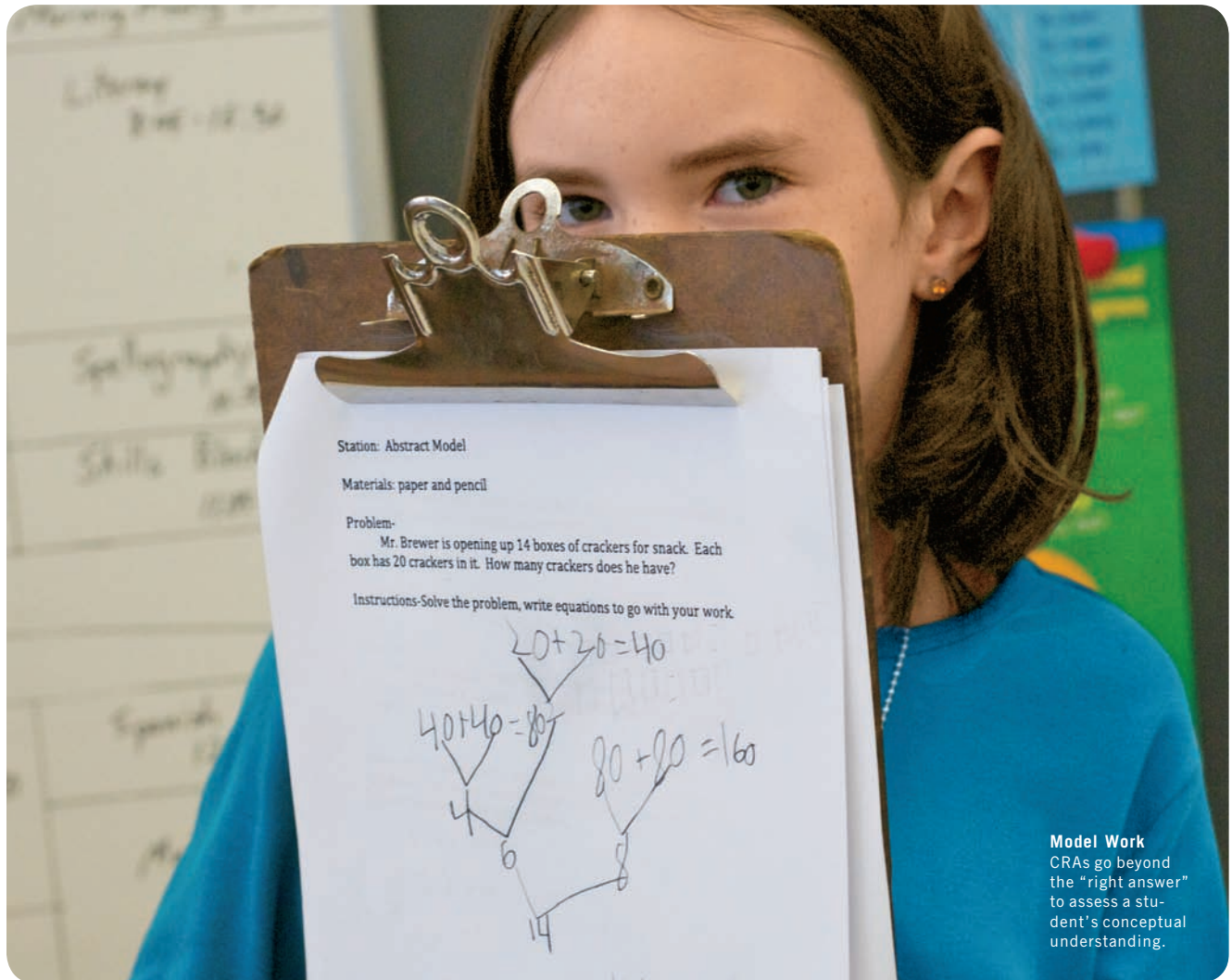




Your Classroom



Model Work
CRAs go beyond the “right answer” to assess a student’s conceptual understanding.

COMMON CORE: Solve Math Problems

Help your students figure out why they aren’t getting math concepts. BY ERICH STROM

THE NEW COMMON CORE STANDARDS for mathematics demand that students (and teachers!) exhibit deeper conceptual understanding. That’s music to the ears of education professor John Tapper, who says we’ve overemphasized teaching procedures—and getting right answers. In his new book, *Solving for Why*, he makes a powerful case for moving beyond right and wrong and exploring what students understand, where they are

struggling, and most important, why they are struggling.

We talked with Tapper about concrete-representational-abstract assessments, or CRA, a tool that does just that. It’s easy to do, and it provides a sophisticated portrait of kids’ models for mathematical concepts. That ties in with the Core, and with Tapper’s call for teachers to focus on the learner. As he puts it: “Before I do anything, I need to know what’s going on in this student’s head.”

PHOTOS: GALE ZUCKER



COMMON CORE: MATH

What is a CRA assessment and what does it do?

CRA is a way for teachers to look at the models students use to solve problems. The students work on similar problems at three different stations in three different ways—concretely, representationally, and abstractly. It's primarily a screening activity, so you're looking for patterns in the class.

At the first station, students use physical materials—place-value blocks, Unifix cubes—to solve a problem. At the representational level, you're talking about drawings at the lower end to sophisticated models like charts, organized lists, diagrams, and graphs. Finally, at the abstract level, you're asking kids to work with equations to solve problems.

In America, particularly, we have an overemphasis on procedural understanding. Most teachers see the end goal as knowing the procedure instead of understanding the mathematical idea. So I like to tell teachers, "No model, no understanding."

Isn't deeper conceptual understanding exactly what the Common Core calls for?

Absolutely: "Deeper, not wider." If you look at the practice standards, you realize that just the way CRA is set up is going to support most of them. There's a whole standard about modeling. You want students to be able to think of multiple ways to solve problems. But the real connection is the depth. CRA helps teachers look deeply into students' conceptualization, so they understand how students understand a mathematical concept.

Getting a right answer on a test represents the potential for understanding, but it could be at the level of "I did the right steps—I followed the procedure." In fractions, for example, where there's heavy emphasis on procedure, it's not uncommon for a student to be able to write an equation to solve a problem but not be able to create any model at all. This is where instruction falls down. When

you learn procedures, it's a trick you do for your math teacher.

What do CRAs look like in action?

They are usually given at the beginning of a large unit, as a needs assessment. Teachers also use them at the end of units and sometimes with individual students. Generally, teachers go to the end-of-unit assessment and pick one problem that is rich and representative of the bulk of the work. In third grade, for instance, you're focused on multiplicative reasoning. It's this idea of counting with groups. You'll want a problem that says something like, "There are 12 children in a Girl Scout troop. The troop leader wants to give each of them 7 Hershey's Kisses. She has a bag with 80 Kisses. Will she have enough? And if not, how many can everyone get?" Then you alter that slightly for each of the three stations, by changing the numbers or context in some way.

At the concrete station, there will be lots of materials available—tiles or Unifix cubes. At the representational station, you need different kinds of paper, pencils, and drawing materials, and the abstract station has pencils and paper as well.

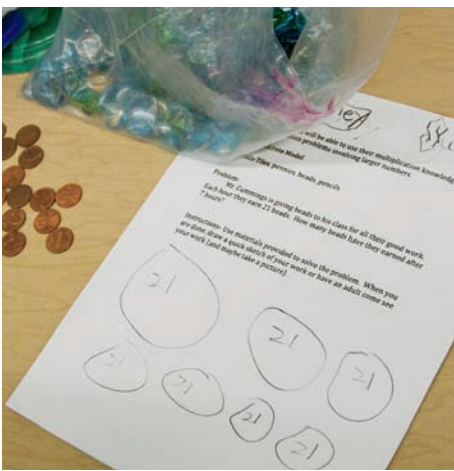
Teachers recommend letting the kids move from station to station on their own. Make the stations large, so they can accommodate a number of kids at once. The CRA itself takes an hour. Assessing the results, once teachers get used to it, is a 15- to 20-minute deal.

What happens at each of the stations?

At the concrete station, to go back to our example problem, you're hoping students make groups of seven with the objects and do some counting. The best way to record the concrete work is with a camera. Many teachers use their phones. At the representational station, students will make circles on the page; they'll make slash marks or dots or something inside the circles and they'll start to count. They'll do any of a number of things.



The Concrete Station

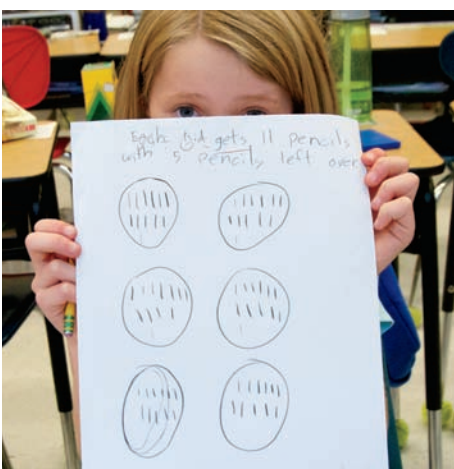


Group Work Fourth graders at the Academy School in Brattleboro, Vermont, use manipulatives at the concrete station to solve a multiplication word problem (essentially, 7×21).

The station draws out whether students are able to think in terms of grouping, a key concept at the heart of multiplication.

When they're done with their work, they draw a picture of it, or the teacher comes around and takes a photo.

The Representational Station

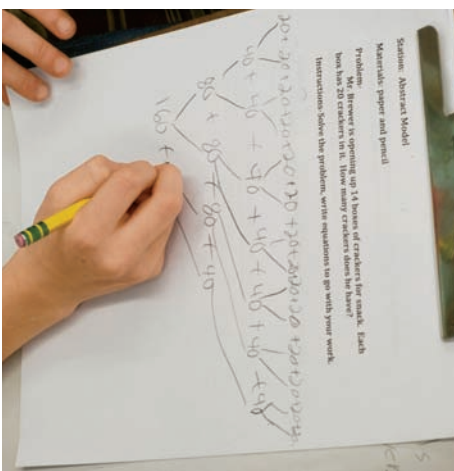


Drawing Connections Here, the students are equipped with various writing and drawing tools, graph paper, and unlined paper. They are instructed to use words and pictures to show their thinking. The word problem has been modified a bit (this time, $71 \div 6$).

Responses often use marks and circles to represent any number of methods for counting and grouping.

This station is "the really rich part," where kids make connections and develop a range of strategies for solving problems.

The Abstract Station



Numbers Game Finally, students are asked to solve a similar problem (here, 14×20) using equations and with just paper and pencil.

Typically, students learning multiplication will represent the problem as an equation using repeated addition.

The work at this station also sheds light on the variety of strategies students use to solve equations.

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Representational work seems to range from concrete-style markers to nascent formulas.

Absolutely. The middle is the really rich part. It's where kids are developing strategies and making the large connections. The most frequent response at the abstract station for this sort of problem has to do with repeated addition. They'll write "7, 7, 7," twelve times and then add them all together.

How do you assess the CRAs?

The best process I've seen is for two teachers to do it together. They go through the pile and make comments on what they see: "Oh, a lot of kids are doing repeated addition in the abstract pile," or "A lot of kids use circles and slashes to show groupings," or "Kids at the concrete station are making long stacks of Unifix cubes—they're not grouping." That takes about five minutes. Then you go through the work a second time and sort by those features. Usually, you end up with four or five piles and have a good sense of what's going on with the class as a whole.

There are always pieces of work where you say, "I have no idea what this kid was thinking." It's a drawing you can't make sense of, or there are numbers on the page without any context. These go into the questions pile, also known as the "What the heck?" pile.

What do you do with those?

That's where the flexible interview comes in. You sit down, present the same problem, and ask the student to think aloud.

How do you use what you've learned to inform instruction?

Let's suppose I have five kids who made those ultralong stacks of Unifix cubes. And the other parts of their CRAs also indicate the notion of grouping is lacking. During the individualized, differentiated part of the lesson—"the menu," as I call it—I'll pull that group together, and I might play the game Circles and Stars with them. They roll the dice and make a certain number of circles. They roll the

ADDITIONAL RESOURCES

- **Curriculum Associates.** The Ready Common Core package provides materials built to the new math standards from the ground up, along with a teacher resource book and an online tool kit. curriculumassociates.com
- **Peoples Education.** You'll find free online videos that give an overview of the Common Core and dive deeper into the shifts at each grade level, as well as a set of CCSS workbooks with lessons for each standard, project-based activities, and more. peopleseducation.com
- **Math Solutions.** With its rich lineup of webinars, school-based coaching, and PD books (Tapper's *Solving for Why* among them), Math Solutions can ease the transition to the new standards. mathsolutions.com
- **Math Common Core Coalition.** The NCTM and its partners have assembled a trove of Core-related curriculum, PD, and assessment resources. mathccc.org

dice again and make that number of stars in each circle. And then they find the total. After playing the game for a couple of days, we begin to talk about, "Could you do this without actually drawing the stars?" and "How would you go about doing that?"

And CRA challenges teachers to think conceptually, too.

It's used for professional development for just that reason. I tell my students, I know very few of them are becoming elementary school teachers because they want to teach math. They want to teach reading. But all of them are going to be math teachers, so they need to develop a deep knowledge of the math itself. One really common thing I hear is, "The second and third time I used CRA, I knew so much more." □



Sample CRAs

Download examples of first- and fifth-grade CRAs at scholastic.com/instructor.