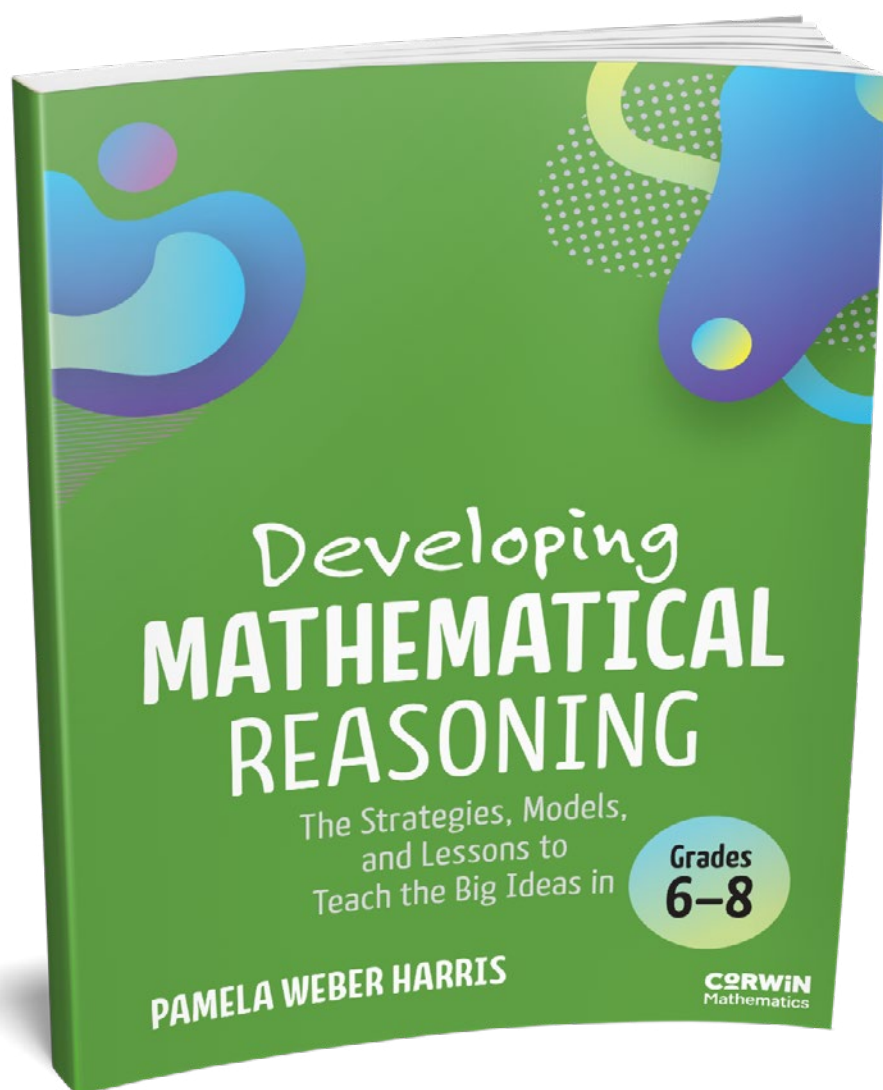


**Complimentary
excerpt**



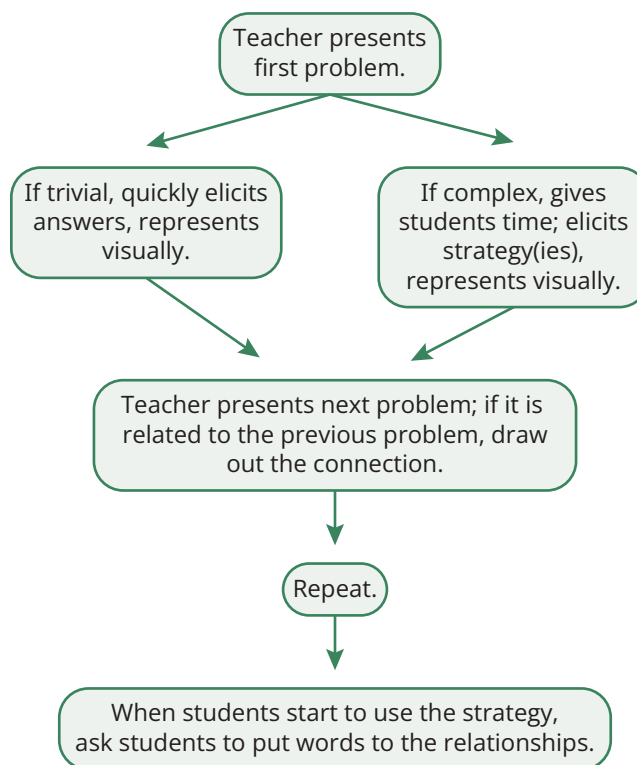
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ANATOMY OF A PROBLEM STRING

The following is a general flow of facilitating a Problem String:

- Teacher asks an accessible first question of the class; students respond; teacher represents the relationships on the board.
- Teacher asks the second question; teacher circulates to find certain reasoning they want shared; teacher elicits one or a few strategies and models the thinking on the board.
- The string continues, repeating the process of posing the problem, giving think time, choosing who will share, with the teacher modeling thinking on the board.

When enough students are using the target strategy, the teacher elicits student noticings about patterns. The conversation hangs here for a beat to support students in making connections about structures and relationships. Students who have not yet begun being metacognitive about the target strategy are looped into the conversation and given new ideas to consider. Then the problems resume with the intent that students can try using the new ideas that just came out in the discussion.



The teacher looks for misinterpretations and misapplications and brings them before the community so that everyone can become clearer.

Wait to anchor a strategy until the pattern (strategy) is occurring to them more frequently and they can make sense of how to use the strategy when it comes to mind because of the numbers involved.

Students should contribute to creating the anchor chart, but have the plan for the anchor chart in mind and encourage dialogue around the patterns students are noticing and using. Peer students toward mathematical description. With guidance, let students choose a representative problem.

cups of pasta	cups of sauce
8	5
16	10
1.6	1
14.4	9
4	2.5
40 + 1.6	25 + 1
41.6	26
40	25

Problem Strings are not intended to be a “one and done” routine. Students need multiple experiences with new ideas to solidify them. To give them more experience, you can use “echo” strings, strings that use similar numbers and work on the same big ideas. You can follow those with a string that ups the ante by using bigger or more complicated numbers. When most students are using the target strategy, invite students to start to put words to what they are doing. In the pasta : sauce ratio table building string, students might respond, “It’s helpful to scale to friendly amounts, like 10 to get to 1 or 40 to get to 41.6 and then adjust from there.”

Once you get some language around the idea, have students solve more problems. Continue to notice the relationships. When enough students are getting consistent, co-create an anchor chart like the one in Figure 6.1 with the class to describe the learning and show an example. You can hang the anchor chart in the room and have students put it in their notebooks to refer to when needed.

FIGURE 6.1 ● A Sample Anchor Chart

Scale to find helpful entries

cups of pasta		cups of sauce	
	8	5	
$\times 2$	16	10	$\times 2$
$\div 10$	1.6	1	$\div 10$
$\times 5$	40	25	$\times 5$

*from 10 to 1 to get unit rate

FREQUENTLY ASKED QUESTIONS

Q: When you say that a teacher chooses who shares, how do I know who to choose?

A: Always choose with equity in mind. Be cognizant of positioning all students over time as helpful contributors. Look for students who are just starting to notice and use a pattern—often they will grapple aloud as they try to explain their reasoning. This is helpful because it gives the class something to discuss and clarify. It's rarely helpful to have the clearest explanation given; otherwise, you could just tell students everything. In a Problem String where you are developing a particular strategy, ask for a couple of different strategies at first. As the string progresses and as you do more strings for the same strategy, focus on representing the target strategy. Allow students to solve the problems however they want, but help them develop the target strategy by representing, discussing, and asking about that target strategy.

Q: Are Problem Strings the same as Problem (Number) Talks?

A: No. Problem Talks are a single problem that students solve, and the resulting conversation is about the many ways to solve it. There are a few reasons to use Problem Talks: to convince students that there are multiple ways to solve a given problem (you don't need this if you are doing Problem Strings), to assess which strategies students are using, and most importantly, to compare strategies for efficiency for a given problem. Students need many more Problem String experiences for every Problem Talk experience.

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Q: Are Problem Strings the same as thin slicing (Liljedahl, 2021)?

A: No. Thin slicing is when students solve a group of problems with no teacher-facilitated class discussion between the problems. Problem Strings require teacher modeling of student thinking and discussion that highlights important relationships. Throughout a string, students can try ideas that are new to them because they have seen and heard the ideas from their community.