PBS Lesson Series

Math: Grade 4, Lesson 13, Multiplication

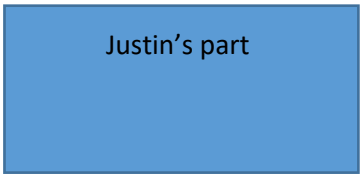
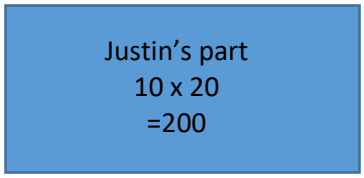
Lesson Focus: Multiply two 2-digit numbers
Practice Focus: Students will focus on solving multiplication problems using area models and partial products
Objective: Students will use the area model and partial product strategies to multiply two 2-digit numbers
Key Vocabulary: area, place value, partial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

- Whiteboard and markers
- Student Practice Packet

Student Materials:

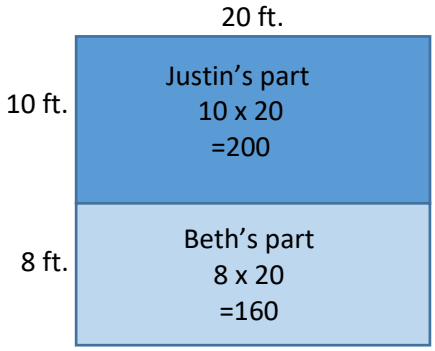
- Paper and a pencil, and a surface to write on

Teacher Do	Student Do
Opening (1 min) **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 thirteenth 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** **Ok, let's begin!**	Students get materials ready for the lesson.
Intro (5 mins) **Let's start off our lesson today by reading a word problem to see how we might be able to help some students build a new playground for their school.** **Mrs. Cohen is the principal of a school and she has a very special project for some of her students.**	This warm-up will support students' understanding of finding the area of different rectangles, foreshadowing the work in the Teacher Model section of multiplying using area models.

[As you read through the problem, underline key information: rectangular, 20 feet, 10 feet, and area.] **Justin and some of his friends have been asked to help design a playground for their school. Mrs. Cohen, the principal, tells Justin that his part of the playground is rectangular and measures 20 feet by 10 feet. Help Justin find the area of his part of the playground.** **What is this problem asking us to do?** [pause] **Yes, find the area of Justin's part of the playground.** **Let's begin by drawing a picture. What shape is Justin's part of the playground?** [pause] **Yes, the problem tells us it's rectangular.** [Point to the word rectangular.] **So let's draw a rectangle and label the side lengths.** [Draw and label the rectangle and label it like this example.] 20 ft. 10 ft.  **What does the problem mean when it asks us to find the area? What is area?** [pause] **Yes! Area means how much space is covered in this playground.** **How do we find the area of this rectangle?** [pause] **That's right! We multiply 10 x 20, because if we were to fill this rectangle 10 squares tall and 20 squares wide,** [Indicate these in the picture.] **it would be like asking how many is 10 squares repeated 20 times. Go ahead and write 10 x 20 inside the rectangle.** [Write 10 x 20 inside the rectangle.] **What is 10 x 20? Let's see if we can find that product in our heads.** [pause] **Good for you for remembering your strategies for multiplying by a multiple of 10! It's 200. So that means Justin's part of the playground is 200 square feet. Write 200 inside the rectangle so we can remember what the area is.** [Write =200.] 20 ft 10 ft 	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 multiplying on their own paper and responding to teacher questioning.

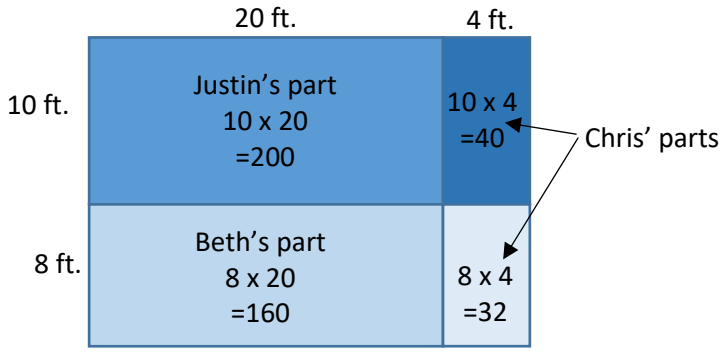
Okay, let's keep going!

Mrs. Cohen told Justin's friend Beth that she is designing a piece of the playground next to his that is 8 feet by 20 feet. So let's add to the picture we have and draw Beth's part of the playground. [Add to the first rectangle and draw and label the new rectangle and label it like this example.] **We don't have to label the length with 20 ft. again, because it is already labeled.**



So how do we find the area of Beth's part? [pause] **Yes! We multiply 8 x 20, so write that in the model.** [Write in 8 x 20.] **What is 8 x 20?** [pause] **160, right. So Beth's part of the playground measures 160 square feet. Let's put that in there, too.** [Write in =160.]

Mrs. Cohen told Justin's friend Chris that he has two parts to design. The first one is 10 feet by 4 feet and the second one is 8 feet by 4 feet. Let's draw each of those rectangles in our picture. [Add to the first rectangle and draw and label the new rectangles and label them like this example.] **Again, we don't have to label the 10 feet and 8 feet again because they are already labeled.**



What do we need to multiply to find the area of Chris' first part? [pause] **Yes, 10 x 4** [write 10 x 4]**, which is?** [pause] **Good! 40.** [Write =40.]

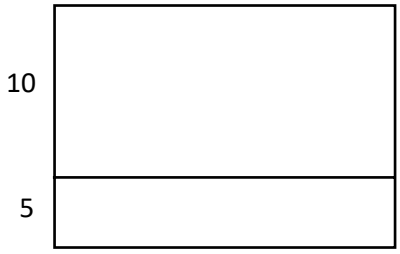
And Chris' second part? [pause] **Yes, 8 x 4** [Write 8 x 4.]**, which is?** [pause] **Excellent. 32.** [Write =32.] **So Chris's 2 parts measure 40 square feet and 32 square feet.** **So how can we find out how big this whole playground is?** [pause] **Of course! We can just add all four of those smaller areas together. Let's do that.** [Indicate each number in the model and write out the addition problem saying it as you write.] **200 + 160 + 40 + 32. Use your addition strategies to add these quickly.** [Allow time for students to think and add.] **What did you get?** [pause] **432? Me, too!** [Write this out as you say it.] **I added the 160 + 40 first, because I know they make 200. Then I added 200 + 200 and got 400. And lastly, I added 400 + 32 and got 432.** **So the whole playground has an area of 432 square feet.** **Did you know that you can use these area models to multiply two 2-digit numbers?** [pause] **You can!** **Let's learn how to do that!**	
<u>Teacher Model</u> (14 minutes) **Area models are a great way to break down bigger numbers into more friendly numbers that are easier to multiply. There are different ways to use them depending on the numbers in the problem. Let's look at an example to see how this works.** Objective #1: Teacher will explicitly instruct how to draw an area model to multiply two 2-digit numbers by breaking down both factors. **There are 15 players on each baseball team of the Strike Out Club. There are 25 teams. How many players are on all of the teams of the Strike Out Club?** **What information is this problem telling us?** [pause] **Yes, it's telling us there are 15 baseball players on each of the 25 teams.** **What information is this asking us to find?** [pause] **Good job reading the problem like a mathematician! It's asking us to find how many players are on all the teams together.** **So we need to find out how many is 15 repeated 25 times, once for each team. What operation do we use for this?** [pause] **Yes! Since multiplication is repeated addition, we can just multiply 15 x 25. Let's see how we can use an area model to help us multiply these 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 of the problem through finding the solution. Objective #1: Through following along with the think aloud, students solve a problem that requires multiplying two 2-digit numbers by breaking apart both factors by place value and finding partial products. Students will use an area model to model the problem. The purpose of this problem is to have students develop strategies to more easily multiply two digit numbers.

Do this with me. Start by drawing a large rectangle. [Draw a large rectangle.]

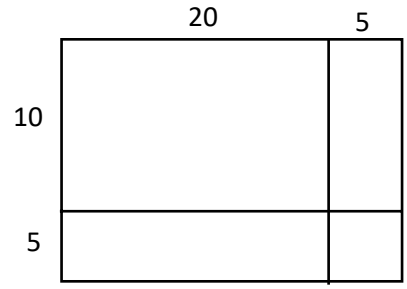
How can we break down each of these numbers to make friendlier or easier numbers to multiply? [pause] **We reviewed how to multiply by multiples of 10 in a previous lesson, so let's try breaking them down by place value.**

Let's look at 15 first. To break this down by place value, we need to know how many tens and how many ones we have. How many tens are in 15? [pause] **Good! There is 1 ten in 15 because the number in the ten's place is a 1.** [Point to the 1.] **How many ones are in 15?** [pause] **Yes! There are 5 ones, because there is a 5 in the ones place.** [Point to the 5.] **So we can break apart 15 into 10 + 5.**

Let's write that along the side of our rectangle to represent the length. As we are putting these in our model, we need to consider the size of each piece. After all, this is an area model and we want it to make sense. So since 10 is 5 doubled, we want to make the space for 10 have about twice the length of the space for 5. Like this. [Label and draw a line to divide the 10 and the 5 like in this example.]



Now how would we break up 25 by place value? How many tens are there in 25? [pause] **Yes! 2 tens, which is the same as saying 20. Good! How many ones are there in 25?** [pause] **Yes! 5 ones. So we can break apart 25 into 20 + 5. So let's write those across the top of the rectangle to represent the width. Again, remember that 20 is much bigger than 5, so we need to indicate that in our drawing. It doesn't have to be exact, but estimate the widths so they make sense.** [Label and draw a line to divide the 20 and the 5 like in this example.]



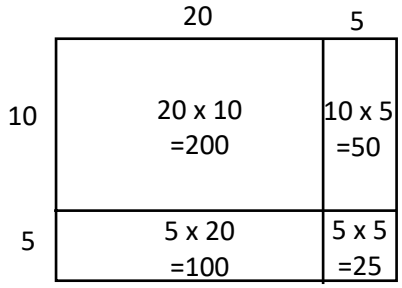
Do you see how this looks like our model of Justin's playground earlier? [pause] **So now we need to find the area of each smaller rectangle. These are called partial products, because we are finding the product of two numbers that are parts of our original numbers.**

[As you work through this next part, write each multiplication problem and each area in the appropriate rectangle. See below for an example.]

We can fill in each of these areas in any order, but I'm going to start with the top left rectangle. [point to it] **I see that the dimensions of this rectangle are 10 and 20, so to find the area, I need to multiply 10 x 20. What is 10 x 20?** [pause] **Good! 200. Be sure to record these as you go, because we will need to add them all up at the end just like we did to find the total area of the playground.**
[Teacher writes in multiplication expression and partial product in appropriate section.]
Next I'll calculate the area of the top right rectangle. This one has dimensions of 10 and 5. 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 5?** [pause] **Good job! 50.**
[Teacher writes in multiplication expression and partial product in appropriate section.]

Next I'll calculate the area of the bottom left rectangle. This one has dimensions of 5 and 20. Even though the width is not directly labeled, we know that it's 20 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 5 x 20?** [pause] **Yes! 100.**
[Teacher writes in multiplication expression and partial product in appropriate section.]

And finally, I'll calculate the area of the bottom right rectangle. Neither of these dimensions are labeled, but I know it has dimensions of 5 and 5, because we can look at this length [point] **and this width** [point] **since they are the same. So what is 5 x 5?** [pause] **You got it! 25.**
[Teacher writes in multiplication expression and partial product in appropriate section.]

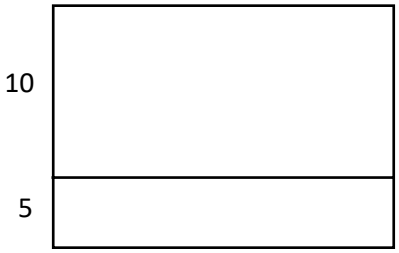
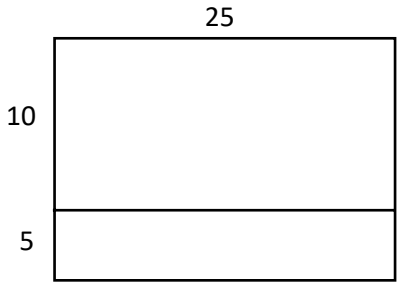


Now that we have found all the partial products, let's answer the original problem. To find [Point to the 10 and the 5 along the length as you say.] **15 x** [Point to the 20 and the 5 along the top as you say them.] **25, we just need to add all four of these partial products together to find the total area just like we did with the playground.** [Point to each of these and list them to the side as you say them.] **200 + 50 + 100 + 25. Use your addition strategies to find this sum.** [Allow students time to think and add.] **Did you get 375? I did, too! How did you add these numbers?** [Allow students time to explain.] **Very nice! I started by adding 200 + 100 which is 300 and then I added 50 + 25 which is 75. Then I added 300 + 75 which is 375.**

Good job everyone!

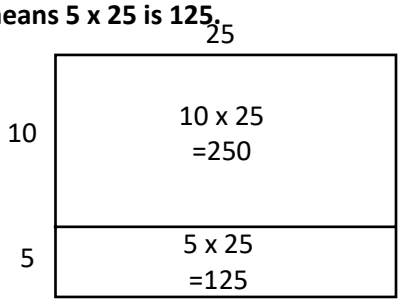
Remember, there are different ways to use area models depending on the numbers in the problem.
Sometimes you may find that you don't have to break apart both numbers to make it easier to multiply. For example, if you were multiplying 30 x 42, 30 has zero ones, so you would only need to break apart the 42 to create your area model. Or you may already know your multiplication facts for 11, so if you're multiplying 11 x 56, you would only need to break apart the 56 to create your area model.

Some of you may use a strategy like minutes on a clock to help you with your multiplication facts for 15 or quarters in money to quickly calculate the multiplication facts for 25. That's great, we always want to think about how we use

math in our everyday lives! Let's think about what that would look like using an area model. Objective #2: Teacher will explicitly instruct how to draw an area model to multiply two 2-digit numbers by breaking down only one factor. **Let's say you know your multiplication facts for 25. Since each quarter in money is worth 25 cents, and we know there are 4 quarters in a dollar, we know that 25 x 4 = 100, because a dollar is worth 100 cents.** **Let's set up an area model that shows 15 x 25, but this time let's just break down the 15 by place value to get our partial products. Start by drawing the large rectangle. Do this with me on your own paper.** [Draw a large rectangle.] **So how do we break down 15 by place value?** [pause] **Yes, we know there is 1 ten and 5 ones in 15, so 15 can be written as 10 + 5. Where do we put those numbers?** [pause] **Okay, we can put them either along the side or across the top. Either will work. I'm going to put mine along the side to represent the length of this rectangle like we did earlier so you can see the difference between doing it this way from the way we created the model earlier. Remember to make the length for the 10 longer than the length for the 5.** [Draw the 10 and 5 along the side and draw a line separating them.]  **Since we don't need to break apart the 25, we are just going to put it at the top to represent the width.** [Write 25 at the top.]  	Objective #2: Through following along with the think aloud, students solve a problem that requires multiplying two 2-digit numbers by breaking apart only one of the factors. Students will use an area model to model the problem. The purpose of this problem is to have students develop strategies to more easily multiply two digit numbers.

Now we only have two partial products to find: [Point to these as you say them.] **25 x 10 and 25 x 5. What do we need to multiply to get the top partial product?** [Point to the top rectangle.] **Yes! 10 x 25.** [Write in 10 x 25 in the top rectangle.] **Remember your strategy for multiplying by ten. What is 10 x 25?** [pause] **250, Great!** [Write in =250.]

What about the bottom rectangle? What are we going to multiply to get this partial product? [pause] **Yes, 5 x 25.** [Write 5 x 25 in the bottom rectangle.] **Think about those quarters to help you find 5 x 25.** [pause] **You got it! 5 x 25 is 125.** [Write =125.] **I thought about the fact that 4 quarters is 1 dollar, so one more quarter would be 1 dollar and 25 cents, so that means 5 x 25 is 125.**

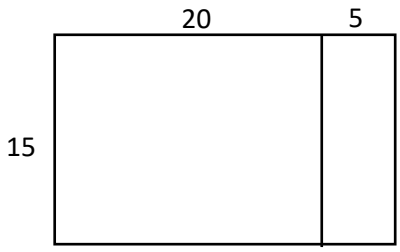


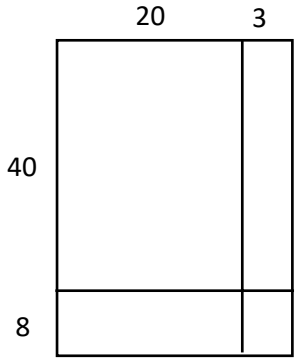
You may also recognize this as the distributive property, [Write 25(10 + 5) and point to it as you explain.] **because you just multiplied 25 by both the 10 and the 5.**

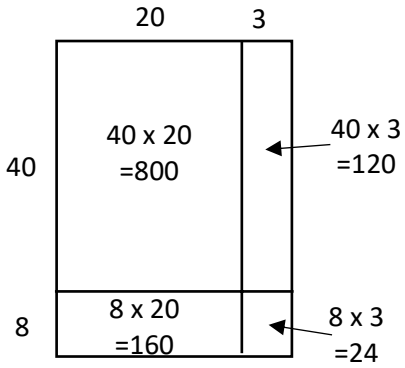
So what do we need to do to find 15 x 25? [pause] **Yes! Find the area of the whole rectangle by adding the partial products 250 + 125.** [Indicate these in the picture and write this out.] **So what's the answer?** [pause] **Exactly! 375! To add these partial products in this example, I added the hundreds** [Point as you say them.] **200 + 100 and got 300, and then added the rest 50 + 25 which is 75. Then I put those together and got 375!**

I bet you're wondering what this would look like if we broke apart the 25 by place value and kept the 15. Let's try that!

Let's say I am feeling pretty confident in my multiplication facts of 15. So I am going to break apart the 25. I know that there are 2 tens and 5 ones in 25, so it can be broken apart into 20 + 5. I'm going to put those across the top like we did earlier, and then put the 15 along the side. Again, we only have to find 2 partial products with this model.

 **What numbers do we multiply to find the area of the rectangle on the left?** [pause] **Yes! 15 x 20.** [Write in 15 x 20 n the rectangle on the left.] **Remember to use your strategies for multiplying by a multiple of 10!** [pause] **What did you get?** [pause] **Great! 300.** [Write = 300.] **What was your strategy?** [pause] **Nice! When I did this one, I started by multiplying 15 x 2 in my head and got 30 and then since I knew I was really multiplying by 2 tens, I knew the answer was 30 tens or 300.** **What numbers do we multiply to find the area of the rectangle on the right?** [pause] **Yes! 15 x 5.** [Write this in the rectangle on the right.] **Use your own strategy to find this product.** [Allow students time to think and multiply.] **What did you get?** [pause] **75? Great!** [Write = 75.] **What was your strategy this time?** [pause] **Very good! My strategy was to think of a clock. Since I know that there are four 15-minute sections in an hour, then 4 x 15 is 60, so if I add one more 15, I get 75.** **What are the partial products this time?** [pause] **300 + 75.** [Write these out.] **And what is 300 + 75?** [pause] **Yes! 375.** **Great work everyone!** Tying the learning together: **So, let's think about what we learned today about area models and multiplication!** **How do area models make multiplying bigger numbers easier?** [Pause – allow time for students to explain their thoughts.] **I agree! We can use these models to break apart the bigger numbers into smaller friendlier numbers using place value so they're easier to multiply and then all we have to do is add the partial products we found together. And we can even be flexible in which numbers we break apart. Remember, the goal here is to make multiplying easier!**	Tying the learning together: Students will think about how using area models makes multiplying bigger numbers easier by breaking them apart into friendly numbers and then adding the partial products.
<u>Guided Practice</u> (8 mins) **Let's try another problem.**	

[I do] **Let's model 48 x 23 using an area model. Do these steps with me on your own paper. Go ahead and draw a large rectangle so it's ready for our numbers.** [Draw a large rectangle.] **To start, we need to break apart both numbers and put them into the area model. I am going to break apart the 48 by place value. I see there are 4 tens and 8 ones, which gives me 40 + 8. I'll write those numbers along the left side of the rectangle allowing more room for the 40 to show that it's bigger than 8 in my model.** [Write the numbers and draw the line separating the sections – see example below.] **Then I'll break apart 23 into 2 tens and 3 ones or 20 + 3. I'll write those numbers across the top allowing more room for the 20.** [Write the number and draw the line separating the sections – see example below.] **Notice that my rectangle is longer than it is wide, because 48 is bigger than 23. Of course, these lengths are just estimates and not exact. They just help show the size of the numbers being multiplied.**  **Now I'll multiply the length and width of each smaller rectangle to find their areas. This will give me the partial products.** **Remember you can do these in any order, but I like to start on the top left rectangle. Remember to record your multiplication problem and your partial product in each rectangle.** [Write each of these in each rectangle – see completed example below.] **To find the area of the top left rectangle, I'll multiply 40 x 20. Using one of my strategies for multiplying by a multiple of ten, I know that 4 tens times 2 tens is 8 hundreds or 800.** [Write into model.]	Students work alongside the teacher as the teacher thinks aloud.

To find the area of the top right rectangle, I'll multiply 40 x 3. Using the same strategy for multiplying by a multiple of ten, I know that 4 tens times 3 is 12 tens or 120. [Write into model.] **To find the area of the bottom left rectangle, I'll multiply 8 x 20. Using the same strategy for multiplying by a multiple of ten, I know that 8 times 2 tens is 16 tens or 160.** [Write into model.] **To find the area of the bottom right rectangle, I'll multiply 8 x 3, which is a basic fact and is 24.** [Write into model.]  **So to find the product of 48 x 23, I will add the four partial products I found.** [Point to and say them as you write these to the side.] **800 + 120 + 160 + 24.** [Write out the following as you say it.] **To add these quickly, I'll start by adding 120 + 160 to get 280 and then add 800 + 280, which is 1080. Then I'll break apart the 24 into 20 + 4 in my head and add the 20 to the 1080 to get 1100 and finally add the 4. So my answer is 1,104.** **Thanks for following along with me on that example. Now let's try this one together.** [We do] **How can an area model help you multiply 12 x 16?** **For this one, I am feeling pretty confident about my multiplication facts of 12, so I am only going to break apart the 16 in my area model.** **Help me with this one. Go ahead and draw your rectangle on your paper.** [pause] **Now show me how you break apart 16 by place value?** [pause] **Okay, great! I see some of you writing 10 + 6, because there is 1 ten and 6 ones in 16. I like how some of you wrote that on the side of your rectangle and others across the top. Good job making the length for 10 a little bigger than for 6. I am going to put mine across the top**	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.

this time. If you wrote yours along the side, don't change it! You are good! **Now where does the 12 go if you wrote your 10 and 6 across the top like me?** [pause] **Yes! On the side. And if you wrote your 10 and 6 along the side, you should have your 12 at the top. Good job!** **Now go ahead and find your partial products and put them in your area model.** [Allow time for students to work.] 10 6 12 | 12 x 10 =120 | 12 x 6 =72 **Did you use your multiplying by a ten strategy when you multiplied 12 x 10?** [pause] **Great! Did you get 120?** [pause] **Good. What strategy did you use when you multiplied 12 x 6?** [pause] **Nice! I started by multiplying 12 x 5 because I know that's 60 and then I added another 12 and got 72.** **So how do we get the answer to 12 x 16?** [pause] **Yes! Just add the partial products 120 + 72. And what is that sum?** [pause] **192! Very nice!** [You do] **Now try this one on your own. You can choose to break apart one or both numbers in this problem. It's your choice! I'm going to give you a few minutes to work and then we'll go over the answer to see how you did. Okay, go ahead and draw a rectangle for your area model.** **Now find the product of 35 x 12.** [Allow time for students to work.] **How did you do? If you chose to break apart both of your numbers by place value, did you find your partial products to be 300 + 60 + 50 + 10 in any order?** [pause] **Great! If not, go back and check your multiplication.** **If you chose to break down the 35 by place value, but not the 12, did you find your partial products to be 360 + 60?** [pause] **Good job! If not, try your multiplication strategies again to see if you can find your mistake.**	Students are working almost exclusively independently with the teacher providing answers at the end.

So what is 35 x 12? [pause] **If you got 420, then you are absolutely correct. Give yourself a pat on the back for a job well done.** Additional Problems (if needed): **Try the following on your own using the area model strategy we've been working on. I will share the answer in a few minutes so you can check to see if you did it right.** **18 x 25** **30 x 27**	
Independent Practice (1 min) **Great work, everyone! Today, we practiced multiplying two 2-digit numbers using area models by breaking apart the numbers by place value. I hope you're seeing how using the area model 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 min) • **Boys and Girls, I enjoyed learning about multiplying two 2-digit numbers 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!**	