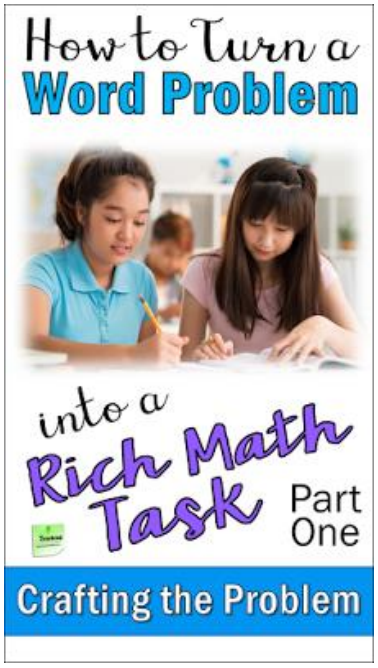
How to Turn a Word Problem into a Rich Math Task
Part One - Crafting the Problem

By Laura Candler



Growth mindset is much more than a buzzword, and nowhere is this more apparent than in mathematics. Research findings in this field are transforming our perceptions about best practices in math instruction. As it turns out, developing a mathematical mindset is more highly correlated with future success in math than scores on standardized tests!

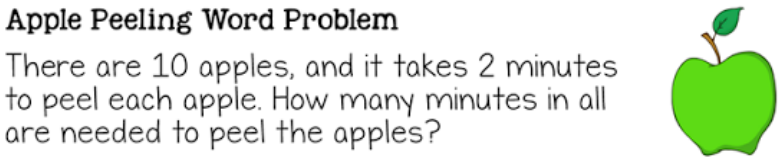
One way to begin fostering a math mindset in your students is to turn word problems into "rich math tasks." I tackled this topic in my webinar, Math Problem Solving: Mindsets Matter, but I want to dig into rich math tasks a bit more in this article.

Rich math tasks have two critical components, the WHAT (the problem) and the HOW (the process). In this article, we'll look at how to transform a boring word problem into a rich math task. In Part Two, I'll share active engagement strategies you can use to help your kids rock the problem-solving process!

How a Word Problem Differs from a Rich Math Task

Basic Word Problems

Word problems at the elementary level tend to be simple problems with a single correct answer. Children are often taught to solve them by learning to identify key words and numbers in the problem and then applying the necessary mathematical operation. For example, a basic word problem might read like this: "There are 10 apples, and it takes 2 minutes to peel each apple. How many minutes in all are needed to peel the apples?"



A typical method of solving this problem would be to underline the key words "each" and "in all" and circle the numbers 10 and 2. The key words tell students to multiply the numbers to find the answer, so they multiply 10 and 2 and record the number 20 as the answer. If you ask these students to draw or model the solutions visually, they are at a loss. If you ask them to label the answer with the unit, they are as likely to write "20 apples" as they are to write "20 minutes."

Word problems don't inspire deep thinking, analysis, or discussion because the solutions are usually straight forward. Sure, you can encourage your students to talk with a partner about how they solved the problem, but their explanations will sound like this: "First I underlined the key words, and then I circled all the numbers. Next, I multiplied the numbers to get my answer." An explanation like that hardly qualifies as "math talk"!

Rich Math Tasks

Rich math tasks, on the other hand, are usually more open-ended and can be solved in many ways. Some math tasks are inquiry-based questions that have more than one correct answer or problems that require students to use hands-on materials to discover the solutions. Other math tasks look like regular word problems at first glance, but when you attempt to solve them, you realize there are many ways to arrive at the answer. Rich math tasks don't have key words that you can underline, and circling the numbers won't help because you might not even need all the numbers to solve the problem! These types of math tasks stimulate discussion, questioning, and critical thinking as students struggle to choose the best strategy to solve the problem.

6 Tips for Crafting an Awesome Math Task

Finding or creating the right math problem is the first step in developing a rich math task. Here are some tips that will make the process of crafting your problem much easier.

1. Start with a Visual Problem

Select a word problem that's easy to visualize, and try to solve it several ways. Make sure the answer can be represented visually by drawing it or with physical objects. If there's only one way to solve it or it would be difficult to represent the solutions visually, rewrite the problem or find a new one. I'll use the Apple Peeling Word Problem to demonstrate how to turn a simple word problem into something much more challenging and interesting.

2. Remove Key Words

After you've selected a problem, look for key words such as, "in all," "each," "per," and "total." If possible, rewrite the problem without using the key words, making sure that the meaning doesn't change. Removing key words forces students to THINK about which operation is needed instead of just underlining words and mindlessly choosing an operation based on those words.

3. Add Extra Details and Information

Next, add details that aren't really needed to find the solution. If students have been trained to underline key words and circle numbers, these extra details will confuse them. They will have to think about the task and decide which words and numbers are actually important.

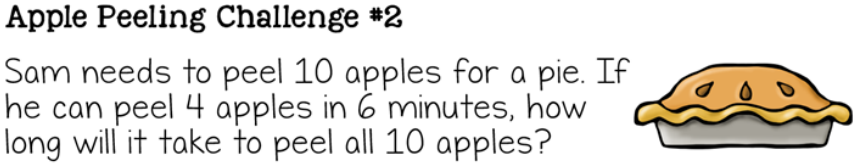
If we apply the first 3 tips to the Apple Peeling Word Problem, we end up Apple Peeling Challenge #1. It's still quite easy, but the lack of key words and the extra numbers make it a bit more challenging. Students must think about what is being asked and decide the best way to solve it. This is a good starter problem for introducing students to rich math tasks because it can be solved in more than one way using visual models. Students could draw circles for the apples, use round objects like pennies or bingo chips, or they could even use real apples!

Apple Peeling Challenge #1

If it takes 2 minutes to peel 1 apple and 4 minutes to peel 2 apples, how long will it take to peel 10 apples?

Ready to take Apple Peeling Challenge #1 to another level? Applying the next 3 tips to that problem will make it even more challenging and interesting!

4. Personalize It and Make It Real
To make the problem more interesting, personalize it by adding a real person's name, maybe even the name of one of your students! Add enough details to make it come to life or turn it into a story. In ***Apple Peeling Challenge #2***, the detail that Sam is peeling the apples for a pie makes the problem more meaningful. A teacher in the Math Mindset Connections Facebook group took this problem and turned it into a story about making a pie for Thanksgiving dinner!

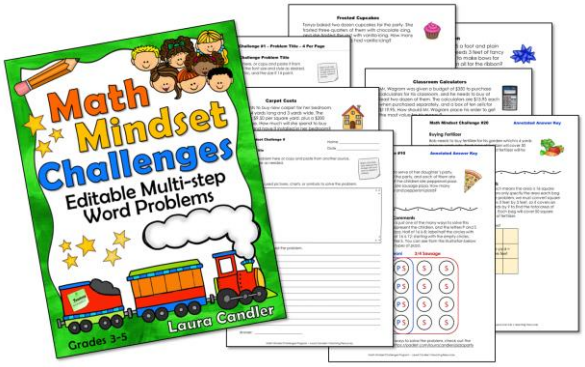


5. Turn It into a Multi-step Problem
Rewrite single-step word problems to ensure that multiple steps are needed to solve it. The information in the basic word problem stated that it takes 2 minutes to peel each apple. The easiest way to add another step is to replace that detail with enough information for students to calculate how long it takes to peel each apple. Each problem will be a bit different, but there's always a way to modify the problem and turn it into a multi-step math task.

6. Change the Numbers
You can often make a word problem more challenging by changing the number. For example, instead of Sam peeling 10 apples, he could peel 100 apples because he's baking 10 pies for a banquet. You can also use numbers that result in fractional answers. For example, in ***Apple Peeling Challenge #2*** above, Sam can peel 4 apples in 6 minutes, but 6 is not divisible by 4, so the number of minutes to peel one apple is not a whole number. Do you see how tweaking the numbers a little can instantly make the problem much more challenging? Now you have a problem that's perfect for a math task!

Where to Find Editable Word Problems

If you don't want to craft your own multi-step word problems, or you don't have time to hunt for them, check out Math Mindset Challenges. It's a growing collection of editable word problems and templates in several different formats. The word problems are in an editable PowerPoint document so you can change the wording and customize them if needed. If you'd like to take a closer look, head over to my TpT store and check it out!

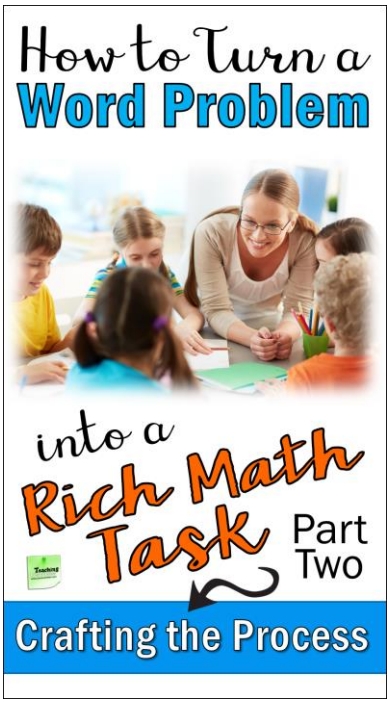


Next Up - Part Two: Crafting the Process

Remember that rich math tasks have two essential components, the WHAT and the HOW. In this article, I've tackled the WHAT, the math problem itself. However, it's not enough to create a great word problem; it's what you do with that problem that counts! In Part Two, I dive into HOW to facilitate the problem-solving experience. I share loads of active engagement strategies that will take problem solving to a whole new level in your math classroom!

How to Turn a Word Problem into a Rich Math Task
Part Two: Crafting the Process

By Laura Candler



When students struggle in math, it's often due to their beliefs about what it takes to be successful in mathematics. They believe that some people were born with a gift for math, and anyone who wasn't born with that gift will never excel in math.

Fortunately, brain research tells us that this belief is nothing more than a myth, and it's not supported by fact. All students can experience success in math if they are taught in ways that foster the development of a mathematical mindset. This means setting high expectations for all students, engaging them in challenging and interesting math tasks, and providing the right kind of support and encouragement.

One way to foster mathematical mindsets is to replace simple word problems with "rich math tasks." Rich math tasks provide opportunities for students to work together as they explore a concept or solve a problem. In my webinar, Math Problem Solving: Mindsets Matter, I give examples of rich math tasks and share several strategies for using them with students. But there's so much to share on this topic that I wanted to provide even more detail about how to implement rich math tasks.

If you're wondering how to get started with rich math tasks, it's easier than you might think. The first step is choosing a suitable math problem, and the second step is guiding your students through the problem-solving process. Both steps are equally important, so I've decided to tackle them in two separate blog posts.

In my first article, ***Part One: Crafting the Problem***, I explained the difference between word problems and rich math tasks, and I shared 6 tips for creating a rich math task from a simple word problem. In this article, ***Part Two: Crafting the Process***, I'll share strategies you can use to actively engage ALL of your students in the problem-solving experience.

7 Tips for Crafting an Awesome Problem-Solving Experience

The problem-solving process is just as important as the problem itself, and that process is greatly enhanced with strategies to facilitate active engagement and critical thinking. Here are 7 tips to help you craft the perfect problem-solving experience for your students.

1. Make Time to Go Deep with Rich Math Tasks

Rich math tasks take time, but there's no doubt that engaging your students in these activities will pay off in the long run. Research shows that a deep discussion about one math problem is far more effective than several shallow discussions about many problems. Fortunately, rich math tasks don't have to be completed in one session. Instead of devoting an entire math period to one task, you could

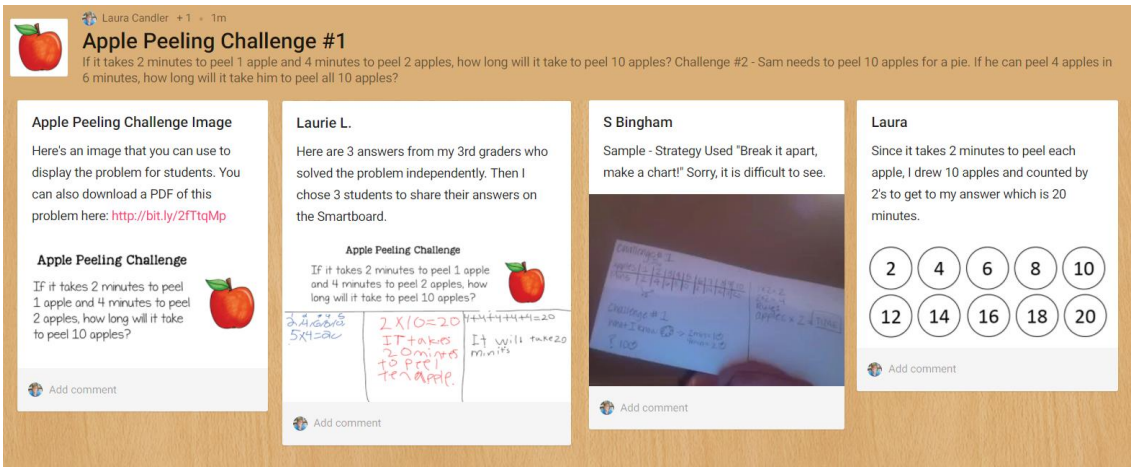
set aside 10 minutes each day for problem solving. You might assign the math task on Monday and give everyone time to solve the problem on their own. On Tuesday, your students could share and discuss solutions with a partner. Wednesday and Thursday could be devoted to a class discussion about strategies for solving the problem, and Friday could be spent on extension activities.

2. Choose a Method for Showing and Sharing Work
Before you present the first math task to your class, you need to choose a method your students can use to show their work and explain their thinking. Math strategy discussions are an essential part of the task, and everyone needs to be able to SEE and HEAR the solutions being shared.

Individual dry erase boards offer one of the easiest ways for students to participate in the lesson fully. Students are actively engaged as they solve the problem on their own boards, and when it's time to share, they can hold up their boards to show their work. If you have a document camera, students can place their dry erase boards under the camera to display their work while explaining the solution.

However, dry erase boards can be limiting if the rich math task continues for several days because students won't be able to save their work for future sessions. If your students have access to digital devices with cameras, they can take a picture of their dry erase boards before erasing them. Another solution is to have students solve the problem on paper on in a math journal.

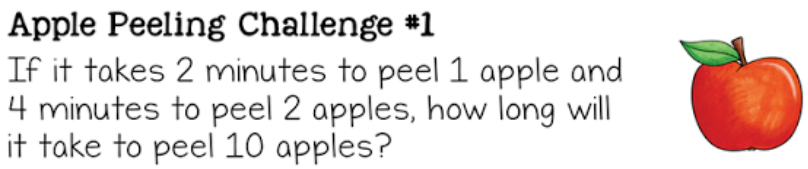
Padlet, a free online tool, offers another way to share solutions and strategies. It's easy to set up a free Padlet account and create a math problem solving "wall" for each rich math task. During the class discussion phase of the math task, students can post their solutions on the wall using text and images. The Padlet wall below was created for sharing solutions to the Apple Peeling Challenge #1 problem. For more information about how to use Padlet in math, watch my Math Problem Solving: Mindsets Matter professional development webinar.



3. Defer math strategy discussions until AFTER students work on the task.
I used to teach problem-solving strategies before giving my students problems to solve, thinking it would be helpful for them to be able to choose from a list of strategies. Typical strategies included "Make a Chart," "Act It Out," and "Draw a Picture." Unfortunately, this approach is not supported by the most recent research on mathematical problem solving. As it turns out, it's actually more effective to save the strategy discussions until AFTER students have tried to solve problems on their own. Kids are far more creative problem-solvers when they aren't prompted to choose from a list of strategies. They often create highly-unusual but very effective methods of solving problems, and they love sharing their own unique methods with the class.

4. Teach your students how to represent solutions visually.
One strategy that's important to discuss early in the year is how to represent math problems and their solutions visually. Visual representations can involve pictures, illustrations, objects, charts, or diagrams. I'll use the two Apple Peeling Challenge problems we created in Part One illustrate my points. Normally, it's best to focus on a single math problem, but these two problems are related and they work well together to teach an important lesson.

Start the mini-lesson by displaying ***Apple Peeling Challenge #1:*** *"If it takes 2 minutes to peel 1 apple and 4 minutes to peel 2 apples, how long will it take to peel 10 apples?"*



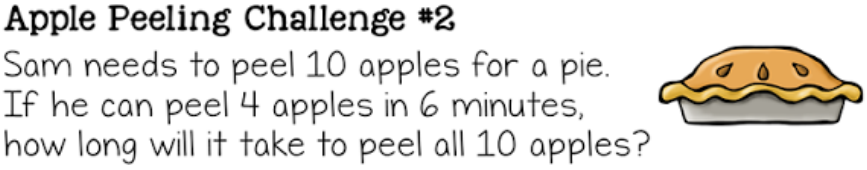
Read the problem aloud and ask your students to solve it. Don't prompt them to draw the solution or give them any hints. Just walk around and observe them as they work. Some will try to draw the solution, some may write a number sentence, and others will simply write a number for the answer.

Next, choose several students who have solved the problem visually to come to the front of the class, show their work, and explain their thinking. One student might represent the answer visually by drawing 10 circles to represent the apples and count by 2's (it takes 2 minutes to peel one apple) until they get the answer which is 20 minutes. Another student might create a simple chart like the one below, where the number of apples is listed across the top and the total minutes is shown in the bottom row. A third student might have used 10 plastic bingo chips to represent the apples, perhaps using a dry erase marker to label them with the total minutes.

Apples	1	2	3	4	5	6	7	8	9	10
Minutes	2	4	6	8	10	12	14	16	18	20

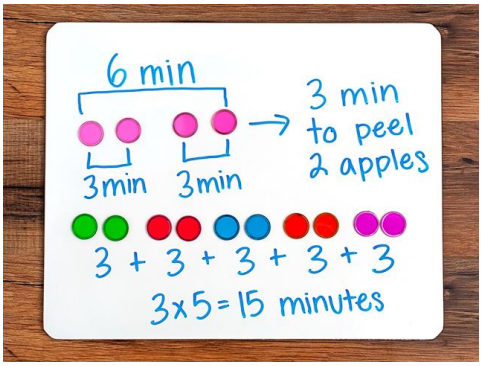
If most students simply wrote the answer or 2 x 10 = 20, ask your class why it might be important to show how you solved the problem, either with simple drawings or with objects. If they don't know, explain that if you can show the solution to an easy problem using pictures or objects, you're more likely to be able to solve more difficult problems using similar methods.

To illustrate this point, ask your students to solve **Apple Peeling Challenge #2:** "Sam needs to peel 10 apples for a pie. If he can peel 4 apples in 6 minutes, how long will it take to peel all 10 apples?"



Because the problem doesn't state how long it takes to peel ONE apple, this problem is quite a bit more challenging that the first one. Students who solved the first problem using mental math or with a simple number sentence will have difficulty solving this one using the same method. However, if you encourage your students to draw the solution or use objects to represent their thinking, you'll be blown away with the creative methods they use to solve a problem like this!

For example, examine this visual solution which is modeled with bingo chips. The top row of bingo chips demonstrates that if it takes Sam 6 minutes to peel 4 apples, then it will take him half the time (3 minutes) to peel half the apples (2 apples.) The row of 10 bingo chips represents the 10 apples he needs to peel, and they're grouped into 5 sets of 2 with the number 3 (minutes) written under each group. The solution is shown by the number sentence 3 x 5 = 15 minutes.



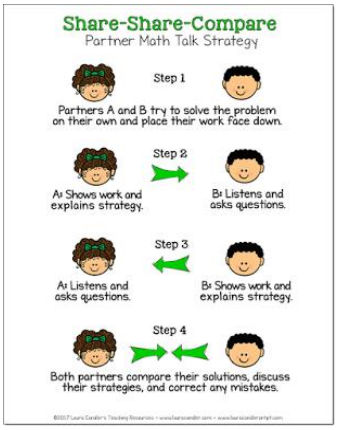
5. Provide time for students to solve problems on their own before working with others.
Cooperative learning can be a powerful tool for boosting student engagement, but students need opportunities to work independently as well. If students never have time to work alone, they may become dependent on others to do their thinking for them.

Fortunately, there's an easy fix. Simply provide a few minutes of quiet, independent work time after you introduce the math task, and ask your students to try to solve the problem on their own. Remind them to show how they solved the problem so they can discuss it with a partner or team later.

Some students will probably raise their hands almost immediately to ask for help, but stay strong and resist the urge to provide assistance. Jumping in to rescue them before they've even tried to solve the problem simply reinforces their belief that they aren't capable of solving it on their own. The truth of the matter is that if they started to draw the solution instead of waiting for someone else to tell them what to do, they might find that they ARE able to solve it on their own. If some students insist that they have no idea what to do, ask them to reread the problem several times and if they still don't know what to do, tell them to write a question mark instead of the solution. I can assure you that within a few days of implementing this practice, almost all of your students will attempt to solve the problem on their own, even if they are not confident about their solutions.

6. Use the Share-Share-Compare strategy to facilitate productive math partner talk.
After everyone has tried to solve the problem independently, the next step is for them to discuss their solutions with a partner. This will prepare them for the upcoming class discussion. I suggest that you assign partners yourself rather than letting your students choose partners. After you pair up your students, ask them to show their work to their partner and explain their solutions.

If your students aren't experienced with math talk, you'll need to guide them through the process the first few times. If you don't, your students are likely to just compare their answers without discussing strategies. If they have the same answer, they won't bother to discuss HOW they solved the problem. If their answers are different, the stronger student will point out the other student's error, and his or her partner will correct it without understanding why it was wrong.



You can avoid these problems by implementing ***Share-Share-Compare***, a cooperative learning strategy to facilitate math partner talk. I described this strategy in detail during the Math Problem Solving: Mindsets Matter webinar, and you can see the steps illustrated on the right.

Before you begin **Share-Share-Compare**, assign A/B Partners, and ask them to sit side by side. Have them place their math papers or dry erase boards face down in front of them.

To begin the activity, ***Partner A shares*** by showing and explaining his or her work to Partner B. Partner B listens and asks questions. Next, ***Partner B shares*** by explaining how he or she solved the problem, and Partner A listens. Finally, ***both partners compare*** their work and discuss any differences in their methods. If they solved the problem using the same strategy, challenge them to try to find another way to solve it.

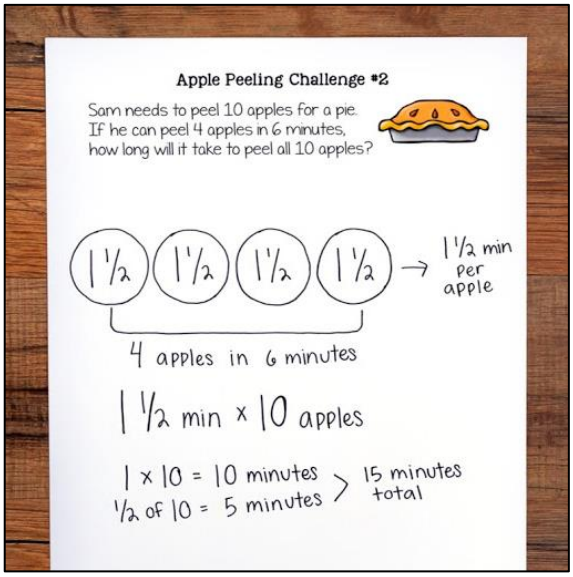
As your students are working, walk around and observe the different methods that are being used to solve the problem. Make a note of the different strategies your students used because this information will be helpful during the class discussion.

6. Wrap up with a strategy-focused, high-energy class discussion.
The final step is a class discussion to share and discuss various problem-solving strategies. The best discussions are high-energy, fun experiences during which students are eager to share their strategies, analyze other methods, and express appreciation for each other's creative solutions.

To begin the class discussion, display the problem and read it aloud. Ask for student volunteers who would be willing to show their work and explain their solutions to the class. When you choose the first volunteer, select someone who has drawn the solution or modeled it with objects because it will be easier for the other students to understand the solution. Invite the student to come forward to show and describe how the problem was solved.

If you have a document camera, the student can place his or her dry erase board, math journal, or paper under the camera so that everyone can see how the problem was solved. If you don't have a document camera, you could take a picture of the student's work and upload the image to a Padlet wall. Project the problem onto a screen for the whole class to see, or have students access Padlet from a digital device. If you use Padlet this way, I suggest that you upload one solution at a time to keep your students focused on the strategy that's being shared.

If the student shows his or her solution, but doesn't explain HOW the problem was solved, you may need to prompt the student to elaborate. For example, if the solution displayed on the right was shared, you might ask how the student discovered that it took Sam 1 1/2 minutes to peel each apple.



After the first volunteer finishes speaking, don't confirm the answer as either correct or incorrect. If it's not correct, the correct answer will be found by the end of the discussion. Simply thank the student and ask if your class has a question about how the problem was solved. On the other hand, if another student discovers an error and questions the solution, you should facilitate a discussion about the perceived error without confirming the answer.

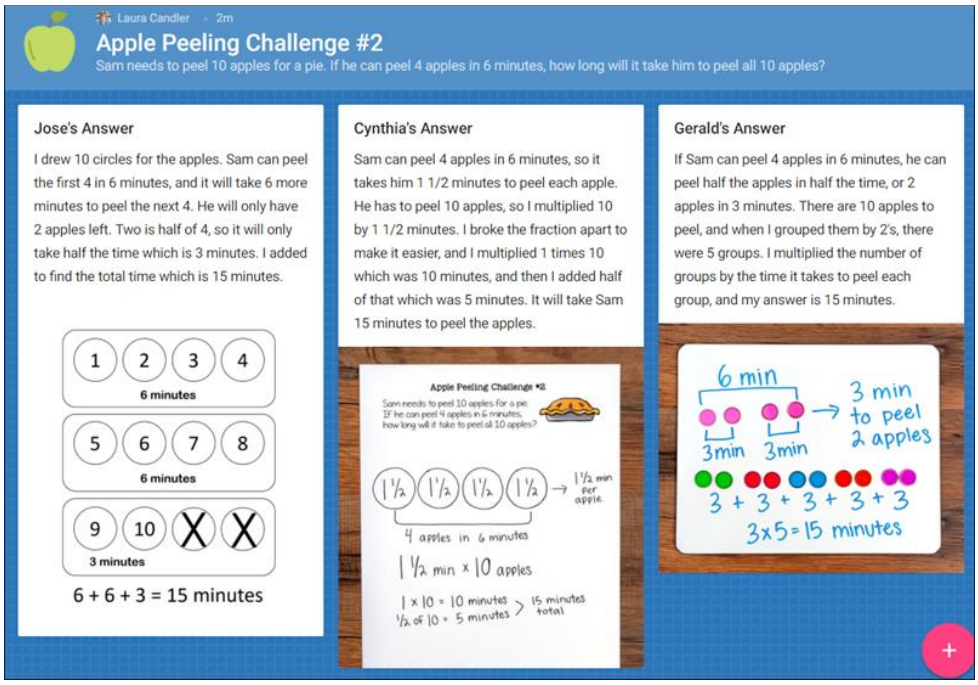
If no one challenges the answer and your students want to know if it's correct, just smile and say, ***"We've only looked at one way to solve the problem. To verify the answer, we need to solve it a different way to see if we get the same answer. Did anyone solve this problem a different way?"***

If anyone says that they solved the problem a different way, ask him or her to come forward to share his or her solution. After that student finishes speaking, ask the class again, ***"Can we find another way to solve this problem?"*** Continue this process until everyone who wants to share a new strategy has had a chance to do so. If you don't have time to finish in one session, ask your students to continue thinking about the problem and conclude the discussion the next day.

Before you wrap up the discussion for this problem, be sure to confirm the correct answer, especially if any answers shared earlier in the discussion were incorrect. After the solution has been verified in several ways, ask your students, ***"Do we all agree that _____ is the correct answer?"***

The first time you facilitate a rich math class discussion, your class may only find a few ways to solve the problem. However, as they become more creative in their problem-solving approaches, they may discover 5 or 10 ways to solve the problem! When that happens, it can become difficult to keep track of the different strategies and to remember who shared each one.

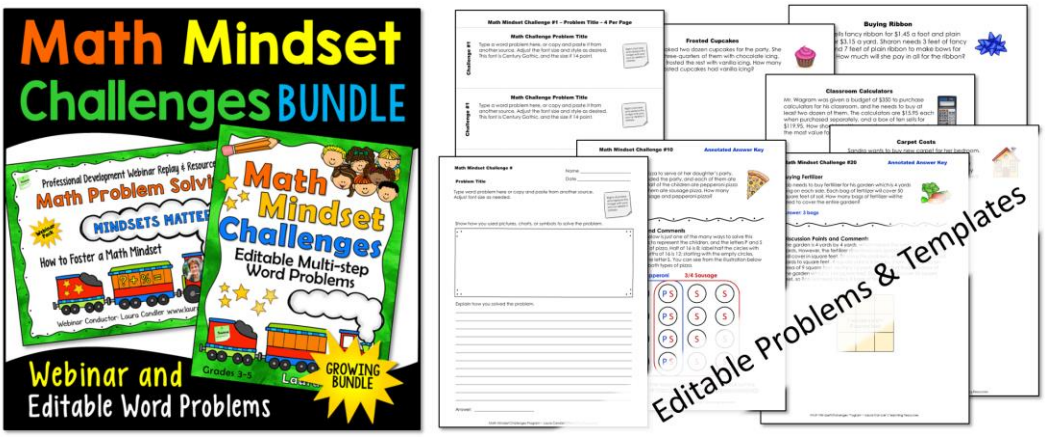
Padlet offers one of the easiest and most effective ways to deal with this problem. Simply take a snapshot of each student's solution and upload it to the Padlet wall you created for the problem. Label the post with the student's name, and ask him or her to complete it by entering a written explanation.



To show you how Padlet works, I created the math problem wall above for the Apple Peeling Math Challenge #2. I uploaded three examples of how students might solve the problem and how their work could be displayed and shared on Padlet. If you use this apple peeling challenge problem with your students, I'd love for you to add any new solutions to the wall. Click over to the Padlet Apple Peeling Challenge #2 Wall, upload an image of the solution and enter a written description.

If you have time, you can extend the rich math task by asking your students to create their own related math problems. For example, some students might create a similar problem that uses different numbers, perhaps even fractions or decimals. Some students may change other elements of the problem, changes that would require an entirely different method for solving it. To share the new problems with their classmates, students could post their problems on the Padlet wall or write them on index cards to be tacked to an "early finishers" board.

To learn more about how to foster mathematical mindsets, check out my webinar, Math Problem Solving: Mindsets Matter, or one of my problem solving bundles. The Math Mindset Challenges Bundle shown below includes the webinar plus a collection of editable word problems and templates to get you started. If you're looking for something more comprehensive, take a look at my Math Problem Solving Mega Bundle which also includes all 4 Daily Math Puzzler books.



Rich math tasks are exciting for kids, even those students who lack confidence in their mathematics ability. In fact, these students often turn out to be the most creative problem solvers in your class! When you take steps to foster mathematical mindsets in your students, you'll be amazed at what happens. If you haven't been using rich math tasks, I hope these tips will help you to jump in and get started now!