PBS Lesson Series

Math: Grade 4, Lesson 14, Multiplication

Lesson Focus: Multiply two 2-digit numbers
Practice Focus: Students will focus on solving multiplication problems using partial products
Objective: Students will use the partial product strategy to multiply two 2-digit numbers
Key Vocabulary: multiple, place value, properties
TN Standards: 4.NBT.B.5
Teacher Materials:

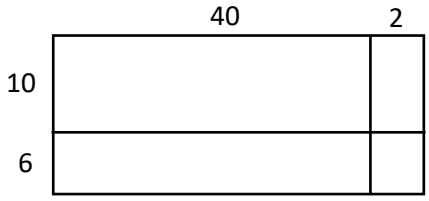
- Whiteboard and markers
- Student Practice Packet

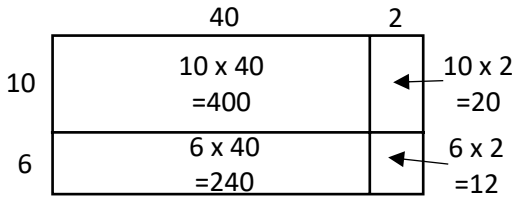
Student Materials:

- Paper and a pencil, and a surface to write on

** Note: This lesson is designed to help students see the connection between the area model and the partial product method of multiplying. Therefore, the first time students see the partial product method the order follows the area model (tens x tens first) and then moves to the more common order of the traditional algorithm of beginning with ones x ones in other examples.*

Teacher Do	Student Do
Opening (1 minute) **Hello! Welcome to Tennessee's At Home Learning Series for math! Today's lesson is for all our 4th graders out there, though all children are welcome to tune in. This lesson is the fourteenth in our series.** **My name is ____ and I'm a ____ grade teacher in Tennessee schools! I'm so excited to be your teacher for this lesson! Welcome to my virtual classroom!** **If you didn't see our previous lesson, you can find it on the TN Department of Education's website at www.tn.gov/education. You can still tune in to today's lesson if you haven't see any of our others. But, it might be more fun if you first go back and watch our other lessons since we'll be talking about things we learned previously.** **Today we will be learning about multiplying two 2-digit numbers in mathematics! Before we get started, to participate fully in our lesson today, you will need:** • **Paper and a pencil, and a surface to write on** • **The student packet for Math, Grade 4, Lesson 14 which can be found at www.tn.gov/education.** **Ok, let's begin!**	Students get materials ready for the lesson.
Intro (7 minutes) **Let's do a quick review of using an area model to multiply two 2-digit numbers. Go ahead and draw a large rectangle on your paper.** [Draw a large rectangle.] **What are we finding when we calculate the area of a rectangle?** [Pause.] **Good! When we are asked to find the**	This warm-up will support students' understanding of how to break apart factors by place value and then find partial products, foreshadowing the work in in the Teacher Model section by drawing a

area of a shape, we are finding the amount of space that shape covers. **Why does using an area model help us with multiplying large numbers?** [Pause.] **Yes! It makes multiplying large numbers easier because we break apart the large numbers into smaller friendlier numbers that are easier to multiply.** **Let's multiply 16 x 42 using an area model.** **We will start by breaking apart 16 by place value. How many tens are in 16?** [Pause.] **Yes, there is 1 ten in 16. How many ones are in 16?** [Pause.] **Yes, there are 6 ones in 16. So we can write 16 as 1 ten and 6 ones or 10 + 6. Let's write that along the side of the rectangle.** [Write 10 and 6 along the side and draw a line to separate them – see example below.] **Remember that since this is an area model, we want it to make sense. So allow a little more space for the 10 than the 6 since 10 is a little bigger than 6.** **Now, let's break apart 42 by place value. How many tens are in 42?** [Pause.] **Good! 4 tens, which is the same as 40. And how many ones are in 42?** [Pause.] **Yes! 2 ones. So 42 is the same as 4 tens and 2 ones or 40 + 2. Let's write that across the top allowing more space for 40 than 2, since 40 is much bigger than 2.** [Write 40 and 2 across the top and draw a line to separate them - see example below.] **Also remember to make the side for 42 longer than the side for 16, because 42 is bigger than 16. These don't have to be exact, but just estimate so the model makes sense for the size of the numbers.**  **Now we need to find the area of each smaller rectangle inside. These are called partial products, because we are finding the product of two numbers that are parts of our original numbers.** **How do we find the area of a rectangle?** [Pause.] **Good, we multiply the length times the width. You can start anywhere, but I like to start with the top left rectangle.** [Point to the top left rectangle.] **So what do we need to multiply to get the area of this rectangle?** [Pause.] **Good! 10 x 40. Remember to use your strategy for multiplying by a ten. What is 10 x 40?** [Pause.] **400, great! Write 400 inside that rectangle, so we remember what it is.** [See example below.]	picture (area model) to represent this work. Students will listen to the teacher think aloud modeling the thought process for a problem from the start of the problem through finding the solution. Students will follow along by drawing and calculating on their own paper and responding to teacher questioning.

Next we'll calculate the area of the top right rectangle. What are the dimensions of this one? [Pause.] **10 and 2. Even though the length is not directly labeled, we know that it's 10 because it's the same length as the first rectangle.** [Point to this length in the first rectangle and in this one to show they are the same.] **So what is 10 x 2?** [Pause] **Good job! 20. Write 20 in that rectangle.** [See example below.] **Next we'll calculate the area of the bottom left rectangle. What are the dimensions of this one?** [Pause.] **6 and 40. Even though the width is not directly labeled, we know that it's 40 because it's the same width as the first rectangle.** [Point to this length in the first rectangle and in this one to show they are the same.] **So what is 6 x 40?** [Pause.] **Yes! 240. Write 240 in that rectangle.** [See example below.] **And finally, we'll calculate the area of the bottom right rectangle. Neither of these dimensions are labeled, but I know it has dimensions of 6 and 2, because we can look at this length** [Point.] **and this width** [Point.] **since they are the same in this rectangle. So what is 6 x 2?** [Pause.] **You got it! 12. Write 12 in that rectangle.** [See example below.]  **Now that we have found all the partial products, let's answer the original problem. To find** [Point to the 10 and the 6 along the length as you say.] **16 x** [Point to the 40 and the 2 along the top as you say them.] **42, we just need to add all four of these partial products together to find the total area of the big rectangle.** [Point to each of these and list them to the side as you say them.] **400 + 20 + 240 + 12. Use your addition strategies to find this sum.** [Allow students time to think and add.] **Did you get 672? I did, too! How did you add these numbers?** [Allow students time to explain.] **Very nice! I started by adding 400 + 240 which is 640. Then I added 640 + 20 which is 660. And finally I added 660 + 12 which is 672. Therefore, 42 x 16 = 672.** **Nice work!**	
Teacher Model (9 minutes) **Today, let's explore another strategy to use when multiplying big numbers.**	Students will listen to the teacher do a think aloud working a contextual problem modeling the thought process for a problem from the start

Objective #1: Teacher will help students see the connection between the area model and the partial product strategy to multiply two 2-digit number. **Look at our area model again.** [Show area model again.] **Remember that the original problem was 16 x 42.** [Write this vertically next to the area model – could be a separate sheet as long as both can be seen.] **In the top right rectangle, we multiplied 10 x 40. Where did the 10 and the 40 come from in the original problem?** [Point to the 16 x 42 and pause.] **Yes! The 10 is from the one ten in 16 and the 40 is from the 4 tens in 42.** [Underline these place values.] **So what we really did in that top left rectangle was multiply the value of the tens in the first number, 10, by the value of tens in the second number, 40, and got 400.** [Write out like this as you say it: 16 x 42 tens x tens 10 x 40 = 400] **And where did we get the 10 x 2 in the top right rectangle?** [Point to the 16 x 42 and pause.] **Yes! The 10 is from the one ten in the 16 and the 2 is from the 2 ones in 42.** [Underline these place values.] **So what we really did in that top right rectangle was multiply the value of the tens in the first number, 10, by the value of ones in the second number, 2, and got 20.** [Write this on the next line: 16 x 42 tens x tens 10 x 40 = 400 tens x ones 10 x 2 = 20] **And where did we get the 6 x 40 in the bottom left rectangle?** [Point to the 16 x 42 and pause.] **Yes! The 6 is from the 6 ones in 16 and the 40 is from the four tens in the 42.** [Underline these place values.] **So what we really did in that bottom left rectangle was multiply the value of the ones in the first number, 6, by the value of tens in the second number, 40, and got 240.** [Write this on the next line: 16 x 42 tens x tens 10 x 40 = 400 tens x ones 10 x 2 = 20 ones x tens 6 x 40 = 240] **And where did we get the 6 x 2 in the bottom right rectangle?** [Point to the 16 x 42 and pause.] **Yes! The 6 is from the six ones in the 16 and the 2 is from the 2 ones in 42.** [underline these place values] **So what we really did in that**	of the problem through finding the solution. Objective #1: Through following along with the think aloud, students will solve the multiplication problem they did in the intro using the partial product strategy. The purpose of this problem is to have students see how these two strategies are connected.

bottom right rectangle was multiply the value of the ones in the first number, 6, by the value of ones in the second number, 2, and got 12. [Write this on the next line: 16 x 42 tens x tens 10 x 40 = 400 tens x ones 10 x 2 = 20 ones x tens 6 x 40 = 240 ones x ones 6 x 2 = 12] **And then to get our final answer, what did we do?** [P.ause] **You got it! We added these 4 numbers together and got 672.** [Your completed example should look like this: 16 x 42 tens x tens 10 x 40 = 400 tens x ones 10 x 2 = 20 ones x tens 6 x 40 = 240 ones x ones 6 x 2 = 12 672] [Point to the completed example.] **This way of writing out the partial products is another strategy called the partial product method. Do you see how it's connected to the area model method?** [Pause.] **It's very similar to the area model method without the drawing. Both methods allow you to break apart the large numbers into smaller friendlier numbers to find partial products and then add them together to get the final answer.** **Let's try another problem and this time we will only use the partial product method.** Objective #2: Teacher will explicitly instruct how to multiply using the partial product method. **Marcia put 7 oranges and 8 apples into each of 12 bags. How many pieces of fruit did Marcia put into all of the bags?** **Some problems, like this one, have more than one step to solve. What information is the problem giving us?** [Pause.] **Ok, Marcia is putting both oranges and apples into bags. Each bag gets 7 oranges and 8 apples. So how many pieces of fruit is she putting into each bag?** [Pause.] **Good! 15 pieces of fruit go into each bag. And how many bags is she filling?** [Pause.] **Yes, 12 bags.** **What's the problem asking us to do?** [Pause.] **Good, we are asked to find how many pieces of fruit in all. So how are we going to do that?** [Pause.] **Consider that she is putting 15**	Objective #2: Through following along with the think aloud, students will multiply two 2-digit numbers using the partial product method. The purpose of this problem is to have students develop another strategy to multiply.

pieces of fruit into each of 12 bags. That means 15 fruits are repeated 12 times, once for each bag. So what operation do we need to use? [Pause.] **Yes! Since multiplication is repeated addition, we can just multiply 15 x 12. Since those two numbers are pretty big, let's use the partial product method to multiply them.** **To use the partial product method, we will write the numbers vertically. This is not required, but it can help us keep the place values straight.** [Write 15 x 12 vertically.] [This is the completed example for your reference: 15 x 12 tens x tens 10 x 10 = 100 tens x ones 10 x 2 = 20 ones x tens 5 x 10 = 50 ones x ones 5 x 2 = 10 180 pieces of fruit] **As we find each partial product, we will need to record them underneath so we can add them altogether for our final answer. Remember with the area model, we started by multiplying the tens. Actually, as long as you include all four partial products, you can calculate and list them in any order. After all, the commutative property says we can add them in any order. But for this example, let's start with the tens since that's what we did with the area model.** [As you go through this, indicate which place values you are talking about by underlining that digit. Write tens x tens and 10 x 10 slightly to the left of the first line underneath the problem then fill in the answer when you get to it– see completed example above.] **So how many tens are in 15?** [Pause.] **Yes, there is 1 ten in 15. And how many tens are in 12?** [Pause.] **Yes, there is 1 ten in 12. And how much is 1 ten times 1 ten?** [Pause.] **Good! 100. So write 100 on the first line underneath your problem.** **What did we multiply together next in the area model?** [Pause.] **Okay, we multiplied the value of the tens in the first number by the value of the ones in the second number. So let's do that with this problem.** [As you go through this, indicate which place values you are talking about by underlining that digit. Write tens x ones and 10 x 2 slightly to the left of the second line underneath the problem then fill in the answer when you get to it– see completed example above.]	

How many tens are in 15? [Pause.] **Yes, there is 1 ten in 15. And how many ones are in 12?** [Pause.] **Yes, there are 2 ones in 12. So what is 1 ten times 2 ones or 10 x 2?** [Pause.] **Good! 20. Write 20 on the second line underneath your problem.** **What did we multiply together next in the area model?** [Pause.] **Okay, we sort of reversed what we just did. We multiplied the value of the ones in the first number by the value of the tens in the second number. So let's do that with this problem.** [As you go through this, indicate which place values you are talking about by underlining that digit. Write ones x tens and 5 x 10 slightly to the left of the third line underneath the problem then fill in the answer when you get to it– see completed example above.] **How many ones are in 15?** [Pause.] **Yes, there are 5 ones in 15. And how many tens are in 12?** [Pause.] **Yes, there is 1 ten in 12. So what is 5 ones times 1 ten or 5 x 10?** [Pause.] **Good! 50. Write 50 on the third line underneath your problem.** **And what did we multiply together last in the area model?** [Pause.] **Okay, we multiplied the value of the ones in the first number by the value of the ones in the second number. So let's do that with this problem.** [As you go through this, indicate which place values you are talking about by underlining that digit. Write ones x ones and 5 x 2 slightly to the left of the fourth line underneath the problem then fill in the answer when you get to it– see completed example above.] **How many ones are in 15?** [Pause.] **Yes, there are 5 ones in 15. And how many ones are in 12?** [Pause.] **Yes, there are 2 ones in 12. So what is 5 ones times 2 ones or 5 x 2?** [Pause.] **Good! 10. Write 10 on the fourth line underneath your problem.** **And the last step is to add all four partial products. I'll give you a minute to try that in your head.** [Allow students time to think and add.] **What did you get?** [Pause.] **180? Great job! So Marcia put 180 pieces of fruit in the bags all together.** [See completed example above.] Tying the learning together: **What's similar about the area model method and the partial product method of multiplying numbers?** [Pause.] **True. In both methods, you are breaking apart the numbers by place value in smaller friendlier numbers that are easier to**	Tying the learning together: Students will compare and connect the different methods and identify how they are similar and how they are different.

multiply. These give you partial products that you then add together to get the final answer. **What's different about these two methods?** [Pause.] **Yes, in the area model, you're drawing a picture. In the partial product method, you don't need the picture. Of course, if you get confused while using the partial product method, you can always draw the area model to help you get back on the right track.** **Let's practice the partial product method a little more.**	
Guided Practice (10 minutes) [I do] **Follow along with me as I use the partial product method to multiply 41 x 25.** [Write 41 x 25 vertically.] **Remember that the commutative property of addition tells us that you can add the partial products together in any order. So with this problem, I am going to start with multiplying the ones together instead of the tens. I am also going to record on each line which calculation I am doing. This part is not required, but I want you to be able to see what I am thinking, so I'll write it down.** [This is the completed example for your reference: 41 x 25 ones x ones 1 x 5 = 5 tens x ones 40 x 5 = 200 ones x tens 1 x 20 = 20 tens x tens 40 x 20 = 800 1025] [As you go through this, indicate which place values you are talking about by underlining that digit. Write ones x ones and 1 x 5 slightly to the left of the first line underneath the problem then fill in the answer when you get to it – see completed example above.] **I know there is 1 one in 41 and there are 5 ones in 25. So 1 one times 5 ones or 1 x 5 is 5.** **Next I am going to multiply the tens in the first number by the ones in the second number.** [As you go through this, indicate which place values you are talking about by underlining that digit. Write tens x ones and 40 x 5 slightly to the left of the second line underneath the	Students work alongside the teacher as the teacher thinks aloud.

problem then fill in the answer when you get to it– see completed example above.] **I know there are 4 tens in 41 and 5 ones in 25. So 4 tens times 5 ones or 40 x 5 is 200.** **Next I'm going to do the reverse of what I just did and multiply the ones in the first number by the tens in the second number.** [As you go through this, indicate which place values you are talking about by underlining that digit. Write ones x tens and 1 x 20 slightly to the left of the third line underneath the problem then fill in the answer when you get to it– see completed example above.] **I know there is 1 one in 41 and 2 tens in 25. So 1 one times 2 tens or 1 x 20 is 20.** **And for the last partial product, I am going to multiply the tens in each number together.** [As you go through this, indicate which place values you are talking about by underlining that digit. Write tens x tens and 40 x 20 slightly to the left of the fourth line underneath the problem then fill in the answer when you get to it– see completed example above.] **I know there are 4 tens in 41 and 2 tens in 25. So 4 tens times 2 tens or 40 x 20 is 800.** **And lastly, I will add all four partial products together to get my final product. Using my addition strategies, I know I can add these numbers in any order, so I am going to add 200 and 800 to get 1000 and then add 5 and 20 to get 25. Then I'll add 1000 and 25 together to get 1025.** [See completed example above.] **Thank you for following along with me on that one. Now let's try another one together.** [We do] **Let's try one more together that's just a little different. See if you can tell me how it's different.** **Let's multiply 34 x 30.** [Write this vertically.] [This is the completed example for your reference: 34 x 30 ones x tens 4 x 30 = 120 tens x tens 30 x 30 = 900 1020]	Students will respond to teacher questions with less scaffolding than the previous example. Students will have more time to think and respond on their own prior to the teacher providing solutions.

Again, we're going to start by multiplying the ones for both numbers. [As you go through this, indicate which place values you are talking about by underlining that digit.] **How many ones are in 34?** [Pause.] **Yes, there are 4 ones in 34. And how many ones are in 30?** [Pause.] **What? There aren't any ones in 30? Okay, there are 0 ones in 30. So we need to multiply 4 ones times 0 ones. And how much is 4 x 0?** [Pause.] **Good! 0. So when a partial product is 0, do we need to write it down?** [Pause.] **True, we can write it down. But remember that we're going to be adding these partial products. So what happens when we add a number to 0?** [Pause.] **Right! Nothing happens. The number doesn't change. So we don't really need to write that one down.** **Okay, let's keep going. Next we need to multiply the value of the tens in the first number by the value of the ones in the second number.** [As you go through this, indicate which place values you are talking about by underlining that digit.] **How many tens are in 34?** [Pause.] **Yes, there are 3 tens in 34. And how many ones are in 30?** [Pause.] **Oh, look! It happened again. There are 0 ones in 30. So when we multiply 3 tens times 0 ones. What do we get?** [Pause.] **Yes! We got 0 again. So we don't have to write that one either.** **What do you think is going to happen next? Do you think we'll get another zero?** [Pause.] **Let's see. Next we will reverse what we just did. Multiply the value of the ones in the first number by the value of the tens in the second number. Go ahead and try this one on your own.** [Pause – allow time for students to think and multiply.] [As you go through this, indicate which place values you are talking about by underlining that digit. Write 4 x 30 slightly to the left of the third line underneath the problem then fill in the answer when you get to it– see completed example above.] **Did you multiply the 4 ones in 34 by the 3 tens in 30?** [Pause.] **So did we get zero again?** [Pause.] **No. What do we get when we multiply 4 ones times 3 tens?** [Write that down to the side and pause.] **Good! 120. Did you write 120 on the first line underneath your problem?** [Pause.] **Good.** **We have multiplied both the ones, the tens in the first number by the ones in the second number, and the ones in the first number by the tens in the second number. What do we have left to multiply?** [Pause.] **Yes! For our last partial**	

product, we'll multiply the value of the tens in the first number by the value of the tens in the second number. Go ahead and try this one on your own. [Pause – allow time for students to think and multiply.] [As you go through this, indicate which place values you are talking about by underlining that digit. Write 30 x 30 slightly to the left of the fourth line underneath the problem then fill in the answer when you get to it– see completed example above.] **Did you multiply the 3 tens in 34 by the 3 tens in 3?** [Pause.] **And what is 30 x 30?** [Pause.] **Good! 900. Did you write 900 on the second line underneath your problem?** [Pause.] **Good!** **What is the last step to get our final answer?** [Pause]. **Yes! We need to add the partial products. I'll give you a minute to try that in your head.** [Allow students time to think and add.] **What did you get?** [Pause.] **1020? Great job!** [See completed example above.] **So how was that problem different from the other problems we have tried?** [Pause.] **You got it! It only had 2 partial products that weren't zero. Why do you think that happened?** [Pause.] **Good observation! We were multiplying by a multiple of 10. As we know, multiples of ten have zero ones. So when we are finding our partial products, we know that we have to multiply by that zero ones for two of the four partial products, which just gives us zero! Therefore, we end up with only 2 partial products that aren't zero.** [You do] **Now try using the partial product on your own to multiply 23 x 14.** [Write this vertically.] **You can choose which order to find your partial products, but be careful that you get all the combinations like we did when using the area model. If you get confused, try recording them as you go so you can see what you have already done. If needed, you can always draw the area model to help you.** [Allow time for students to think and multiply.] **How did you do?** [Pause.] **Check to see if you got the same partial products as I did. Remember that it's okay if yours are in a different order than mine. I got 12, 80, 30, and 200.** [Pause.] **And when you added these partial products together, did you get 322?** [Pause.] **Great job!** <u>Additional Problems (if Needed):</u> 38 x 17; Partial products are 56, 210, 80, 300; Answer 646	Students are working almost exclusively independently with the teacher providing answers at the end.

26 x 53; Partial products are 18, 60, 300, 1000; Answer 1378	
Independent Practice (1 minute) **Great work, everyone! Today, we practiced multiplying two 2-digit numbers using partial products. I hope you're seeing how breaking down the large numbers into smaller friendlier numbers by place value to find partial products can help you multiply 2-digit numbers more easily! You sure did a great job! I will show you the independent practice problems now, or you can find them in the student practice for this lesson posted on our website, www.tn.gov/education.** [Teacher shows student practice page under document camera or camera zooms in on student practice page.] **Good luck and do your best!**	
Closing (<1 minute) • **Boys and Girls, I enjoyed learning about multiplying large numbers using partial products with you! Thank you for inviting me into your home. I look forward to seeing you in our next lesson in Tennessee's At Home Learning Series!** • **Bye!**	