PBS Lesson Series

Math: Grade 6, Lesson 18, Area of Trapezoids

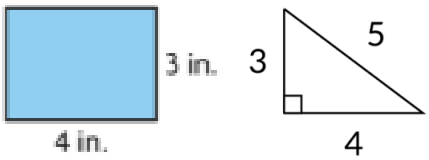
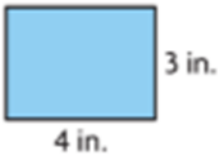
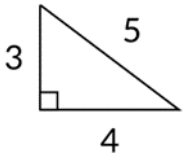
Lesson Focus: Finding the Area of Trapezoids
Practice Focus: Students will focus on practicing identifying key features of a trapezoid in order to find the area.
Objective: Students will use the relationship to triangles and rectangles to find the area of trapezoids.
Key Vocabulary: area, trapezoid**,** triangle, base, height, rectangle
TN Standards: 6.G.A.1
Teacher Materials:

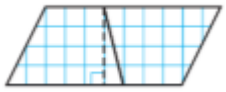
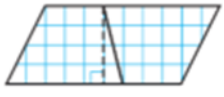
- White board and markers or projector
- Student Practice Packet

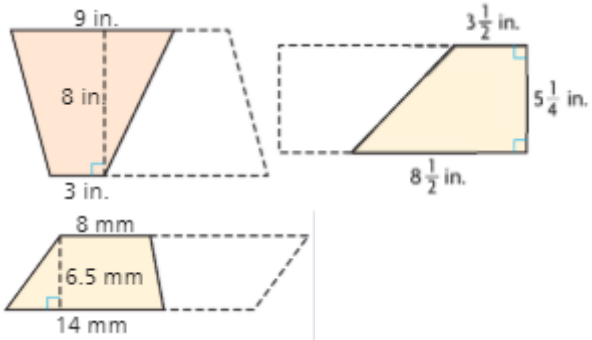
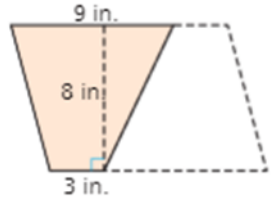
Student Materials:

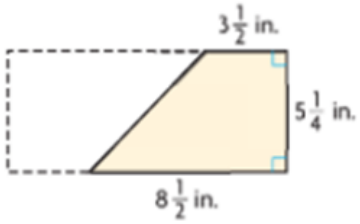
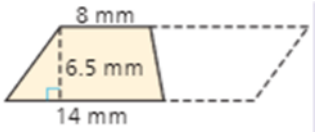
- Paper and a pencil, and a surface to write on
- Calculator, optional

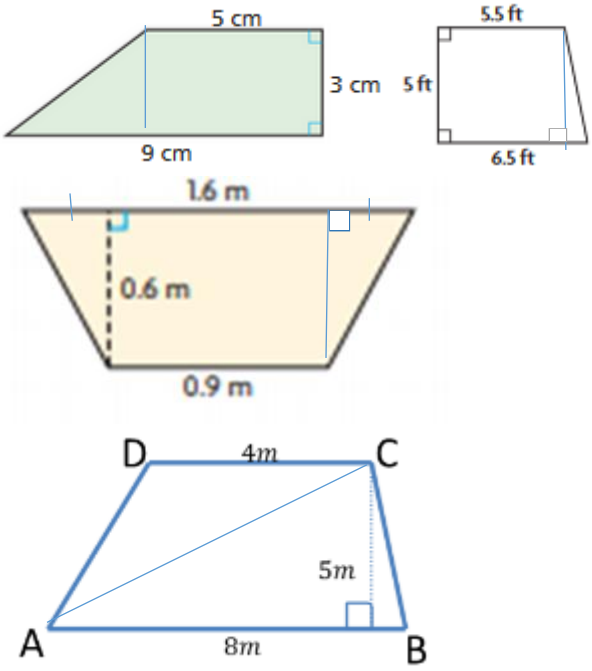
Teacher Do	Student Do
Opening (1 min) **Hello! Welcome to Tennessee's At Home Learning Series for math! Today's lesson is for all our 6th graders out there, though all children are welcome to tune in. This lesson is the eighteenth in our series.** **My name is ____ and I'm a ____ grade teacher in Tennessee 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 finding the area of trapezoids 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, optional (you can even use one on a phone)** **Ok, let's begin!**	Students get materials ready for the lesson.
Intro (4 min) **I can't wait to spend time with you today as we continue working on area of special quadrilaterals. Let's start out getting our brains warmed up!**	Students will do the introduction on their own. This activity will allow students to connect today's learning to finding the area of triangles and rectangles. This will be used today to find the area of trapezoids.

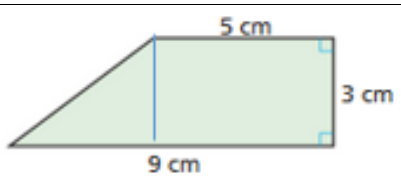
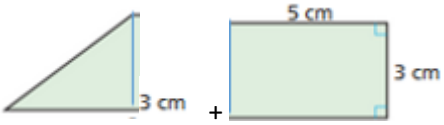
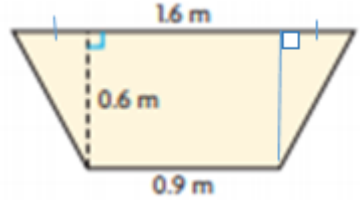
[Write the given problems on the board. We will start with building a connection to 6.EE.A.2c centered on the area of a triangle and a rectangle/parallelogram.] **To get us started, look at the 2 given figures. What geometric shapes are we given?** [Pause] **Yes! We have a rectangle and triangle.** **Find the area of each shape?** [Pause to allow students to work.]  **Let's see how you did.** **The area of the rectangle is:**  **A=length x width = 3 x 4 = 12 in^2** **The area of the triangle is**  **A = $\frac{1}{2}$ bh = $\frac{1}{2}$ x 4 x 3 = 6 in^2** **You all did great!** **What operation would you use to find the total area of all three shapes?** [Pause] **Yes. It's addition.** **Find the total area of the two shapes**. [Pause] **You are right! It is 12 in^2 + 6 in^2 = 18 in^2** **Today, we are going to look at situations where we are asked to find the area of figures with triangles and rectangles together. Let's dive in!**	
<u>Teacher Model</u> (14 min) [The focus of this lesson is to connect the trapezoid to triangles, rectangles and parallelograms. Students will not use the formula for the area of the trapezoid.] Objective 1: Connecting Trapezoids to Parallelograms and Rectangles	Objective #1: Students will be using what they know about the areas of rectangles,

Today we are going to determine how we can find the area of trapezoids. Before we can work with trapezoids, we need to make sure we know what a trapezoid is. Who remembers working with trapezoids? [Pause]. **Draw a trapezoid on your paper and we will compare.** [Pause] **Sample responses:**  **What do you notice about the trapezoid?** [Pause] **A trapezoid is a quadrilateral, which tells us it has how many sides?** [Pause] **It does have 4 sides. A trapezoid also has one pair of parallel sides called the bases.** **Yes! It looks like a combination of triangles and rectangles! Remember, we can describe this as composed of triangles and rectangles.** **You first worked with trapezoids in 1st grade! That seems like forever ago! At that time, you worked with shapes, such as a trapezoid, to create a composite shape to make new shapes. We're going to do something similar today to determine how to find the area of a trapezoid.** **To do this, let's start with a parallelogram.** [First draw the parallelogram without the division into two trapezoids.]  **What did we determine in an earlier lesson that we can use to find the area of a parallelogram?** [Pause] **Yes! We said that the area of a parallelogram is found the same way that we find the area of a rectangle. We can find the product of the base and the height. So,** **A = bh. Remember, the height is the length of a segment that forms a 90° angle, or is perpendicular, with the base and extends to the opposite side**. **Let's see how that can help us find the area of a trapezoid.** **If we carefully divide the given parallelogram into 2 equal trapezoids, we have this:** [Now, draw the segment inside the parallelogram to show two trapezoids.] 	parallelograms and triangles to find the area of trapezoids. This objective engages students in composing trapezoids into rectangles/parallelograms. Students will also see examples of real-world problems. Students respond.

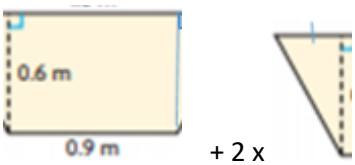
What do you see? [Pause] **We see that one trapezoid is ½ of the parallelogram!** **Any parallelogram can be divided into 2 trapezoids with one pair of parallel sides that are also the same shape and size.** **Here are a few examples:** [Put examples on the board for students to see. Point out the 2 trapezoids in each example.]  **Let's try to find the area of the given trapezoids using the fact that the trapezoid is $\frac{1}{2}$ of the parallelogram.** [We will find the area of the 3 given trapezoids above.] **You can use your calculator, if needed.**	Students respond.
Example 1: **Find the area of the shaded trapezoidal region.**  **To find the area of the entire parallelogram, what do we do?** [Pause]. **Yes! We can multiply base by height. What is the base in this trapezoid?** [Pause]**. Hmm….I heard 3 inches, I heard 9 inches and I heard 12 inches.** **Look carefully at the parallelogram. What is the length of the total base?** [Pause]. **It is 9 in + 3 in, which is 12 inches. Great job!** **What is the height of the parallelogram?** [Pause]. **It is 8 inches.** **We can now find the area of the parallelogram.** **A=bh** **A = 12 x 8 = 96** **So, the area of the parallelogram is 96 in^2. Is this the area of the trapezoid?** [Pause]. **You are correct. Since the trapezoid is ½ the parallelogram, we need to take $\frac{1}{2}$ of 96 to find the area of the trapezoid.** **$\frac{1}{2}$ x 96 = 48. So, the area of the shaded trapezoid is 48 in^2.** Example 2:	Students respond during solution. Students respond.

Let's try the 2nd one. We will do the same thing.  **What is the base and height of the entire parallelogram?** [Pause] **I heard someone say the height is $5\frac{1}{4}$ inches. I agree. What about the entire base?** [Pause] **Oh! It is $8\frac{1}{2} + 3\frac{1}{2}$. Great job! What is that sum?** [Pause]**. It is 12 inches.** **Using that base and height, how can we find the area of the entire parallelogram?** [Pause] **A = bh** **A = $5\frac{1}{4}$ x 12 = $\frac{21}{4}$ x $\frac{12}{1}$ = $\frac{252}{4}$ or 63. Since the parallelogram has an area of 63 in^2, what is the area of the trapezoid that is shaded?** [Pause]. **You got it! The area of the trapezoid is $\frac{1}{2}$ the area of the parallelogram, which is $\frac{1}{2}$ x 63.** **$\frac{1}{2}$ x 63 = $31\frac{1}{2}$ or 31.5 in^2.**	Students respond.
Example 3: **Using what we've been doing, see how far you can get on the 3rd figure.** [Pause and allow students time to set up and get an answer.]  **Let's check your work.** **For the entire parallelogram, you have a height of 6.5 mm and a total base of 12 mm. Great! Does everyone see how they added the 8 mm and 4 mm to get the total base?** [Pause] **A = bh = 6.5 x 12 = 78 mm^2 for the area of the entire parallelogram. What about the shaded trapezoid?** [Pause] **Awesome! It is $\frac{1}{2}$ the area of the parallelogram, which is $\frac{1}{2}$ of 78.** **$\frac{1}{2}$ x 78 = 39 mm^2** **How would you summarize what we just did?** [Pause] **Let's try together. For each example, the sum of the bases of the trapezoid, we will call them Base 1 (b_1) and Base 2 (b_2), form the base of the parallelogram.**	Students work through problem.

The area of each trapezoid is half the area of the parallelogram. **Let's look at trapezoids and how they connect to other polygons.** Objective 2: Connecting Trapezoids to Triangles and Rectangles [Draw the given trapezoid on the board and label all sides.] **Trapezoids are composed of triangles and rectangles. What did we say in earlier lessons that composed means?** [Pause] **It means to put things together.** **Let's look at a few trapezoids and see if we can find the triangles and rectangles. Take a moment to look at each and find the triangle(s) and rectangle.** [Pause]  **Do you see the rectangles and triangles?** [Pause] **Let's see how we can use this information to help us find the area**. [Pause] **We will use these given triangles in a few problems to build our knowledge of finding the area of trapezoids by decomposing them into triangles and other shapes.** Example 1 **Find the area of the given trapezoid by decomposing into triangles and other shapes.** **Let's decompose this one together.** [Pause]	Objective #2: Students will be building off the connection between the area of triangles and rectangles to find the area of a trapezoid. The connection to the composing and decomposing of the triangle, parallelogram and rectangle remains their foundation.

 **This trapezoid is decomposes to**  **We can see all of the dimensions for the two shapes except the base of the triangle. Does anyone know what the base of the triangle is equal to**? [Pause]. **Yes! You are right! The base of the triangle is 4 cm. Great!** **Let's find the area of the two figures. How do we find the area of the triangle**? [Pause] **Yes!** **The area of the triangle is $\frac{1}{2}$ x base x height** **A = $\frac{1}{2}$ x 4 x 3 = 2 x 3 = 6 cm^2** **How do we find the area of the rectangle?** [Pause] **Yes!** **The area of the rectangle is length x width, so** **A = 5 x 3 = 15 cm^2** **What does the problem ask us to find?** [Pause] **The area of the trapezoid. So, we need to add the area of the triangle and the area of the rectangle to compose the trapezoid.** **6 cm^2 + 15 cm^2 = 21 cm^2** **Let's try another one.** Example 2 **Mr. Desmond has tables in his office with tops shaped like trapezoids. The diagram shows the dimensions of each tabletop. What is the area of each tabletop?** [Write the problem on the board and read for students. Draw the given figures on the board before reading the problem.]  **Look carefully at Mr. Desmond's tabletop. How can we decompose the tabletop into triangles and other shapes?** [Pause]. **You're right! We can decompose into 2 triangles and a rectangle**.	Students listen and respond. Students respond. Students respond.

Take a moment to decompose and I will wait for you. [Pause] **Did you notice that the two triangles are the same size? Since they are the same size, we can find the area of one of them and then double that value to represent both triangles.**



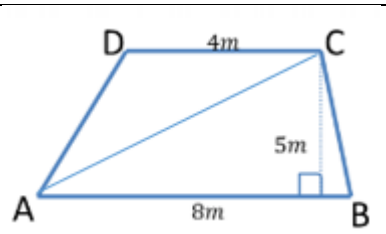
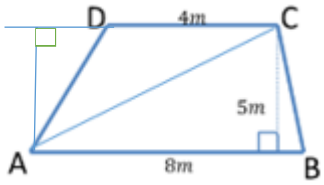
Let's find the area of the rectangle first? What are the length and width? [Pause] **Yes! Go ahead and use those to find the area of the rectangle.**
A = length x width = 0.6 x 0.9 = 0.54 sq meters

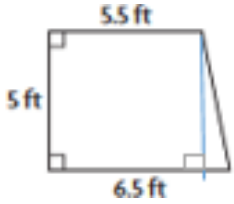
What about the triangles? What are the base and height of those? [Pause] **The height is the same height as the rectangle, 0.6 m. Let's find the base. We see that the entire base is 1.6 meters. If the rectangle is 0.9 meters of that 1.6 meters, how can I find the base of the triangles?** [Pause]. **Great thinking! We need to subtract. Let's see how this works.**
1.6 – 0.9 = 0.7. We then need to $\frac{1}{2}$ that for each of the triangles.
$\frac{1}{2}$ x 0.7 = 0.35
[Point to the original figure while you are working through these calculations to make sure they see where the numbers are coming from.]
Let's put this together to find the area of one of the triangles.
A = $\frac{1}{2}$ x 0.35 x 0.6 = 0.105 sq meters.

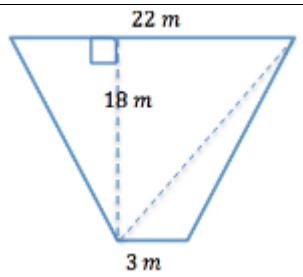
What does the problem ask us to find? [Pause] **The area of the tabletop. How can we do this**? [Pause]. **Wow! You are doing great! We add the rectangle and two of the triangles to find the area of the trapezoidal shape.**

Area of tabletop = 0.105 + 0.105 + 0.54 = 0.75 sq meters.

Let's do one more!
Example: **Find the area of the given trapezoid by decomposing into triangles and other shapes.** [Draw the figure on the board with the given dimensions.]

 **How can we decompose this trapezoid into triangles and other shapes?** [Pause] **Oh! I see that too! This one can be decomposed into two triangles. Good catch. Let's find the area.** **We have Triangle ABC and Triangle ACD. Which do you want to start with?** [Pause]. **Ok, Harrison! We will start with Triangle ABC.** **Since the base = 8 m and height = 5 m,** **A = $\frac{1}{2}$ x 8 x 5 = 20 m^2** **What about Triangle ACD**? [Pause**]. It is an obtuse triangle. What is the height?** [Pause] **It is also 5 m. Here is a sketch of that height** [Point to the height of the obtuse triangle that has to be sketched outside the triangle.]  **What is the base of Triangle ACD?** [Pause] **It is 4 m.** **Let's use those dimensions to help find the area of Triangle ACD.** **A = $\frac{1}{2}$ x 4 x 5 = 10 m^2** **We are asked to find the area of the trapezoid, so A = 20 m^2 + 10 m^2 = 30 m^2.** **Isn't it awesome to see what you've been learning in the last few lessons come together for the area of the trapezoid?** 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 trapezoid by using the relationship between a trapezoid and a triangle, a rectangle and a parallelogram.**	Students read, find values and set the problem up. 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 trapezoids and the area of a rectangle and the area of a parallelogram.
<u>Guided Practice</u> (8 min)	Students will move through the gradual release process. Teachers

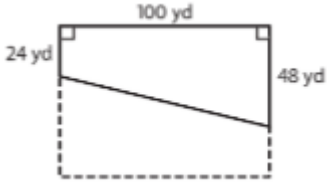
You have done great today! Let's work two more where you are doing most of the work and we then compare our answers. If you have a calculator, you may use it. Problem 1 **Find the area of the trapezoid:**  [Draw the given problem on the board. Allow students a moment to read and write down key information that is given.] **Write down all of the information that you are given and start thinking of ways you can use it all to find the area.** [Pause] **The trapezoid decomposes into a rectangle and a triangle.** **The rectangle has dimensions of 5 ft and 5.5 ft** **The triangle has a height of 5 ft.** **The triangle has a base of 6.5 – 5.5 = 1 ft** **Let's check to see how we are doing. I see that many of you have the same given information written down. Great job! How can we use it?** [Pause]. **Yep! I agree Evan, we need to find the area of the rectangle and then the triangle. Take a minute to do that and let's check our final answer.** [Pause] **Area of rectangle= 5 x 5.5 = 27.5 sq ft** **Area of triangle = $\frac{1}{2}$ x 1 x 5 = 2.5 sq ft** **Total area of trapezoid = 30 sq ft** **I'm so excited! You've got this!** **Do this one all on your own. I'll jump back in in a moment to check your progress**. [Write the given problem on the board and allow students time to write down key information and determine how to use it.] Problem 2 **What is the area of trapezoid by decomposing into triangles?**	will allow students to solve the problems alongside the teacher to ensure student understanding. Students respond. Students respond. Students work through most of the problem alone. Teacher enters to have students check their work.



[After allowing students time to find key information.]
What shapes can we decompose the trapezoid into? [Pause]
2 triangles is correct! What are we given? [Pause]
I heard Sharon say the height of Triangle 1 is 18 m. I agree.
I heard Tim say the base of Triangle 1 is 22 m. Great!
Find the area. [Pause]
A = $\frac{1}{2}$ x 18 x 22
A = 198 m^2
I agree with you!
Let's see about Triangle 2.
Oh! Good job, Jen! The base of triangle 2 is 3 m and the height is 18 m, so we can find the area.
A = $\frac{1}{2}$ x 18 x 3 = 27 m^2
Take a moment to find the area of the trapezoid. [Pause]
Way to go! It is 198 + 27 = 225 m^2

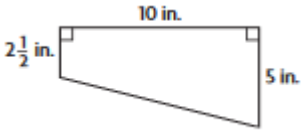
Additional Problems (if needed):

1.) Find the area of the given figure.



Answer: 3600 yd^2

2.)



Answer: 37 $\frac{1}{2}$ square inches.

Independent Practice (1 min)

Great work! Today, we reviewed how to find the area of trapezoids. I hope you're seeing some connections to area of rectangles, parallelograms and triangles! 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 area of trapezoids 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!**	