PBS Lesson Series

Math: Grade 4, Lesson 20, Division

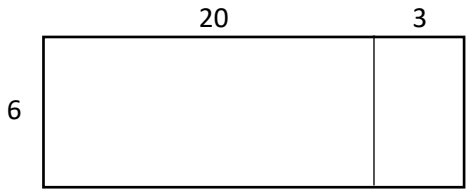
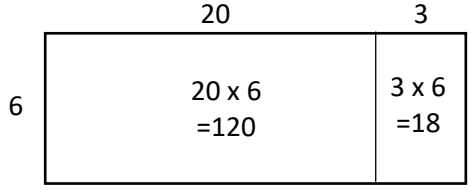
Lesson Focus: Division with Partial Quotients
Practice Focus: Students will focus on practicing division using the area model and partial quotients.
Objective: Students will use partial quotients to divide whole number quotients and remainders
Key Vocabulary: division, divisor, dividend, quotient, remainder
TN Standards: 4.NBT.B.6
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 twentieth 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 a division strategy called partial quotients! 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 20 which can be found at www.tn.gov/education.** **Ok, let's begin!**	Students get materials ready for the lesson.
Intro (3 mins) **If you participated in Lesson 13 with us, you saw how to use area models to multiply. Today we are going to learn how to divide using area models. So let's review that multiplication strategy now.** **Let's multiply 23 x 6 using an area model.**	This warm-up will support students' understanding of using area models to multiply, foreshadowing the work in the Teacher Model section.

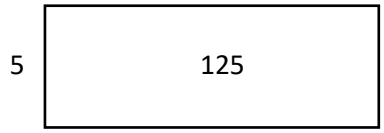
Start by drawing a rectangle. [Draw a rectangle.] **Remember that this method uses the concept of area of a rectangle. How do you find the area of a rectangle?** [Pause.] **You got it! Length times width. So we need to label the length and width with the factors.** [Label the 6.] **To make this easier on us, let's break apart the 23 by place value.** **How many tens are in 23?** [Pause.] **Yes, 2 tens, which is the same as 20.** **How many ones are in 23?** [Pause.] **Yes, 3 ones.** **Remember to make the section you label as 20 longer than the section you label as 3, so the rectangle makes sense. After all, 20 is much bigger than 3.**  **Now to find the product of 23 x 6, we just need to find the area of this rectangle. So what do we multiply to get the area of the part of the rectangle on the left?** [Pause.] **Yes, 20 x 6.** [Write 20 x 6 inside the rectangle on the left.] **Is it okay if we say 6 x 20?** [Pause.] **Yes! Remember that multiplication is commutative, so either way works. What is 20 x 6?** [Pause.] **Good! 2 x 6 is 12, so 2 tens x 6 is 12 tens or 120.** [Write 120 in the rectangle on the left.] **And what do we multiply to find the area of the rectangle on the right?** [Pause.] **You got it. 3 x 6 or 6 x 3.** [Write 3 x 6 inside the rectangle on the right.] **And what is that product?** [Pause.] **Yes, 18.** [Write 18 in the rectangle on the right.]  **So what is the area of the whole rectangle?** [Pause.] **Good! All we have to do is add these two pieces together. And what is 120 + 18?** [Write out 120 + 18, pause.] **Yes! 138!** [Write 138.] **And therefore, 23 x 6 = 138, which is the area of the big rectangle!** **Great job, everyone!**	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 and responding to teacher questioning.

Teacher Model (12 mins) **Now that we have reviewed how to multiply numbers using an area model, let's explore how we can use the area model to divide numbers.** Objective #1: Recognize that the area model can be used as a strategy for both multiplication and division due to the relationship between these operations. **Think about how multiplication and division are related. In the problem we just did, we found that 23 x 6 = 138. How would I write that as a division problem?** [Pause.] **Good! I could write it as 138 ÷ 23 = 6 or 138 ÷ 6 = 23.** **And where in the area model did the 138 appear?** [Pause.] **Yes! 138 is the total amount of inside the rectangle. It represents the area of the whole rectangle. And where did the 23 and 6 appear?** [Pause.] **Yes, as the dimensions or the length and width of the rectangle.** **In the multiplication problem 138 was the product which gave us the area and the 23 and 6 were the factors. So if we think about this in the division problem, the 138 is the dividend. So the dividend also represents the area of the rectangle. And what about the dimensions?** [Pause.] **Very good! One is the divisor, or what we're dividing by, and the other is the quotient, or the answer to our division problem.** **So let's see how the area model can help us divide.** Objective #2: Use area models as a strategy to divide large numbers. **Let's consider this problem.** **At camp, there are 5 players on each lacrosse team. If there are 125 people on lacrosse teams, how many teams are there?** **What do we know?** [Pause.] **Yes, we know there are 125 people playing lacrosse and 5 players on each team. What are we asked to find?** [Pause.] **Yes, we are finding the number of teams.** **What operation will we need to use to find the number of lacrosse teams?** [Pause.] **Good. Division. We have to figure out how many teams of 5 players we can make out of 125**	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 will see how the area model can be used as a strategy for both multiplication and division due to the relationship between these operations. The use of the area model for division will be strengthened in objective 2. Objective #2: Through following along with the think aloud, students will divide using an area model.

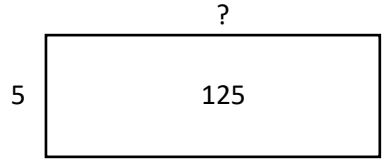
people. So that means we need to divide 125 ÷ 5. [Write 125 ÷ 5.]

Just like with multiplication, to use an area model to divide, we will need to start by drawing a large rectangle. [Draw a large rectangle.] **Now where do we need to put each number? Hmm. Well, we need to think about the relationship between multiplication and division.**

[Point to the expression already written 125 ÷ 5.] **What is the dividend?** [Pause.] **Good! 125! Which is the number of total people playing lacrosse. So where do we write 125 in the area model?** [Pause.] **Very good! It goes inside the rectangle, because it represents the total area of the rectangle.** [Write 125 inside the rectangle.] **And where do we write 5?** [Pause.] **Exactly! 5 is the divisor, so it goes along one of the dimensions, either length or width.** [Write 5 along the side of the rectangle.]

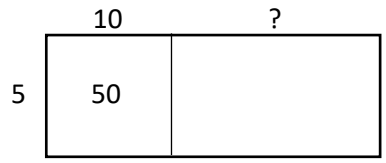


What are we missing in this rectangle? What are we trying to find? [Pause.] **Good! We are trying to find the other dimension. Let's put a question mark there to remind us that's what we are trying to find.** [Draw a question mark at the top.]

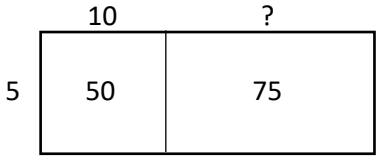


Remember how we broke apart the top number in the model for the multiplication problem to make multiplying easier? We can do that here, too!

So how do we know where to start? Just like in the multiplication problem, we know that we have to multiply 5 [Point to the 5.] **by some number** [Point to the?.] **to get 125. So let's start with something we can easily multiply. It's always easiest to start with friendly numbers. So how about 10? What is 5 x 10?** [Pause.] **50, good. Is 50 less than 125?** [Pause.] **Yes, so I am going to redraw my rectangle the same size as the first one so I can break up the area.** [Draw the figure below.]

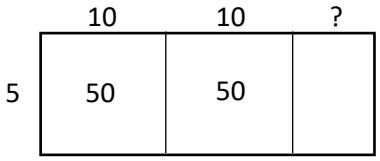


Now remember that the area inside the rectangle has not changed, so this total area [Indicate the area inside the whole rectangle.] **will always be 125. Since we just divided it so that this** [Indicate the rectangle on the left.] **part is 50, what value do we write here?** [Indicate the rectangle on the right.] [Pause.] **Good! I'm hearing we need to write what's left over. So we need to subtract 125 – 50. What is 125 – 50?** [Pause.] **Yes, 75.** [Write 75 in the rectangle on the right.]

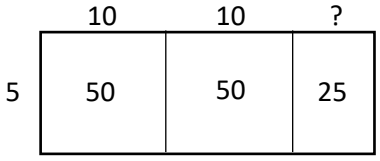


How can we check that the area has not changed? [Pause.] **Of course! We can just add 50 + 75. Does that equal 125?** [Pause.] **Yes it does. So we're good. Now, we still don't know the whole length of this side, which remember is the quotient. So let's keep going.**

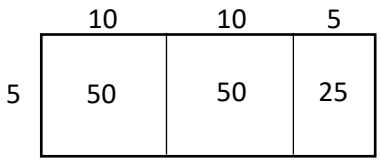
We need to break apart the 75. Can we multiply 5 x 10 again without going over 75? [Pause.] **Yes! So let's draw another rectangle that shows that.** [Draw and label.]



And what goes in the rectangle on the right so that the area of the whole rectangle is still 125? [Pause.] **Yes! 75 – 50 = 25.** [Write 25 in the rectangle on the right.]



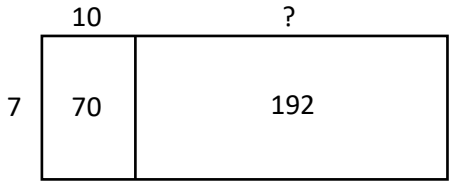
So what number can I put where the question mark is to make this true? 5 times what equals 25? [Pause.] **Yes, 5!** [Replace the ? with 5.]

 **Let's check again that the area has not changed. Add 50 + 50 + 25 in your head. Does that equal 125?** [Pause.] **Yes it does. So we're good.** **So what does this tell us? Where is our answer or in this case, the quotient?** [Pause.] **You got it! It's across the top. We refer to these numbers as partial quotients, because each of these numbers is part of the whole quotient. So to get our quotient, all we have to do is add these numbers.** [Indicate the numbers across the top of the rectangle.] **What is 10 + 10 + 5?** [Pause.] **Yes! 25. Therefore 125 ÷ 5 = 25.** **Let's check our answer using multiplication. Look at the completed area model. If we multiply the length of 5 times the width of 25, what do we get?** [Pause.] **125, very good! We did it right!** **Great job!**	
Objective #3: Use partial quotients as a strategy to divide large numbers. **If we think about what we did to find each partial quotient, we can actually work this out without drawing the picture. Let's do the same problem that way so you can see what that looks like.** **This time we're going to set the problem 125 ÷ 5 up like this.** [Write it this way.] $5\overline{)125}$ **This is another way to show a division problem. Notice that the dividend is underneath the bracket and the divisor is on the outside.** [Pause.] **I agree, this set up is similar to the area model.** **From here, we go through the same thought process as we did when we were using the area model.** **What friendly number can we multiply 5 by and get a product less than 125? Remember that the goal here is to make it easy, so pick a number that's easy to multiply by.** [Pause.] **Yes, like 10. So just like with the area model, we will put a 10**	Objective #3: Through following along with the think aloud, students will divide using partial quotients by connecting this method to the area model.

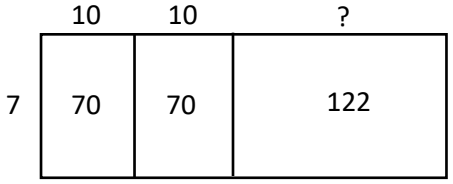
on top. That's our first partial quotient. [Write 10 on top of the bracket.] **What is 5 x 10?** [Pause.] **50, good. Is 50 less than 125?** [Pause.] **Yes, so we need to see how much is left over. In order to do that, we need to subtract 125 – 50, like this.** [Fill it in like this.] 10 5 ⟌125 - 50 **What is 125 – 50?** [Pause.] **Yes, 75.** [Write 75 below the last line.] 10 5 ⟌125 - 50 75 **Since we still have 75 in the dividend and 75 is bigger than 5, the divisor, we keep going. Can we multiply 5 x 10 again without going over 75?** [Pause.] **Yes! 5 x 10 is 50 and 50 is less than 75. Let's do that. Write another 10 on top. That's our second partial quotient. Now since 5 x 10 is 50, we will subtract 50 again. 75 – 50 is what?** [Pause.] **Yes, 25.** [Fill in as you talk through it.] 10 10 5 ⟌125 - 50 75 - 50 25 **Now we still have 25 in the dividend. So what is 25 ÷ 5?** [Pause.] **Yes, 5. So put the 5 on top and subtract the 25 at the bottom to make sure you got it all. If you have, you will end up with 0, and that means 5 is the last partial quotient.** 5 10 10 5 ⟌125 - 50 75 - 50 25 - 25 0	

So what is our answer? [Pause.] **Good for you! Yes, just like with the area model, we add all the partial quotients on top. What is 5 + 10 + 10?** [Draw a bracket next to these and pause.] **Yes! 25.** 5 10 } 25 10 5 | 125 - 50 75 - 50 25 - 25 0 **Therefore, 125 ÷ 5 = 25.** Tying the learning together: **Using the partial quotient strategy either with or without the area model picture is a great way to help you break down the dividend into smaller friendlier numbers which in turn makes it easier to divide larger numbers.** **Thank you for thinking through these strategies with me today. Now you will get to practice these strategies. So get your paper and pencil ready!**	Tying the learning together: Students will review the strategies used in this lesson and consider how they are related.
Guided Practice (12 mins) **Work through this next problem with me as I think aloud.** [I do] **I'm going to divide 262 ÷ 7 using an area model.** **First, I'll draw a large rectangle. You draw one with me. Now put the dividend, 262, inside to represent the area of the rectangle, and the divisor, 7, outside to represent the length of the rectangle, I'll label the width with a question mark because that's what I am trying to find.** [Draw.] ?	Students work alongside the teacher as the teacher thinks aloud.
7 | 262	

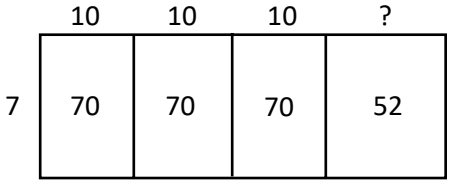
Now I'm going to choose a friendly number to multiply 7 by to get a product less than my dividend, 262. I think I'll try 10 first. [Draw another rectangle the same size as the first one. Include the 7, but put a 10 at the top and draw a line separating the 10 from the rest and the ? over the rest. See example below.] **Let's draw another rectangle the same size as the first one. Draw one with me. I know that 7 x 10 is 70, so I'll write that in the first rectangle. I also know that the area is still 262, so I am going to subtract 262 – 70 to see what's left of my dividend. 262 – 70 = 192 so I'll write 192 in the other rectangle.**



192 is more than 70, so I am going to do that again. Draw another rectangle, write another 10 at the top, draw another line to separate the partial quotients, and subtract to see what's left. 192 – 70 = 122. [Draw another rectangle the same size as the first one. As you talk through it, draw.]



122 is still more than 70, so I am going to do that again. Draw another rectangle, write another 10 at the top, draw another line to separate the partial quotients, and subtract to see what's left. 122 – 70 = 52. [Draw another rectangle the same size as the first one. As you talk through it, draw.]



Now I have 52 left of my dividend. 52 is less than 70, so I can't use 10 again. However, 52 is more than 7, so I can use my multiples to find 52 ÷ 7. [List the multiples as you say them.]

7 x 1 is 7
7 x 2 is 14
7 x 3 is 21
7 x 4 is 28
7 x 5 is 35

7 x 6 is 42 **7 x 7 is 49** **7 x 8 is 56. Oh, wait. 56 is too much and 52 is not in my list. Hmm. That means there will be a remainder.** **Okay, let's go back to 49. Since 7 x 7 is 49, then 49 ÷ 7 is 7. So let's draw another rectangle, put a 7 at the top, and separate this last rectangle into two parts. 49 goes in the first part and I can subtract to find what goes in the last part. 52 – 49 = 3** [Draw another rectangle the same size as the first one. As you talk through it, draw.] 10 10 10 7 R 7 | 70 | 70 | 70 | 49 | 3 **I see that 3 is not bigger than 7, so that is the remainder. Let's label it with an R.** [Label it with an R.] **So to get my answer, the quotient to 262 ÷ 7, I am going to add together the partial quotients I found at the top of the rectangle. 10 + 10 + 10 + 7 which is 37 with a remainder of 3.** [Put + between each partial quotient and write = 37 R3. See below.] 10 + 10 + 10 + 7 R = 37 R3 7 | 70 | 70 | 70 | 49 | 3 **Thank you for thinking through that problem with me. Now you can see what the area model for division looks like when you have a remainder!** [We do] **Now let's try one together using the partial quotient method without the picture.** **Let's divide 529 ÷ 4.** [Write it like this.] $4\overline{)529}$ **Let's start by picking a friendly number. What should we pick?** [Pause.] **I hear several of you saying 10. Yes, we can start with 10. But 529 is a really big number, is there another bigger friendly number we can try?** [Pause.] **100? Is 100 a friendly number?** [Pause.] **Yes! Because 4 x 100 is 400! Very good!** [Write 100 at the top of the bracket.] **Now we need to subtract 400 from the dividend to see what's left.** [Write -400	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.

underneath 529.] **What is 529 – 400?** [Pause.] **Good job using your strategy for subtracting multiples of a hundred! 529 – 400 is 129. Let's record that.** [Write.]

```
  100
4| 529
 - 400
   129
```

Now, since we still have 129 left in the dividend, which is way more than 4, the divisor, we need to keep going.

Can we divide by 100 again? [Pause.] **No? Why not?** [Pause.] **Oh, because we can't take out another 400 from 129. Good! So what's another friendly number we can use?** [Pause.] **Yes, 10! So where does that go?** [Pause.] **At the top, yes. And what comes next?** [Pause.] **Good! We need to multiply 4 x 10 and subtract it. Go ahead and do that.** [Allow time for students to think through and do this.] **Does yours look like mine? What did you get when you subtracted?** [Pause.] **89? Yes! What comes next?** [Pause.] **We can divide by 10 again? Yes! Go ahead and divide by ten as many times as you can until the dividend is less than 40.** [Pause. While students are working, go ahead and divide by 10 twice more.]

```
   10
   10
   10
  100
4| 529
 - 400
   129
 - 40
    89
 - 40
    49
 - 40
     9
```

Did you find that you could divide by 10 two more times? [Pause.] **Did you get the dividend all the way down to 9 like me?** [Pause.] **Great! If you didn't, make sure you divided by 10 a total of 3 times, which means you would subtract the dividend by 40 a total of 3 times. That gives you 9 left.**

So are we finished? Is 9 the remainder? [Pause.] **No? Why not?** [Pause.] **Oh, of course! 9 is still more than the divisor, 4! So we have to keep going. Can we divide by 10 again?** [Pause.] **No? Why not?** [Pause.] **Oh yes! 9 is less than 40, so we can't subtract 40 again. Okay, so what now?** [Pause.]

You got it! Using our multiples of 4, we can see that 4 x 2 is 8. So let's divide by 2.

```
   2
  10
  10
  10
 100
4 ⟌529
 - 400
   129
 - 40
    89
 - 40
    49
 - 40
     9
 - 8
     1
```

Very good! But we still have a 1 left in the dividend! What does that mean? [Pause.] **Yes! Since 1 is less than the divisor, 4, it's the remainder. So what's the answer to 529 ÷ 4?** [Pause.] **Yes, we have to add all these partial quotients together.** [Draw a bracket next to the partial quotients.] **Go ahead and do that in your head.** [Pause.] **What did you get?** [Pause.] **132 with a remainder of 1. Excellent job!**

```
   2
  10
  10   132 R1
  10
 100
4 ⟌529
 - 400
   129
 - 40
    89
 - 40
    49
 - 40
     9
 - 8
     1
```

[You do] **Now it's your turn. Divide 177 ÷ 8 using either the area model method or the partial quotient method without the area model picture.** [Allow time for students to think and work through this problem.] **How did you do?** [Pause.] **Did you find that 177 ÷ 8 = 22 R1? You may have tried different friendly numbers than I did, but I found partial quotients of 10, 10, and then 2 and found there was a remainder of 1.** **Great job, students!** Additional Problems (if needed): 738 ÷ 6 [answer 123] 218 ÷ 3 [answer 72 R2]	Students are working almost exclusively independently with the teacher providing answers at the end.
Independent Practice (1 min) **Great work, everyone! Today, we practiced division using partial quotients. I hope you're seeing that breaking down the dividend by trying friendly numbers as partial quotients makes dividing large numbers easier! You sure did a great job! After the video, you will have some problems to practice on your own. 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 division 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!**	