PBS Lesson Series

Math: Grade 6, Lesson 20, Area of Composite Figures

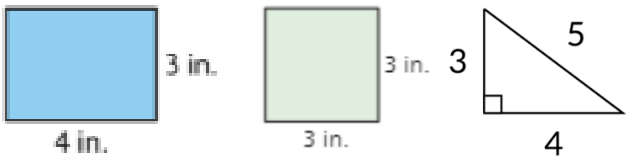
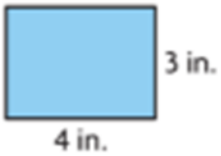
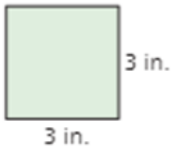
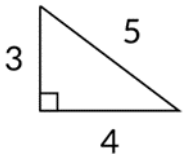
Lesson Focus: Find the area of composite figures
Practice Focus: Students will focus on practicing finding the area of figures composed of multiple polygons.
Objective: Students will use areas of polygons to find the area of composite figures.
Key Vocabulary: area, composite figures, compose, decompose
TN Standards: 6.G.A.1
Teacher Materials:

- White board and markers or smart board
- Student Practice Packet

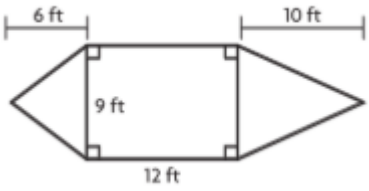
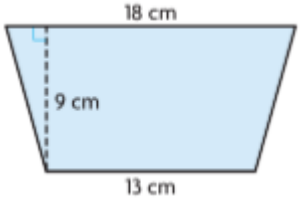
Student Materials:

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

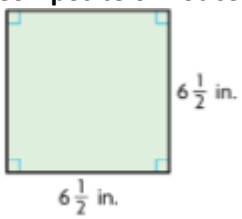
Teacher Do	Student Do
Opening (1 min) **Hello! Welcome to Tennessee's At Home Learning Series for math! Today's lesson is for all our 6th graders out there, though all children are welcome to tune in. This lesson is the twentieth in our series.** **My name is ____ and I'm a ____ grade teacher in Tennessee 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 area of composite figures 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 cell phone** **Ok, let's begin!**	Students get materials ready for the lesson.
Intro (4 min) [Draw the given figures on the board with all key features labeled. All sides of the 3 figures are measured in inches.] **Today, we are going to combine the information we have been working on in the previous lessons. To get us started,**	

look at the 3 given figures. What geometric shapes are we given? [Pause] **Yes! We have a rectangle, square 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 square is also length x width or side x side:**  **A = 3 x 3 = 9 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 all three shapes**. [Pause] **You are right! It is 12 in^2 + 9 in^2 + 6 in^2 = 27 in^2** **Today, we are going to look at situations where we are asked to find the area of figures with multiple polygons involved. Let's dive in!**	
Teacher Model (13 min) [The geometric figures in this section are large and detailed. Make sure that the figures on the board are drawn large enough for students to see all needed measures.]	

PBS Lesson Series

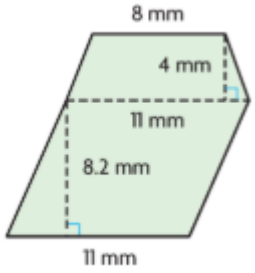
Objective 1: Understanding Composite Figures **Today, we are going to find the area of composite figures. Before we can find the area of composite figures, we must know what composite figures are and how we can work with them.** **What is the root word of composite?** [Pause] **Compose. What did we say in earlier lessons it means to compose?** [Pause]**. It is to put things together.** **Composite figures are sometimes called compound figures. Either way, they are figures composed of, or made up of, two or more simpler figures. We will work with composite figures made up of triangles, which have how many sides?** [Pause] **and quadrilaterals, which have how many sides?** [Pause] **Let's look at a few figures and determine if it is a composite figure.** [Draw the following figures on the board. We are working to build conceptual understanding, so we must first help students identify composite figures.] **I am going to show you a figure. You tell me if it IS a composite figure or if it IS NOT a composite figure. If it IS a composite figure, tell me what polygons it is COMPOSED of. Let's go!** **1.) Composite or not composite?** [Pause]  **Answer: Composite! Great! What polygons is this figure composed of?** [Pause] **Triangles and rectangle** **Let's try another one.** 2.) **Composite or not composite?** [Pause]  **Answer: Composite. Yep! What polygon is this figure?** [Pause] **It is a trapezoid. We learned to decompose trapezoids into triangles and other shapes in an earlier lesson. It can be decomposed into 2 triangles and a rectangle.**	Objective #1: Students will be reviewing what it means to be a composite figure and understand how to recognize the polygons used to compose the figures. Students respond. Students respond to the 5 figures with composite or not composite. Students engage in the discussion of what polygons are used to compose the figures.

3.) **Composite or not composite?** [Pause]



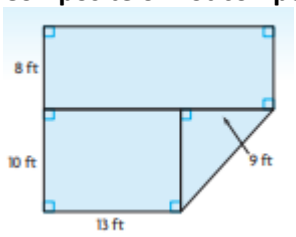
Answer: Not composite. This one was a bit easier to agree on!

4.) **Composite or not composite?** [Pause]



Answer: Composite. What polygons is it composed of? [Pause] **It is composed of 2 trapezoids.** [Point to the trapezoids as you say this.] **What figures are trapezoids composed of?** [Pause]. **You got it! They are composed of triangles and rectangles. Great!**

5.) Composite or not composite? [Pause]



Answer: Composite. What polygons is it composed of? [Pause] **It is 2 rectangles and a triangle.**

Before we begin finding the area of composite figures, look at the examples we have given. What are similarities and differences? [Pause]

[Read through possible answers.]

Possible answers:

Similarities-

They all are composed of polygons.

They are big figures.

The right angles are marked with the right angle symbol.

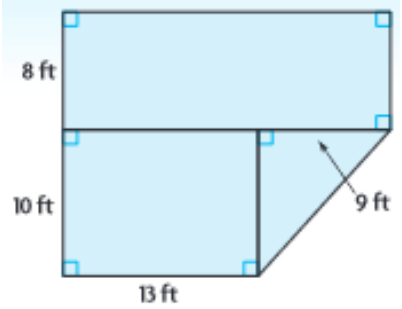
Units are the same

Differences-

They are composed of different combinations of polygons.

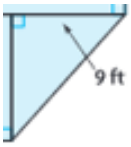
The shapes are oriented differently

Students respond.

I heard Jack mention the right angle symbols. Why are the right angle symbols important in the figures? [Pause] **I agree! They are necessary for determining the shape of each figure and the dimensions of each figure.** **I heard Mary Helen mention that the units are the same. Great catch! Why do you think this matters?** [Pause] **As we calculate with these figures, we must make sure we are working with the same units within each figure. If we are not given like units, we must convert to like units before we can combine values.** **Let's keep that in mind as we move forward today. Let's go work with some composite figures!**	
Objective 2: Finding the Area of Composite Figures **We are going to work together to find the area of composite figures. We do not have any new formulas today, but instead, we will be using the formulas that you have used in previous lessons. Let's review those before we get started so we will have ourselves a list to work with. Make yourself a list as we recall each of them.** **What polygons have we worked with?** [Pause and write the following on the board. We will refer to these as we work through the problems.] **Rectangles, Parallelograms, Triangles and Regular Polygons.** **Our formulas are:** **Rectangle (also a square): A = length x width** **Parallelogram: A = base x height** **Triangle: A = $\frac{1}{2}$ x base x height** **Regular Polygons: A = Area of one triangle x number of sides** **You may use a calculator, but it is not required. Let's get started.** Example 1: **Find the area of the given figure.**  **Where should we begin?** [Pause] **We must first decompose the composite figure, this means we must break the figure down into smaller parts. What polygons is this figure**	Objective #2: Students will be use previous knowledge of finding the area of polygons to find the area of composite figures.

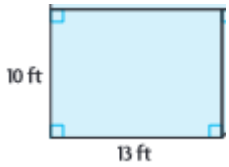
composed of? [Pause] **I agree! There are 2 rectangles and a triangle**. [Point to all shapes as you call them out.]

Let's start with the triangle:



How do we find the area of a triangle? [Pause] **Yes. A =** $\frac{1}{2}$ **bh**
What is the base and height? [Pause**] The base is 9 ft, but I don't see the height given. Can anyone find the height?** [Pause]. **I heard Brooks say that it is 10 ft. How do you know?** [Pause] **Yes! Great job! If we look at our original figure, the triangle is adjacent to the rectangle.** [Point to the original figure as you discuss this side of the triangle.]
Since the width of the rectangle is 10 ft, so it is the side, or height, of the triangle.
Let's use those dimensions to find the area. [Pause]
A = $\frac{1}{2}$ **x 9 x 10 = 45 ft²**

Let's now move to one of the rectangles:



How do we find the area of a rectangle? [Pause]
Yes. A = l x w. What are the side lengths? [Pause] **They are both 10 ft and 13 ft. Find the area of the rectangle.** [Pause]
A = 10 x 13 = 130 ft²

One more part of our composite figure to go! Let's find the area of the 2nd rectangle:

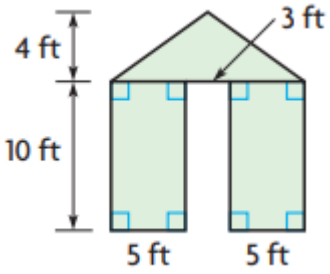
What are the dimensions of this rectangle? [Pause]
The width is 8 ft and the length is 13 + 9 = 22 ft. Great job! That length took an extra step.

You go ahead and find that area and I will wait so we can check our answers. [Pause]
A = l x w = 22 x 8 = 176 ft²

Now that we have the area of the decomposed figure separated into 2 rectangles and a triangle. How can we put

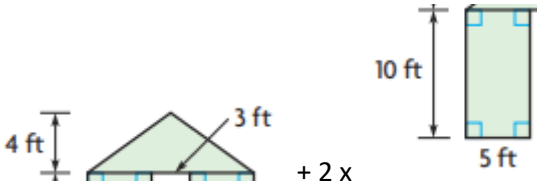
them all back together for the composite figure? [Pause]. **We can add! Super! What do we add?** [Pause]**. We add the areas. 176 ft^2 + 130 ft^2 + 45 ft^2 = 351 ft^2. So, the area of the composite figure is 351 ft^2.**

Example 2: **Let's do another one. I'm going to lean on you for help with this one.** [Draw the given figure on the board.]
Find the area of the composite figure:



Take a moment to decompose the figure to determine the polygons in the figure. [Pause] **You are right. There is 1 triangle and 2 rectangles. How do you know they are rectangles?** [Pause] **Yep. We see 4 right angles. Good.**

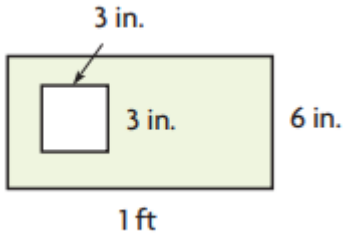
Separate the figure into the 3 pieces. [Pause] **Someone just asked the question, "Since the two rectangles are the same size, can we find that area once and then double it?" Absolutely! Great thinking!**



Before we start finding the area, are the units all the same in the figures? [Pause] **Yes! Ok, go ahead and find the area of the figures and we will check our answers.** [Pause]
Triangle area:
A = $\frac{1}{2}$ x 13 x 4 = 26 sq ft
How many of you got this answer? [Pause] **Oh! Several of you got 6 sq ft. Let's see if we can figure out what you did. What did you use as the height of the triangle?** [Pause] **That's right. It is 4 ft. What about the base?** [Pause] **Oh! You used 3 ft as the entire base length. If you look carefully at the original figure, you see that there are two 5 ft pieces PLUS the 3 ft piece that make up the base** [Point to this on the original figure on the board.] **5 + 5 + 3 = 13, so the base of the triangle is a total of 13 ft.**
Rectangle area:

A = l x w = 5 x 10 = 50 sq ft
How do I use these two calculations to find the area of the composite figure? [Pause]
The composite figure has an area of 26 sq ft + 2 x 50 sq ft or 26 sq ft + 100 sq ft, which equals 126 sq ft.

Example 3: **In this problem, we are asked to find the area of the shaded region**. [Draw the given figure on the board and point to the shaded region. If it is difficult to see, the large rectangle is shaded, while the square is NOT shaded.]

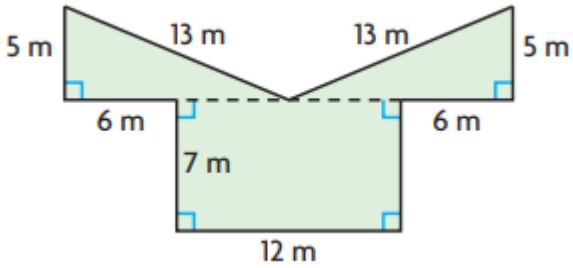


Ok! How is this one different from the previous problems? [Pause]
Good observations! One of you said that instead of having a square attached to the outside, it is cut out of the inside. We can summarize that to say, the rectangle is composed of a square.
Someone else said the units are not all the same. Great catch!
We need to address BOTH of these observations.
Let's address the units first. What two units are in the figure? [Pause] **Feet and inches. We've spent some time this school year converting measurement units. Since 3 of the 4 measurements are in inches, let's convert the 1 ft to inches. 1 ft = ___ inches?** [Pause] **Yes. 1 ft = 12 inches. We can now use 12 inches for that side length.**

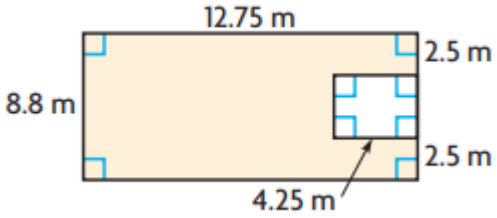
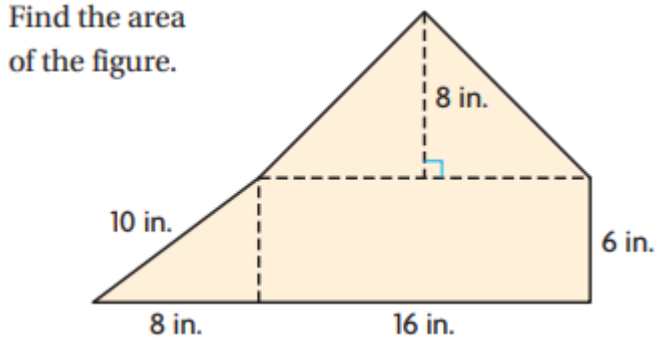
The other observation was concerning the square on the inside.
We need to figure out how to take the area of the square OUT of the figure.
Hmm….what operation allows us to take something away? [Pause] **I agree. It is subtraction. We will have to use subtraction in this one.**

What is the problem asking us to find? [Pause] **The area of the shaded part. What does that mean?** [Pause] **It is the area of the rectangle – the area of the square.**

Since we need both areas, take a moment to find those two areas. [Pause for students to work.] **Let's check our work.**

Area of Rectangle: **A = l x w = 12 x 6 (remember we converted 1 ft to 12 inches so that we can continue working in this problem)** **A = 72 in^2** **Area of Square:** **A = l x w = 3 x 3 = 9 in^2** **We will subtract the area of the square from the area of the rectangle, so** **A = 72 in^2 – 9 in^2 = 63 in^2** **So, the area of the shaded region is 63 in^2** Tying the learning together: **Today, we have spent time working with composite figures. To find the area of these figures, we have had to decompose them into separate polygons. We have used area formulas in previous lessons to help us find the area of the composite figures.**	Tying the learning together: Students will listen to the teacher do a think aloud concerning finding the area of composite figures.
Guided Practice (8 min) **Before you are on your own, let's try two more together. In this part, if you get ahead of me, go for it! I want to make sure you are able to find these areas by yourself.** [Draw figure on the board clearly placing measurements in the correct locations. It will help students see the individual polygons if you continue to point to them as you work.] Problem 1: [Display the problem on the board.] **Where do we begin with this one?** [Pause] **Yes! We have the same units, so we can begin. We should decompose the figure into separate polygons. Take a moment to see what polygons the composite figure contains and write down their area formulas.** [Pause]  **Let's see how you did. This composite figure has the following polygons:** **1 Rectangle + 2 Triangles**	Students and teacher will move through the gradual release process during the guided practice. Students will do more of the work on their own with teachers providing guidance and checks for understanding. Students respond.

We know that we use A=l x w for the area of a rectangle and A= $\frac{1}{2}$ b x h to find the area of a triangle. How did you do? [Pause to allow students to check their work.] **Take a moment to find the dimensions of the rectangle**. [Pause] **The length is 12 meters and the width is 7 meters. Go ahead and find that area.** [Pause] **Good!** **We all got 84 m^2.** **Let's do the same for the triangles**. [Pause] **The height is 5 meters and the base is 12 meters. Randi just said that she got 6 meters for the base. Can anyone help her out?** [Pause] **To re-phrase what Jalen said to help you, "we need to look at the dotted line. It is a total of 12 meters.** [Point to the figures as you state the following information.] **The triangles are the same size and they come to a point that divides that into two equal segments. Each segment is 6 meters. Since the dotted line portion is 6 meters and we already know there are 6 meters, the base of the triangle is 6 + 6, which is 12"** **Can everyone see what Jalen is referring to?** [Pause] **Did you notice that Jalen said that the two triangles are the same size?** [Pause] **How does that help us?** [Pause] **Yep. We can find the area of one of the triangles and then multiply it by 2 for the areas of both of them.** **A = $\frac{1}{2}$ bh = $\frac{1}{2}$ x 12 x 5= 6 x 5 = 30 m^2** **Take a moment to find the area of the composite figure?** [Pause] **The area of the composite figure is 30 + 30 + 84 = 144 m^2** **Great job! You are doing awesome! We have one more to work through together.**	Students respond.
Problem 2: **Take a look at this one. Jot down everything you notice and the formulas you think we will use.** [Pause to allow students to look at given figure and list what they know.] **Before you begin working, let's list what you noticed.** **I just heard someone say they noticed that we will subtract the small figure from the large figure. Ok! I agree. We will subtract those areas.** **Someone else said that our units are all meters, so we don't have to convert anything. Woohoo!** **Yep. I heard you Beth. You noticed that we have right angles for all angles, so we have rectangles.**	Students take the time to jot down everything they notice.

One more. Ok, Molly, what did you see? You noticed that small rectangle has side lengths of 4.25 meters and 3.8 meters and the large rectangle has side lengths of 12.75 and 8.8. **Oh, wait, someone has a question for you, Molly.** [Pause] **How did you get 3.8 for the side length of the small rectangle?** [Pause] **If the entire side length is 8.8 and the 2 small pieces are 2.5, we can subtract 8.8 – 2(2.5) = 8.8 – 5= 3.8, so have a side length for the small rectangle of 3.8 meters.** **Let's use their help to find the area of the shaded region. We can check our answers in a bit.** [Pause to allow students to set up and work.]  **Solution:** **Large Rectangle Area = 8.8 x 12.75 = 112.2 sq meters** **Small Rectangle Area = 4.25 x 3.8 = 16.15 sq meters** **Area of Shaded Region = 96.05 sq meters.** Additional Problem (if needed):  Answer: 184 square inches	Students find the area.
<u>Independent Practice</u> (3 min) **Great work! Today, we reviewed the area of composite figures. I hope you're seeing some connections to finding the area of polygons to composite figures! 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 composite figures 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!**	