PBS Lesson Series

Math: Grade 6, Lesson 16, Area of Parallelograms

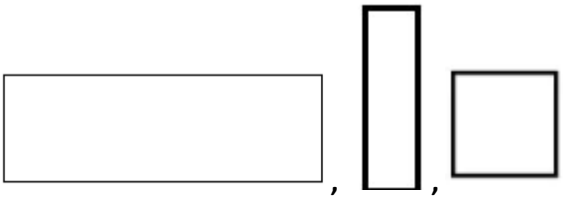
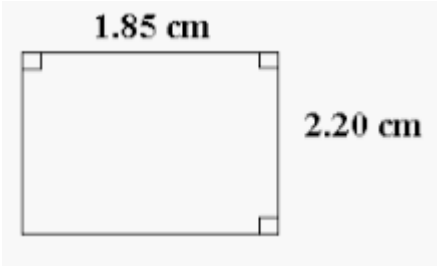
Lesson Focus: Find the area of parallelograms
Practice Focus: Students will focus on practicing using the formula, A = b x h, to find the area of a parallelogram.
Objective: Students will use the formula, A=b x h, to find the area of parallelograms.
Key Vocabulary: area, parallelogram, base, height, compose, decompose, quadrilateral, rectangle
TN Standards: 6.G.A.1
Teacher Materials:

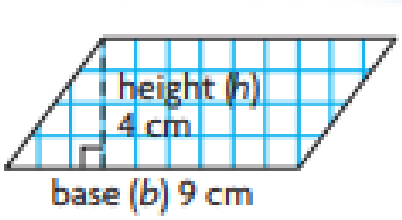
- White board and markers or smart board
- Projector, if possible, for geometric shapes
- Student Practice Packet

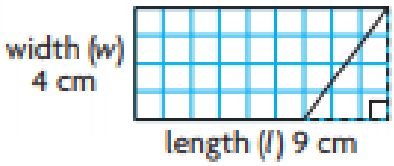
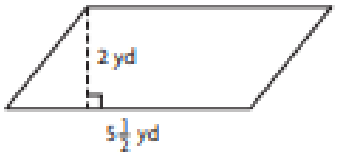
Student Materials:

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

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 6th graders out there, though all children are welcome to tune in. This lesson is the sixteenth 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 the area of parallelograms 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** • **Calculator is optional (you can even use one on a phone)** **Ok, let's begin!**	Students get materials ready for the lesson.
Intro (4 min) [This introduction will connect to the previous knowledge of working with rectangles. It will also connect to 6.NS.B.3, multiplying decimals.]	Students will begin by using previous knowledge to find the area of a rectangle. This will allow the teacher to use this connection in the lesson.

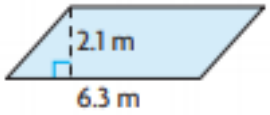
Draw a rectangle on your paper. Don't worry! It may not be perfect! [Pause. Allow students time to draw a rectangle. It can be any size or orientation.] **Sample answers:**  **What do you remember about the parts of the rectangle?** [Pause] **Yes! You do remember! Some of you mentioned that opposite sides are parallel. Others of you said that it has 4 right angles. Oh! I also heard someone say that opposite sides are equal. All of these pieces of information are correct and allow us to work fully with rectangles.** **Given the rectangle below, use what you remember to find the area. You can use a calculator, if you need one.** **We will discuss and see how you did!** [Pause]  **I see that several of you remembered that A = length x width for the area of a rectangle. You have used that for a few years and I know it is familiar. Let's check your calculations in finding the area of the given rectangle:** **Area = length x width** **Area = 1.85 cm x 2.20 cm** **Since 1.85 x 2.20 = 4.07, we see that A = 4.07 square centimeters or 4.07 cm^2 (don't forget the units)** **How did you do?** [Pause] **Great! The area of a figure is the measure of the number of unit squares needed to cover it without any gaps or overlaps. We are going to build on that knowledge to move into a special quadrilateral today.**	
<u>Teacher Model</u> (12 minutes) Objective 1: Find the area of a parallelogram by composing into rectangles **We are going to work together today to determine how we can use the method for finding the area of a rectangle to find the area of a parallelogram.**	Objective #1: In this objective, students will be working alongside the teacher to determine the relationship between the formula for the area of a

Let's get started. [Write the problem on the board and display the picture of the quilt square. This is the first exposure to this formula and the first official work with the parallelogram.]  [Read the problem for the students.] **Victoria is making a quilt. She is using material in the shape of parallelograms to form the pattern. The base of each parallelogram measures 9 cm and the height measures 4 cm. What is the area of each parallelogram?** [Pause] **We need to first determine what shape we are working with on the quilt. We will use grid paper to help us visualize the pattern.** **The shape used for the quilt is**  **What shape is this?** [Pause] **That's right! The quilt design is using a parallelogram. What are similarities and differences that you see between a parallelogram and a rectangle?** [Pause] **Great noticings!** **They do both have 4 sides, which means they are both quadrilaterals.** **Yes, they both have a base.** **Someone mentioned that the opposite sides are parallel.** **I heard someone else say that they are different due to the fact that the parallelogram does not have 4 right angles like a rectangle does.** **All of these are correct. By definition, a parallelogram is a quadrilateral, it has 4 sides, with 2 pairs of parallel sides.** **Let's see how we can use what we know to find the area.** **Is it possible to compose a rectangle by rearranging the pieces of the decomposed parallelogram? Remember, to**	rectangle and the area of a parallelogram. They will work to understand how to decompose a parallelogram and compose it into a rectangle.

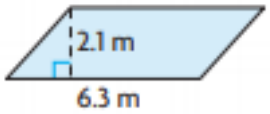
compose is putting figures together, while decomposing is breaking figures down into smaller parts. **If we cut along the dashed line of our given figure to remove a triangle and move the triangle to the right side of the figure, what do we form?** [Pause]  **We see that the parallelogram can be cut along the height (By definition, the height is the length of a segment that forms a 90° angle with the base and extends to the opposite side) and put back together to form the rectangle. We can restate this as the parallelogram can be decomposed and moved around to compose into a rectangle.** **What is the area of the rectangle?** [Pause] **36 square cm.** **Do these two figures contain the same number of unit squares?** [Pause] **Yes! We can see that the base of the original parallelogram is now the length of the rectangle, 9 cm.** **We can also see that the height of the parallelogram is now the width of the rectangle, 4 cm.** **This allows us to see and know that the area of the parallelogram is equal to the area of the rectangle. What is the area of the parallelogram?** [Pause] **It is 9 cm (which is the base) x 4 cm (which is the height) = 36 square cm.** **Let's try another one!** **Compose the given parallelogram into a rectangle to find the area.**  **What is the problem asking us to do?** [Pause] **We are asked to take the given parallelogram and compose it into a rectangle to find the area.** **What did we just see that we could do in the first example?** [Pause]	

We saw that the parallelogram can be cut along the height and put back together to form the rectangle. Let's try it with this one. [Pause]  **That's it! Now, how can we find the area?** [Pause]. **The area of the rectangle is the product of the length and width, so,** **A = 2 x $5\frac{1}{2}$** **Remember, one way to multiply a mixed number is to use the distributive property. This allows us to operate with numbers in an easier way.** **A = 2 x $5\frac{1}{2}$= 2 (5 + $\frac{1}{2}$) = 2 x 5 + 2 x $\frac{1}{2}$ = 10 + 1 = 11.** **So, the area of the parallelogram composed into a rectangle is 11 sq. yds.** **Another way to multiply by 5 ½ is to change the mixed number to an improper fraction. What is 5 ½ as an improper fraction?** [Pause] **We can change 5 ½ to an improper fraction, 11/2.** **A = 2 x $\frac{11}{2}$ = $\frac{2}{1}$ x $\frac{11}{2}$ = 11** **Using what we learned in the first example, we also saw that we can multiply the base of the parallelogram by the height of the parallelogram. Remember, we said the height is the length of a segment that forms a 90° angle with the base and extends to the opposite side.** **If we multiply base x height, what do we get?** [Pause] **Yes! The base= $5\frac{1}{2}$ yards and the height = 2 yards, so,** **Area= $5\frac{1}{2}$ x 2 = $\frac{11}{2}$ x 2 = 11.** **The area of the parallelogram is 11 sq. yds.** **We will use this information to continue working with this special quadrilateral, the parallelogram.** Objective 2: Use the formula to find the area of a parallelogram **What did we just determine the formula for the area of the parallelogram is?** [Pause] **Yes. It is A = bh, where b is the base of the parallelogram and h is the height of the parallelogram.**	Objective #2: Students will be building off of their work with the area of a rectangle to use the formula for the area of a parallelogram.

Let's try a few!
Problem 1: [Draw the given figure on the board and label the sides]
Find the area of



What is the given figure? [Pause]. **It is a parallelogram.**



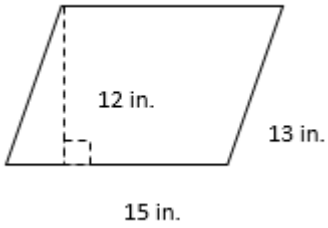
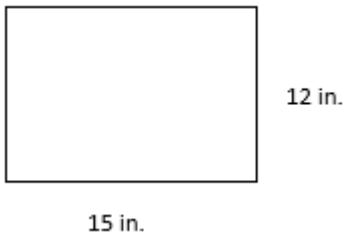
From our previous problems, we know that this also can be used to compose a rectangle:

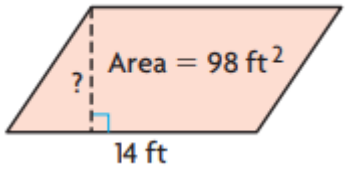
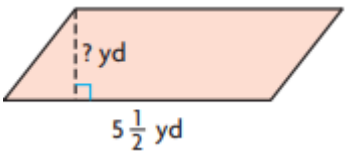
What is the area of the rectangle? [Pause]
Yes.
A = 2.1 x 6.3 = 13.23 square meters

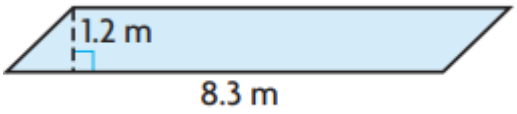
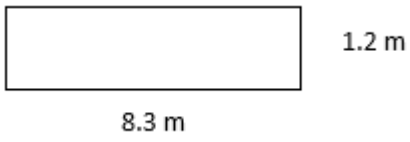
Let's move into using the formula we discovered for the area of the parallelogram.

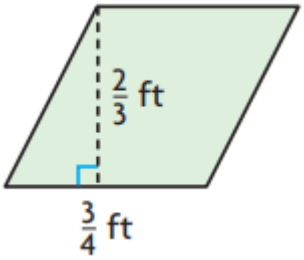
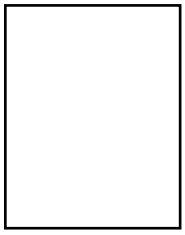
What is the formula for the area of a parallelogram? [Pause]
A = bh
In the given figure, what is the base? [Pause]
Yes! It is 6.3 m. Don't forget the keep track of the units.
In the given figure, what is the height? [Pause]
Yes! It is 2.1 m.
Replace b and h with their values to find the area. [Pause]
A = 6.3 x 2.1
What is the product of 6.3 and 2.1? [Pause]
You got it! So, the area of the parallelogram is 13.23 square meters.

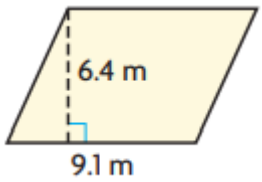
Let's try another one!
Example; **Find the area of the given parallelogram.** [Draw the figure and label it on the board.]

 **Using what we've learned, find the area of the parallelogram in two different ways. How have we've found the area in previous problems?** [Pause] **ONE WAY: We've composed the figure into a rectangle and we've used the area formula. Take a moment to compose the given figure into a rectangle.** **What is the base?** [Pause]**. The base is 15 in.** **What is the height?** [Pause] **Hmm….We have two numbers to choose from. How can we identify the height of the given parallelogram?** [Pause] **Remember, the height of a parallelogram forms a right angle with its base. Which of the given values forms a right angle with the base?** [Pause] **Yep! The height is 12 in. We do not need the side length of 13 inches to find the area. When might we need that side length?** [Pause]. **I agree. When we are finding the perimeter of a figure, we need the side lengths.**	Students respond.
Find the area of the rectangle. [Pause]  **The area of the rectangle is** **A = 15 x 12 = 180.** **So, the area is equal to 180 in^2** **ANOTHER WAY: Use the formula for the area of a parallelogram.** [Pause] **Since b= 15 inches and h=12 inches, we can find the area by multiplying.** **A = bh,** **A = 15 x 12 = 180 in^2.**	Students respond.

Using two different ways, we confirmed that the area of the given parallelogram is 180 square inches. Objective 3: Use the area formula to find the base or height of a parallelogram **You've done great working with parallelograms today! I want to show you one other way we can use the area formula to help us solve for parts of a parallelogram.** Example: **A parallelogram has an area of 98 square feet and a base of 14 feet. What is the height of the parallelogram**? [Write problem on the board and read to students.] **What are we given?** [Pause] **We are given the area and the base. The area is 98 ft^2 and the base is 14 ft.** **What is the problem asking for?** [Pause] **It is asking for the height of the parallelogram.** **Let's draw a figure with the given information.** [Pause and sketch the figure.]	Objective 3: Students will be applying the area formula to find the base or height of a parallelogram. Students respond.
 **If you know the area and height of a parallelogram, how can you calculate the base?** [Pause] **Our formula is A=bh. If we replace A and b with their given values, we have:** **98 = 14 x h** **Solve for h.** [Pause] **Using the division property of equality, $\frac{98}{14} = \frac{14h}{14}$** **Solve for h to get 7 = h.** **So, the height of the parallelogram is 7 feet.** Example: **Find the unknown measurement for the parallelogram.** [Draw the given figure on the board for students.] **Area = 11 yd^2** 	Students draw the figure.

Take a moment to determine what information you are given and what we need to find [Pause] **What are we given?** [Pause]. **We are given the area of the parallelogram is 11 yd^2 and the base is 5 ½ yd.** **What is the unknown?** [Pause] **The height** **How can we find the height?** [Pause] **We can use the relationship between area, base and height to find the height**. **Our formula is A=bh. If we replace A and b with their given values, we have:** **11 = $5\frac{1}{2}$ x h** **Solve the given equation for h.** [Pause] **If we divide both sides by $5\frac{1}{2}$ we have 11 ÷ $5\frac{1}{2}$.** [Work this division out on the board for the students.] **$\frac{11}{1} \div \frac{11}{2} = \frac{11}{1}$ x $\frac{2}{11}$ = 2.** **The height of the given parallelogram is 2 yd.** Tying the learning together: **As we pull our learning for the day together, we see a common thread of understanding. We see that we can find the area of a parallelogram by using the relationship between a rectangle and a parallelogram.**	Students respond. Tying the learning together: Students will listen to the teacher do a think aloud centered on the relationship between finding the area of a rectangle and finding the area of the special quadrilateral, parallelogram.
Guided Practice (8 minutes) **To make sure that you understand how to find the area of a parallelogram, let's do a few together.** **Problem 1: Find the area.** [Draw the figure and label it on the board.]  **Take a moment to re-draw the figure so that it is composed into a rectangle.** [Pause]  	Students will be working on the problems independently. The first problem will gradually release the ownership to the student. After the student works the problems, discuss the answers. Students draw the parallelogram. Students compose the rectangle.

Great! Find the area of the rectangle. [Pause] **A = 9.96 m²** **Good job!** **Use the formula for the area of a parallelogram to confirm.** [Pause] **A = bh** **A = 8.3 x 1.2** **A = 9.96 m²** **Let's work another problem. I'm going to let you work this one, then we'll go over it.** **Find the area by taking the given figure and composing into a rectangle**	Students solve the problem.
	Students solve the problem.
What did you get when you solved the problem? [Pause] **Let's check your work. When we compose the shape into a rectangle, we get this rectangle.** [Draw the rectangle on the board.]	Students respond.
	
Now, let's use the formula for a rectangle which is A=bh. What did you use for the base? [Pause} **Right, $\frac{3}{4}$. What did you use for the height?** [Pause] **Exactly, $\frac{2}{3}$. Let's work this out together.** $\boldsymbol{A = \frac{3}{4}\ x\ \frac{2}{3}}$	

A = $\frac{1}{2}$ ft² **Additional problems (if needed):** **1.) Find the area by first composing into a rectangle and then using the area formula:**  **Answer: 58.24 sq meters** **2.) Find the unknown measure of a parallelogram if the A = $51\frac{1}{4}$ in² and the b = $8\frac{1}{5}$ in.** **Answer: height = $6\frac{1}{4}$ inches**	
Independent Practice (1 min) **Great work! Today, we reviewed finding the area of a parallelogram. I hope you're seeing some connections to area of a rectangle! 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) **I enjoyed reviewing the area of the parallelogram 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!**	