves will become better listeners.

Children need to talk about their ideas as they make sense of new concepts. In order for children to feel comfortable talking about their ideas, they need to know that you view mistakes as opportunities to learn and that you value intellectual risk-taking. Remember that your job is not to provide the correct answer, but to guide and question so that children find solutions that lead to the correct answer. Accept that the road to understanding is long and characterized by numerous missteps. Mistakes become learning opportunities when they lead to further exploration. So, when you encounter a mathematical misunderstanding, prepare yourself to say, “Hmm, that’s an interesting idea, but I notice . . . .” Then point out how the answer may conflict with some aspect of the problem. Ask “What do you make of that?” to invite the child back into the problem-solving quest.

Perhaps the most difficult and important notion to keep in mind is that students need the luxury of time. They require time to experience a concept in many different ways and to make sense out of the many new concepts they will encounter this year. We all want our students to do well, so we sometimes rush this process. We start feeling the need to teach them “the right way” to solve a problem, hoping that this instruction will give them the tool they need to master mathematics. Direct instruction of efficient algorithms seems like such a reasonable thing to do—until you notice how confused students become when asked to do a procedure for which they lack conceptual understanding.

Teaching mathematics in a way that fosters understanding requires a basic trust that children are interested in and capable of understanding mathematical concepts. When you step aside and let students take off in
directions that make sense to them, you may feel uneasy at first. The reward comes when you see children engaged in mathematical thinking and spontaneously saying, “I really like math!”