SO YOU HAVE TO TEACH MATH?

SOUND ADVICE FOR K–6 TEACHERS

MARILYN BURNS

ROBYN SILBEY

Contents

Chapters and Questions

One

Preparing for a Successful Year

Lydia and Samantha both taught fifth grade and wanted to be sure that their students were well prepared for attending middle school the next year. Their district had just published a new framework based on the national math standards, and the district testing program was new as well. Lydia and Samantha weren't sure how these changes should impact their math teaching. What was important to think about for their instruction? What preparation would the students need for the new test?

Janice had different questions about the upcoming year. She had been teaching fourth grade for five years and had just been reassigned to first. She liked math and knew the fourth-grade math curriculum well, but she hadn't taught first graders since her student teaching assignment. She felt she needed to get a handle on the year's goals and a better sense of what first graders could do.

Tom was concerned about another issue. This year he wanted to focus on his students' attitudes toward math. He worried about those students each year who seemed to have already come to hate math, and he wanted to think about what he could do for them. He was thinking about what sorts of field trips might help his students see math as relevant and enjoyable.

As these teachers' concerns demonstrate, there are many aspects to consider when preparing for a year of math teaching. Taking an overall look at them is valuable for identifying issues you want to be sure to address with your instructional program.

1 What's the best way to get a handle on all the math I need to teach during the year?

Having an overall sense of where you're heading mathematically for the year is important. Each grade level has its own specific goals, and you need to look at the big picture of what students in your class should understand and be able to do by the end

of the year. It's hard as a new teacher, or as a teacher new to a particular grade, to have a clear vision of this. You may have some memory about what it was like to have been a student yourself in the grade level you're teaching, but relying on your memory is risky. And, of course, your perspective was much different then. We recommend that you don't rely on just one source for looking at the math content for the year but that you take advantage of resources in several categories. Each will offer you a different perspective that will help shape your thinking.

One category of resources includes national and state standards. We know that these documents won't give you the help you need for planning daily lessons, but they can provide information about math teaching and learning that's valuable for seeing where in the larger picture your specific grade-level concerns fit. Also, national and state standards provide useful information for communicating with students and parents about what's important in learning math. (*See page 2–3 for a nutshell view of the national standards.*)

Next check your district guidelines about what your students should learn and the specific grade-level expectations. Districts use different names to describe these guidelines—math framework, curriculum guide, teaching and learning standards, student learning objectives, performance standards, and so on. It's also possible that your district hasn't compiled a specific document but is relying on the guidance of the state standards. Check with your district for a copy of your state standards, or check your state department's Web site.

A third category of resources includes the instructional materials provided by your district for teaching math. Especially if you're new to teaching math, these will probably give you the most help for charting the year's instruction. They outline lessons and help you gather your thoughts and prepare the materials needed for teaching. As you gain more experience teaching math, you'll probably do what most teachers do and supplement your instructional materials with ideas you've gleaned from colleagues, workshops, other materials, your own experiences, and feedback from your students about lessons you've tried.

2 What's important to know about the national math standards?

Our current national math standards, titled *Principles and Standards for School Mathematics*, are published by the National Council for Teachers of Mathematics. Released in April 2000, our standards are built on several important ideas:

- Learning math is essential for students.
- All students can learn mathematics, not just those with a "gift for math."

- Learning math means more than memorizing facts and performing procedures and includes thinking, reasoning, and applying skills to problem-solving situations.
- Students learn math by being actively involved in making sense of concepts and skills.

The document begins by addressing six guiding principles: equity, curriculum, teaching, learning, assessment, and technology. The rest of the document focuses on ten standards—five content standards and five process standards.

Content Standards

Standard 1. Number and Operation

Standard 2. Patterns, Functions, and Algebra

Standard 3. Geometry and Spatial Sense

Standard 4. Measurement

Standard 5. Data Analysis, Statistics, and Probability

The five content standards define the mathematics students must learn. They're the heart of what we teach. Although they're organized into five separate standards, it's important to remember that there are overlaps among the content areas. Number appears in all areas of math. Learning about measurement, statistics, and probability helps learning about number. Spatial sense plays an important role in patterns, functions, and algebra. The five standards together provide you a way to be sure that your math program is addressing the full breadth of mathematics that your students should know.

Process Standards

Standard 6. Problem Solving

Standard 7. Reasoning and Proof

Standard 8. Communication

Standard 9. Connections

Standard 10. Representation

While the content standards are the heart of the curriculum, the process standards are essential to keep it pumping. They describe the processes students use to learn and apply mathematics. In important ways, the two sets of standards are inseparable. The process standards provide the vehicles for bringing the content of the math curriculum to life and making it accessible to children.

Following a general description of each standard in the document are elaborations in four grade-level sections: K–2, 3–5, 6–8, and 9–12. These sections provide more specific information along with suggestions for classroom instruction.

3 Since my instructional materials give me the direction I need for planning day-to-day lessons, why do I need to give attention to national or state standards?

It's true that national and state math standards, and even your district standards, don't give you the specific planning help you need to face your students each day. But they do provide an overall structure of math teaching and learning that can guide your thinking as you make your daily instructional plans.

Think about when you plan to drive someplace you've never been. Specific directions help, and the more detailed they are, the smoother your trip is likely to be. But if the directions call for getting off at a particular exit or turning at a specific corner, and road construction requires an alternate route, you're better prepared when you have a broader sense of where you're going. In that case, it's also beneficial to have a general map of the area. In the same way, you can think of standards as broad road maps that provide a context for specific instructional choices.

When you make lesson plans, your attention to specifics is important for lessons to go smoothly. Making lesson plans calls for thinking through a variety of details—choosing the right materials, organizing the students, presenting directions, setting expectations for the students, providing for students who finish more quickly than others, and so on. However, along with working out these logistic details, it's also important to understand the key math ideas the lesson addresses and where these ideas fit into students' overall math learning. Standards can help with that.

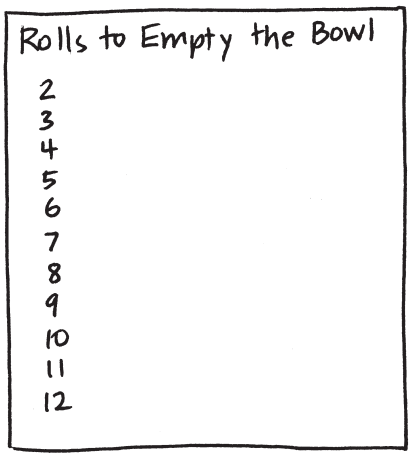
Perhaps an example would be useful to illustrate these ideas. Empty the Bowl is an activity that you might enjoy trying with your students. We've used it with primary children as well as with older students. The activity gives primary children practice with addition, helps children develop their number sense, and provides a way to introduce them to ideas about probability. For older students, probability ideas and analyzing statistics become the focus of the activity.

Here's a plan for teaching Empty the Bowl:

1. Explain the activity: *Put 12 cubes or tiles into a small plastic bowl (such as a margarine tub) and then roll a die. The number on the die tells how many tiles to remove. Continue until the bowl is empty.*
2. Model with a volunteer how the students will work in pairs. You roll the die and remove the tiles; the volunteer student records the number rolled. To prompt the students' thinking, after each roll ask the class how many tiles still remain in the bowl.
3. Explain to the class that when only a few tiles remain, it's not necessary to go out exactly. If you roll a 5, for example, and only two tiles remain, you can remove them.

4. Tell the students that when the bowl is empty, partners should add the recorded numbers. With your volunteer, add the numbers for your game. Point out that if you went out exactly, the total will be 12; if the last roll was larger than the number of tiles left, the total will be more.
5. Before students pair up to work, ask: *What's the fewest number of rolls it would take to empty the bowl*? Discuss. Then ask: *What's the most number of rolls it would take to empty the bowl*? Discuss. List the numbers from 2 through 12 on a class chart and ask: *Is it possible to empty the bowl in all of these numbers of rolls*? Discuss, and have children give possible rolls that would result in each total number of rolls.
6. Tell the students that they are to play five rounds and then record with a tally mark next to the appropriate number on the class chart how many rolls it took on each round to empty the bowl. Record a tally mark for the game you modeled. If you think it's needed, model another game. *(See Figure 1–1.)*
7. Finally, tell the students that if time remains when they have played and recorded five tally marks, they should play more rounds and continue recording tally marks.
8. After all students have played and recorded, discuss the results on the class chart. Ask students how the class results compare to their individual results.

Empty the Bowl, along with providing numerical experience, provides the opportunity to introduce or reinforce several important ideas about probability and statistics:



1–1. Students use a class chart to record how many rolls in each round it took them to empty the bowl.

1. Some events are more likely than others, while some events are equally likely.
2. It's possible to measure the likelihood of events.
3. A sample set of data can be useful for predicting an outcome.
4. Larger sample sizes of data are more reliable than smaller samples.
5. Sometimes an experiment produces data that do not match a theory about probability.

The plans for Empty the Bowl ask students to consider several questions: Why are 2 and 12 the fewest and most numbers of rolls it can take to empty a bowl? Is it possible to empty the bowl in all numbers of rolls from 2 through 12? What do you think the data will show after all students record tally marks? Do you think it's more likely for some numbers of rolls to come up than others? Why? Suppose you had to go out exactly, so that if you had two tiles left and rolled a 5, you couldn't play. How would that change the results on the class chart? What would be the most number of rolls needed in this version? How does the larger sample of the class data compare with students' individual trials? The important ideas about probability and statistics in the previous list not only justify the activity but also guided the selection of these questions.

Thinking about important math goals can also help you think of extensions for your lessons. For example, you could have primary children repeat the activity with 20 items in the bowl. Older students could try the activity a second time using the rule of having to go out exactly and then compare the data from the two versions. You might think of other ideas to extend this lesson.

4 What's important for me to think about when planning instruction?

You should consider three aspects when getting organized for successful lessons: planning, preparing, and management. We realize that there are overlapping issues to these aspects, but we think it's helpful to think of them separately.

Planning first. We think of this more or less as a script for teaching a lesson. In order for lessons to run smoothly, you need to think about your presentation—the explanations you'll offer, the questions you'll pose to stimulate students' thinking, and the assignment you'll give to groups or individuals. It may help you to make written notes about the sequence of your lesson so you have an actual script that you can refer to during instruction. We do this often. (*See the instructions for* Empty the Bowl *on page 4.*) Reread your notes to check on the clarity of the explanations, questions, and directions. Do you think they're crystal clear? Will they promote reasoning?

Preparing next. While planning gives a lesson structure, preparing calls for thinking hard about the mathematics underlying the lesson. How does the topic connect to

other topics the students have studied? What answers might the children give for the questions you pose? What responses might you have in mind to help their learning? The more thinking you do ahead of time about the mathematical content, the better prepared you'll be to maximize the benefit of the instruction. Still, no matter how carefully you prepare, expect—and hope for—surprises. Keep in mind that your role is to concentrate on understanding what children say, not to listen for answers you were expecting or hoping to hear. (*See page 37 for tips about listening to children's responses.*)

Finally, management. Tend to organizational details. If you're planning to use manipulatives during the course of the lesson, for example, have them on hand and ready for distribution before the lesson begins. If you want each group of children to have an assortment of pattern blocks, separate and organize them ahead of time so that distribution takes less than a minute. You may want students to make their own recording sheets. That's a great idea because students are not only recording the results of their math explorations but also learning how to organize their thoughts using a bit of their own style. If you need something to be duplicated, do it before the lesson begins. Make sure that the materials, supplies, and paper required for students to execute your lesson are ready to go.

5 How can I be sure that my instruction promotes students' learning?

We've learned to think carefully about the questions we ask in lessons to be sure that they promote thinking and reasoning and to make our learning goals clear to the class. Here's an example. Suppose you're planning a lesson to focus students' strategies for adding mentally—perhaps single-digit numbers for younger children or two- and three-digit numbers for older students. You want students to be able to compute accurately and efficiently. But your goals should also include helping them develop strategies that allow them to be flexible in their thinking and make computing decisions appropriate for the numbers at hand.

How might you begin such a lesson? You might write 6 + 7 on the board. Or for older students, *Our class has 27 students. Ms. Kringle's class has 28 students*. Then you could pose a problem: "How much is 6 plus 7?" or "How many students are there in our class and Ms. Kringle's class together?" But what typically occurs as a result of questions like these is that hands shoot up from the students who think more quickly while the others either struggle to think or merely wait for the more confident students to reply. Putting the initial emphasis on the correct answer can exacerbate this situation.

We have tried posing the question differently: "How can you find the sum of 6 and 7?" or "Who can explain why 6 plus 7 equals 13?" Or, for the older students, "What would you do to figure out how many students there are altogether in our class and

Ms. Kringle's class?" But from our experience, unless we talked with students first about what we expected, even these sorts of questions resulted in a scurry for the correct answer.

It's important before posing any question to help students understand your interest in how they think and reason. To this end, take a moment at the beginning of a lesson to explain your purpose. For instance, for the example above, you might say, "Today I'm interested in hearing how many different ways we can think of to add numbers in our head. I'm going to give you a problem and give you some time to figure out the answer. Then you'll have a chance to report your answer and also explain to the class how you thought it through." Another approach is to pose the problem and then say, "Figure out the answer and then check with your partner that you both agree. Then each of you should take a turn telling your partner how you figured it out. In a few moments, you'll have a chance to explain your thinking to the class so we can hear all the different ways of solving the problem."

After the students have had time to figure, and before beginning a class discussion, again set the guidelines. Remind the class that you're interested in how they thought about the problem. You might also tell them, "When someone reports, your job is to listen to hear if you figured the same way or in a different way." Remember, your students will do their best to give you what you ask of them, so make sure your directions and questions ask for the result you want.

While lessons like this may seem unusual to students at first, after several experiences they'll be more comfortable with your focus on thinking. They'll come to expect that they'll have to explain how they reasoned, and they'll get better at listening to others' ideas.

6 How do I find out if units or specific lessons will be appropriate for my students?

Whether you're thinking about a whole unit or a particular day's lesson, it's important to begin instruction by finding out where your students' learning can begin. The instructional materials you use may include some sort of formal preassessment. Even so, it's useful to learn from the class informally. Whether you're beginning a unit on addition and subtraction, multiplication, or fractions or planning a specific lesson on measuring length or classifying triangles, put up a sheet of chart paper with two headings: "What I Know About _____" and "What I Want to Find Out About _____." Inviting the class to contribute to the chart can help define where your instruction should begin. For example, your second graders may say that they know how to add, but they'd like to find out how to subtract large numbers. Or perhaps they know how to measure with a ruler, but they'd like to know how to measure the distance around a red rubber ball.

Tell the students that you'll use the results on the chart when planning lessons. Ask yourself, "What would I like my class to know and be able to do as a result of this instruction? How does this learning relate to what else they've been studying?" Share your goals with students in a way that they can understand. You may want to post them in the classroom, maybe on the chart paper of your students' ideas. Your students will benefit from knowing the goals you have in mind for them, and the goals send a clear message about your expectations for their learning. Also, when children see their ideas reflected in goals, they are empowered as participants in their own learning.

7 How should I prepare students for the tests that the district or state requires?

There's a wide variety of math tests that students have to take. Some include only multiple-choice items; some include questions that call for short written answers; some also pose problems that call for longer written responses. Whatever the form of the questions, your students should have experience with it beforehand so that they are familiar with the format of the test and how they are to respond. But rather than think about preparing students just before they have to take a test, think about preparing students for tests as an ongoing part of instruction.

Let's consider multiple-choice test items first. Try some hands-on-the-table math—no pencil, no paper, no writing. These are good starters for math class. Write a problem on the board that's similar to the kind of multiple-choice test item they'll face, listing possible answers as they'll appear in the test booklet. Then tell the students that for this hands-on-the-table problem, they can use only their heads and the ideas of others. Have them talk in pairs first and then ask for responses. Insist that the person answering give an explanation of how he or she found the answer. Always ask if anyone thought about it in a different way.

You might choose a problem for which the math is familiar to them, for example:

> Ruby had 47 marbles in her collection. For her birthday, she received a box of 25 marbles. How many marbles does she have now?
>
> a. 22
>
> b. 62
>
> c. 72
>
> d. 81

Or you might choose a problem for which the math is new. Remember that many standardized tests include items that don't reflect what you're supposed to teach. These items appear on norm-referenced tests as a way to influence the curve of students'

results. For example, fifth graders taking a test in late fall might encounter a problem that calls for dividing by a fraction, something they haven't learned as yet:

$3 \div \frac{1}{4} = ?$

a. $\frac{3}{4}$

b. $\frac{1}{12}$

c. $1\frac{1}{4}$

d. 12

Don't think about rearranging your curriculum for items like these. However, it can be useful to discuss with your students what they might do when they encounter something new and strange. The previous example presents an opportunity for students to think about what they know about division. Or they can think about changing an unfamiliar problem to a similar one that they can do and see if that helps. In this case, even students who haven't formally studied division of fractions can reason to arrive at an answer. By realizing that they can think of division problems with whole numbers such as $8 \div 4$, as "how many 4s fit into 8," they can think the same way for this problem and figure out "how many $\frac{1}{4}$s go into 3."

The goal for these hands-on-the-table exercises is to help your students get used to approaching tests with an attitude of reasoning and making sense of the questions. Mix up the practice to include questions of all the types your students will encounter. The good news, you can tell your students, is that when they take a test they'll have paper and pencil available to them, which can help with their figuring. The tough news, however, is that they won't be able to talk with one another, because a test needs to measure what each of them knows and can do. Reinforce for them that their job when taking a test is to give the best picture they can about what they understand, what they can do, and what they haven't learned yet. This information helps teachers better plan how to help them learn.

Tests can be stressful for students, more for some than for others. Tests are also stressful for teachers, as we sometimes feel they measure our success as well. If you're anxious about the test, don't communicate your anxiety to your students. Instead, let your students know that the test is their opportunity to show their stuff and encourage them to do the best they can.

8 Help! I'm switching from fifth grade to first grade. What advice can you give me?

If you're used to working with older students, changing to first grade will certainly require some adjustments. A year's growth can make an enormous difference in a child, and this growth compounded over several years calls for thinking about the

classroom in very different ways. From our own teaching experiences, however, we've learned that changing grade levels has been tremendously helpful for expanding—and improving—our teaching skills. It's understandable for the change in your teaching assignment to produce some anxiety, but we urge you to embrace the change with curiosity and enthusiasm. You'll be a better teacher for it. Here are some pointers for thinking about the differences between the two grades—both about the children and about the mathematics they study.

One difference is that things in first grade generally require more time than you're accustomed to spending with older students. Writing, for example, is a newly learned skill for young children. Holding a pencil is tough for some children, and the time and labor required for their written work may surprise you. After some experience, however, you'll learn how to predict more accurately the amount of time needed for a particular activity.

In terms of their mathematical ability, children's most evident skill at this age is their ability to count. They count on counting. While our goal is to help children move beyond counting and learn to reason numerically, at this age counting is their safety net, a skill they've learned to trust. You may notice that children's counting ability typically surpasses their understanding. Some children are able to count to one hundred or higher, but while they've learned the *pattern* for counting, they don't understand the *structure* of the numbers—that 67, for example, represents six 10s and seven 1s. At times, of course, fifth graders may resort to counting when they figure, but they also have other strategies available to them and have internalized relationships among numbers that aren't yet available to younger children.

There are also many specifics that young children haven't yet learned. Along with possessing limited writing skills, they're probably not reading well enough for you to rely on written directions. Their vocabulary is limited and they may not know what it means for something to be "twice as much." You'll need to review and reinforce the meaning of words—for example, *same* and *different*—and give children many experiences using them in contexts. They also most likely can't tell time or count the value of coins.

Here's a classroom example that may give you insights into differences between first and fifth graders. A class of first graders was investigating the number of cubes in a handful. The teacher modeled how to take a handful—reaching in with one hand, gathering cubes with it, holding it with her fist down, and shaking it twice to get rid of extra cubes. Each child came up and took a handful, then went back to his or her desk to snap the cubes into a train, count them, and write the number he or she had on a three-by-three-inch Post-it. Then the teacher helped the children organize the Post-its into a class graph. All this took quite a bit longer than it would have with fifth graders!

"How many cubes do you think there are in our handfuls altogether?" the teacher asked. Most of the children raised a hand to respond. But when the teacher asked the

children to explain their predictions, most shrugged or simply said, "I just guessed." The guesses ranged from twenty to "a jillion, billion." The teacher then asked that each group of four students figure out the number of cubes in their handfuls combined. "Put the cubes at your table together into trains of 10. Then be ready to tell how many 10s and how many extras you have." One table had eight extra cubes and figured out that they needed two more to make another 10. The teacher polled the other groups to see who had two extras to offer them. In this way, she helped groups make as many 10s as possible. She had the children bring the 10s up to the chalkboard tray. She modeled how to count the 10s, then the extras, and record the total.

"Suppose we put our cubes into trains with five cubes in each instead of ten," she said. "Then we could count by 5s. Would this give us the same total number of cubes?" While this answer would be obvious to fifth graders, in this first-grade class, it was a pretty even split between those who responded yes and those who thought no. Also, while it would seem obvious to fifth graders that you could make trains of five merely by breaking each train of ten in half, this was a new discovery for the young children.

You'll learn about the many differences between the two grades in short order. Rely on your instructional materials, on the advice of colleagues with more experience with young children, and on paying close attention to the children themselves. Listen to them talk, and watch them at work and at play.

9 Help! I'm switching from first grade to fifth grade. What advice can you give me?

We recommend that you first read the advice we give in the previous section for teachers in the opposite situation—those moving from fifth grade down to first (*see page 10*). This will introduce you to some of the differences between these grade levels that we think are important. Especially pay attention to the classroom example we offered about handfuls of cubes. You can probably imagine the lesson we described with younger children, or you may have taught a similar lesson yourself. Following is how the same lesson was used to meet the needs of fifth graders. The contrast can help illustrate more of the differences.

As the first-grade teacher had done with her class, the fifth-grade teacher modeled for the students how to take a handful of cubes—some organizational tips work in all grades! The students recorded their totals on Post-it Notes that they then organized into a graph. When the teacher asked how many cubes the students thought were in their handfuls altogether, the fifth graders didn't make wild guesses. They reasoned numerically and were able to support their estimates, explaining how they thought about the total in relation to the number of cubes individual students had.

The teacher also asked the students to figure out how many cubes were in their group of four students, but asked them to figure in their heads and leave their individual trains intact. This not only gave the students practice with calculating mentally but also left the trains available for the investigation to come. The teacher recorded the groups' totals on the board and had the class add the numbers, again giving them practice with calculating.

Finally the teacher began a discussion of averages. The students had been introduced to the three kinds of average—*mean*, *median*, and *mode*—and this experience presented another opportunity for them to think about these ideas. It was easy for them to identify the mode by seeing which column on the graph had the most Post-its. Then they talked about lining up all of their trains from smallest to largest to see which train was in the middle of the line and, therefore, was the median. They made predictions first from looking at the graph and then they actually lined up their trains in size order on the floor in front of the chalkboard, placing them on their sides to avoid the distraction of toppling trains. They then talked about figuring the mean by dividing the total number of cubes by the number of students—another chance for calculating mentally. Finally, to make the idea of mean concrete, they "evened out" the trains on the floor, taking cubes from the longer trains and adding them to shorter ones until most of the trains were the same length and a few were just one cube shorter. They compared this to the mean they had calculated.

Fifth graders are more capable than first graders in many ways. Ideas about smaller numbers that are new concepts for first graders will be obvious to fifth graders. Fifth graders, for example, know that if twenty-five children line up in pairs, one child won't have a partner. They most likely will explain that 25 is an odd number, or that there will be twelve pairs and one extra. First graders, however, would need to figure this out in some way. They don't know about odd and even numbers, or if they do, they probably wouldn't apply what they know to this context. If they thought about the problem, they'd benefit from actually lining up to verify their thinking in a real way; fifth graders wouldn't need verification for a problem like this.

There are several different challenges in the upper grades. The mathematics in the fifth-grade curriculum is more extensive and demanding. If, for instance, you're not confident about the ideas of mean, median, and mode, you may have some studying to do. While this can be daunting, take it as an opportunity to expand your own mathematical understanding. Seek help from colleagues if you need to, learn from the instructional materials, and keep an inquiring attitude toward all that you have to teach. And, as we advised for the opposite switch, pay close attention to the children themselves at work and at play. They'll be your best guides for making the change.

10 Some of my students say they hate math. What should I do?

First of all, let's look at why students say they hate math. As a rule, we're uncomfortable in situations in which we lack understanding and feel somehow deficient. It's the same with children. They "hate" math when they haven't been successful learning it, don't think they can learn it, and feel powerless. While math won't be the favorite subject of all students, most probably wouldn't say they *hated* it if they experienced success.

There are other possible reasons that students may say they hate math. Some children have been influenced by their peers or family members and feel that hating math is a cool thing to express. We've heard children say, "My dad hates math, too," or, "All the kids hate math," or, "My brother isn't any good in math either."

We recently spotted an ad in a major popular magazine that showed a full-page photo of a boy with a look of despair holding his face in his hands. The headline read: *Wipe that "I hate fractions" look off his face in less than 15 minutes.* The solution? A recipe for S'mores, a gooey treat made with marshmallows and chocolate. Ah, if it were only that easy to address math aversion!

Whatever the source of the problem, what can you do? First, it's important to acknowledge these feelings and not dismiss them, no matter their origin. We're all different and, therefore, we like different things. While some students really do enjoy the challenge of math, others get excited by learning topics in science or social studies, and others are voracious readers who feel that learning math is an annoying interruption. But although students have favorites, they still need to do their best to learn all of what they're presented with in school. It's not productive for them to carry a negative attitude toward something that is and will continue to be such a big part of their lives.

While this sort of acknowledgment is helpful, it probably won't do much by itself to change attitudes. But it's an important start. At least students will know that you're aware of the situation, respect it, and will do your best to help them. Let them know that you'll do your best to help them see how mathematics can be accessible, interesting, and even enjoyable. For that to happen, children need math experiences that capture their imaginations and get them actively involved. The coin riddles we suggest in Chapter 9 are an example of such an activity (*see page 84*) and we've sprinkled lots of others throughout the book. It's not possible to make every lesson a "wow" experience for every student, of course, but as much as possible, students' math experiences should be engaging. We hope that many of the suggestions we've given in this book will help with this challenge.

When students are having trouble, the best approach is to work from their strengths and interests. Let them know that it's your job as their teacher to help them

learn. They need to participate, of course, but they won't have to do it alone and you won't abandon them. The key to changing students' attitudes is success. Students who are competent in and confident with mathematics still may not choose it as their favorite subject in school, but success goes a long way in diminishing dislike.

11 What field trips can I plan to help my students see math in action?

Many teachers think of field trips as valuable experiences for students in a variety of ways but not often for enhancing their mathematics learning. However, getting out of the classroom for a mathematical purpose can give a boost to learning.

Math field trips don't have to be elaborate or costly. A hike around the school can be a problem-solving field trip. Tell your students to imagine that they have been asked to build a fence around the outside of the entire school and playground area and need to estimate the cost. Beforehand, clip a newspaper ad or make a telephone call to get the cost of fencing. Or have them estimate how far they walk going to and from the lunchroom, library, or gym each day, each month, and in the entire school year.

How about a field trip to a nearby supermarket for an investigation? For example, have your students research the validity of statements such as: "It's always more economical to buy the largest size of an item," "It's less expensive to buy frozen orange juice and add water than to simply buy the bottle of ready-made juice," and "The store brand always costs less than the name brand." Present these statements as examples and add students' ideas to compile a list. Then have students work in groups and choose one statement to investigate. After the trip to the store, students can analyze the results and report their findings to the class. Also, they could write a shopping guide for their families based on what they learned.

Not all field trips have to be centered around a mathematical investigation in order to involve students with mathematics. The organization of any field trip involves using mathematics, and you should invite students to help you with making plans. How soon after the beginning of school will you depart? What time will you return? How long will the field trip last? What costs are involved? Are they per-person expenses, such as admissions, or is there one large cost to be divided among all the participants, such as a bus? These and other questions will help your students figure the total cost per person.