PBS Lesson Series

Math: Grade 6, Lesson 17, Area of Triangles

Lesson Focus: Find the area of triangles

Practice Focus: Students will focus on practicing using the formula, A = $\frac{1}{2}$ b x h, to find the area of a triangle.

Objective: Students will use the formula, A= $\frac{1}{2}$ b x h, to find the area of triangles.

Key Vocabulary: area, parallelogram, triangle, base, height, decompose, diagonal, congruent

TN Standards: 6.G.A.1

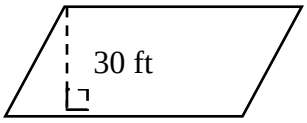
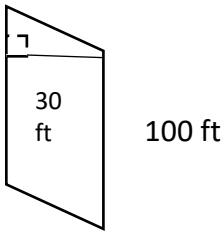
Teacher Materials:

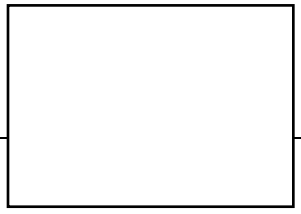
- White board and markers or smart board
- Projector, if possible, for geometric shapes
- Rectangle and parallelogram drawn on paper for Teacher Model Objective 1
- Student Practice Packet

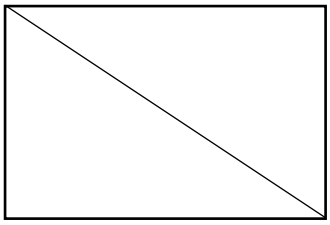
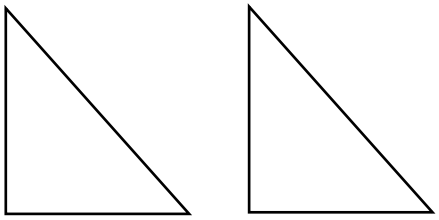
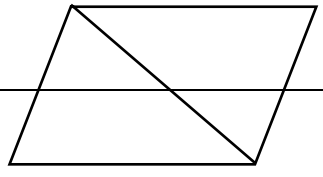
Student Materials:

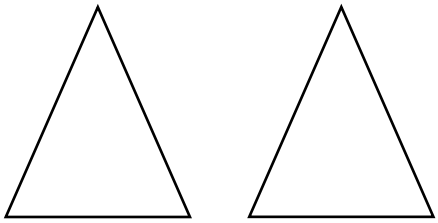
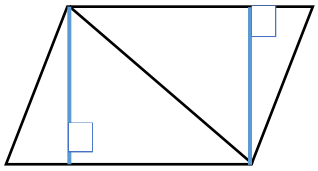
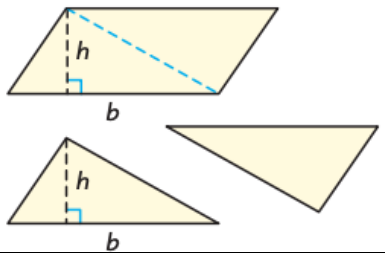
- Paper and a pencil, and a surface to write on
- Scissors and scrap paper to cut
- Calculator, optional

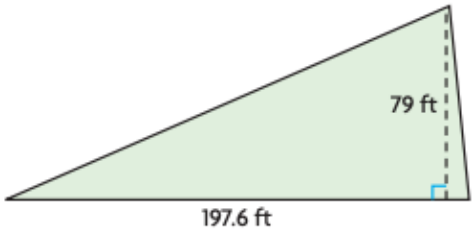
Teacher Do	Student Do
Opening (1 min) **Hello! Welcome to Tennessee's At Home Learning Series for math! Today's lesson is for all our 6th graders out there, though all children are welcome to tune in. This lesson is the seventeenth in our series.** **My name is ____ and I'm a ____ grade teacher in Tennessee 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 triangles 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** • **Additional scrap paper and scissors** • **Calculator is optional (you can even use one on a phone)** **Ok, let's begin!**	Students get materials ready for the lesson.

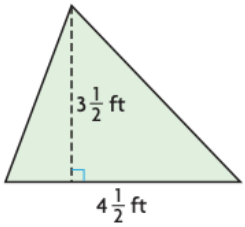
Intro (4 min) [This introduction will connect to the previous knowledge of working with parallelograms. It will also connect to 6.EE.A.2c, where students evaluate expressions including expressions that arise from formulas used in real-world problems.] [Write or display the problem on the board as you read it.] **Tony wants to plant some new grass this year. Tony's backyard is shaped like a parallelogram. The length of the yard is 100 feet, and from one side of the yard perpendicular to the other side is 30 feet. Draw and label the diagram. How much grass seed should he purchase to cover the yard?** **Take a minute to draw and label Tony's yard.** [Pause] **Now, how did you draw your parallelogram?** [Pause] **What characteristics does a parallelogram have? That's right. I heard you say a parallelogram is a quadrilateral, it has 4 sides, with 2 pairs of parallel sides. The height is the length of a segment that forms a 90° angle with the base and extends to the opposite side.** [Draw the parallelogram below.] **Here is how I sketched a representation of Tony's yard.**  100 ft **Yours doesn't have to be exactly like mine, as long as, you have 4 sides with 2 pairs of parallel sides.**  100 ft **You'll remember from yesterday that the base is one of the parallel sides, and the height is formed from a 90° angle from the base. Remember, you could have labeled the base as the top or bottom of the shape. Did you draw your representation correctly?** [Pause] **Awesome! You're off to a great start today!**	Students will begin by using previous knowledge to find the area of a parallelograms. This will allow the teacher to use this connection in the lesson.

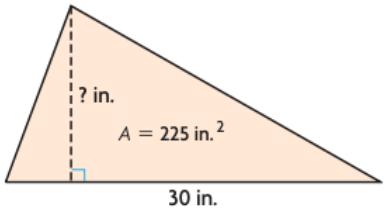
Now, before we get started let's take a minute to think about what we need to do to solve this problem. What is it asking us to find? [Pause] **I heard you say 'area'. That's right, we need to find the area of Tony's backyard. Take a minute and find the area of Tony's backyard.** [Pause] **What is the area of Tony's backyard?** [Pause] **That's right – the area of Tony's backyard is 3,000 sq. feet. How did you find the area?** [Pause] **That's great! I heard at least two different ways you calculated the area of Tony's backyard. I heard that one way you solved the problem was to compose the parallelogram into a rectangle.**  30 ft 100 ft **If you solved it this way, what did you do next?** [Pause] **I heard Davin say he knew that the area of a rectangle is found by multiplying base times height. So, he multiplied 100 times 30 equals 3,000 sq. feet. I heard Sally say she used the formula for a parallelogram. It is A = bh, where b is the base of the parallelogram and h is the height of the parallelogram.** **A=bh** **A= 100(30)** **A= 3,000 sq feet or ft^2** **Great work! We're going to use the connections to how you find the area of a parallelogram to connect to how we find the area of a triangle.**	
<u>Teacher Model</u> (12 minutes) Objective 1: Find the area of a triangle by decomposing rectangles and parallelograms into triangles and realizing that the area of the triangle is half of the rectangle or parallelogram. **We are going to work together today to determine how we can use what we know about finding the area of a rectangle or parallelogram to find the area of a triangle.** **Let's get started by drawing a rectangle on your paper.** [You are going to model cutting a rectangle into two triangles. Draw the rectangle on the board as well as drawing a rectangle on your paper that is large enough for students to see. You can use graph paper if available.] 	Objective #1: In this objective, students will be working alongside the teacher to determine the relationship between the formula for the area of a rectangle and parallelogram to the area of a triangle. They will work to understand how to decompose a rectangle and a parallelogram to realize it is half of the area. Students draw the rectangle.

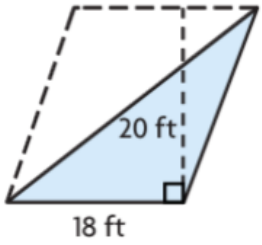
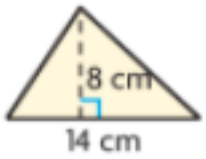
Let's say the base is 10 cm and the height is 5 cm. What is the area? [Pause] **That's right, the area is 50 sq cm. Cut out your rectangle.** [Pause and cut out your rectangle.]	Students cut the rectangle.
Draw a diagonal from the left top corner to the lower right corner. A diagonal is the line segment that two nonadjacent vertices of a polygon. [Pause and draw the diagonal on your paper and the board.] 	Students draw a diagonal.
Cut along the diagonal to divide the rectangle into two right triangles. What do you notice about the triangles? [Pause] 	Students cut along the diagonal.
Congruent figures are the same size and shape. Are the two right triangles congruent? [Pause and show the two triangles beside each other for students to see they are congruent.]	
How do the areas of the two triangles compare? [Pause] **you're right. The triangles have the same area.**	Students respond.
How is the area of each right triangle related to the area of the rectangle? [Pause] **You've got it! Each triangle is half of the rectangle. So, what is the area of each triangle?** [Pause] **Yes, 25 sq cm. Each right triangle is half of the rectangle.**	
What do you think happens when we start with a parallelogram? [Pause] **Let's try it. Draw a parallelogram and draw a diagonal.** [Pause to draw a parallelogram and a diagonal on your paper and the board] 	Students draw a parallelogram and make a diagonal.

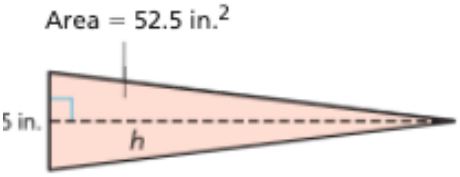
I'm going to cut my parallelogram along the diagonal. [Cut the parallelogram and show the two triangles] 	
Are the triangles in the space congruent? [Pause] **Yes, they are. They have the same size and shape. So, the two triangles are each half of the parallelogram. Any parallelogram can be divided into two triangles that are the same shape and size. What is the difference in finding the area of the parallelogram and finding the area of a rectangle?** [Pause] **I heard someone say that the difference is where the height is located. The height is the length of a segment that forms a 90° angle with the base and extends to the opposite side.** [Draw the line to make a right angle on each triangle.] 	Students respond. Students respond.
So, the area of each triangle is half of the area of the parallelogram. [Write the formula as you read the following words.] **So, the area is equal to half of the product of base and height.**	
Objective 2: Use the formula to find the area of a triangle **We have discovered that the area of a triangle and the area of a parallelogram have a relationship. If we put that relationship into a visual, it looks like this:** 	Objective #2: Students will be building off of their work with the area of a parallelogram/rectangle to use the formula for the area of a triangle.

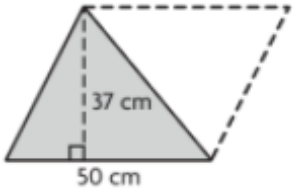
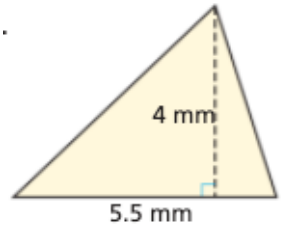
When given a parallelogram, it can be decomposed into two triangles. This allows us to see that half the area of a parallelogram is equal to the area of a triangle. **If we write it as a formula comparing to A=bh, for the parallelogram, it looks like this:** **Area of a Triangle** $A = \frac{1}{2}bh$ where b is the base and h is the height **Let's move into using the formula we discovered for the area of the triangle.** [Write or display the word problem as you read it.] **The Flatiron Building in New York is well known for its unusual shape. The building was designed to fit the triangular plot of land formed by 22nd Street, Broadway, and Fifth Avenue. The diagram shows the dimensions of the triangular foundation of the building. What is the area of the triangle?**  **What is the formula for the area of a triangle?** [Pause] **A = $\frac{1}{2}$ bh** **Let's substitute the values for b and h. What is b?** [Pause] **Yes! It is 197.6 feet. What is h?** [Pause] **Yes, it is 79 feet.** **A= $\frac{1}{2}$ x 197.6 x 79** **Remember, you can use a calculator to help you solve this problem. What is the area?** [Pause] **That's right. The area of the land is 7,806.2 sq. feet or ft^2.** **Let's try another one!** Example: **Find the area of the given triangle.** [Draw the figure and label it on the board.]	Students respond. Students respond.

	
How do we find the area of a triangle? [Pause] **That's right, it is the product of one half the base and height.**	Students respond.
A= $\frac{1}{2}$ **bh** **What is the base?** [Pause] **Yes! The base is 4** $\frac{1}{2}$ **feet. What is the height?** [Pause] **Yes! 3** $\frac{1}{2}$ **feet.**	Students respond.
Let's substitute them in the formula.	
A= $\frac{1}{2}$ **bh** **A=** $\frac{1}{2}$ **x 4** $\frac{1}{2}$ **x 3** $\frac{1}{2}$	
Let's remember, how do we multiply mixed numbers? [Pause] **That's right. We need to convert them to improper fractions.**	Students respond.
$A = \frac{1}{2} \times \frac{9}{2} \times \frac{7}{2}$	
$A = \frac{63}{8}$	
Let's rewrite it as an equivalent mixed number. [Pause] **What it is as a mixed number?** [Pause] **That's it.** $7\ \frac{7}{8}$**.** **What does this number represent? [Pause]. Yes. The area of the triangle is** $7\ \frac{7}{8}$ **ft²**	Students respond.
Objective 3: Solve for unknown numbers using the area formula for a triangle	Objective 3: Students will use the area formula to solve for unknown parts.
You've done great working with triangles today! I want to show you one other way we can use the area formula to help us solve for parts of a triangle.	
Example: [Write problem on the board and read to students.]	

Daniella is decorating a triangular pennant for her wall. The area of the pennant is 225 in.^{2} and the base measures 30 in. What is the height of the triangular pennant? **What are we given?** [Pause] **We are given the area and the base. The area is 225 in.^{2} and the base is 30 in.** **What is the problem asking for?** [Pause] **It is asking for the height of the triangle.** **Let's draw a figure with the given information.** [Pause and sketch the figure.]  **Our formula is A= $\frac{1}{2}$ bh. If we replace A and b with their given values, we have:** **225 = $\frac{1}{2}$ x 30 x h** **Solve for h.** [Pause] **First, let's multiply $\frac{1}{2}$ x 30 = 15** **Using the division property of equality, $\frac{225}{15} = \frac{15h}{15}$** **Solve for h to get 15 = h.** **So, the height of the triangular pennant is 15 feet.** Tying the learning together: **Today we learned how to use the relationship between a parallelogram and a triangle to find the area of a triangle. Since a parallelogram can be divided into two triangles that are the same size and shape, we can find the area of the triangle by using the formula A= $\frac{1}{2}$ bh**	Students respond. Tying the learning together: Students will listen to the teacher explain the relationship between the area of a parallelogram and a triangle.
Guided Practice (8 minutes) **To make sure that you understand how to find the area of a triangle, let's do a few together.** **Problem 1: Find the area of the shaded portion.** [Draw the figure and label it on the board.]	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 and label the base and height.
What is the base of the parallelogram? [Pause] **That's right! 18 feet Keep in mind that the base is one of the parallel sides.**	Students respond.
Both of the parallel sides are equal in a parallelogram. What is the height of the parallelogram? [Pause] **Yes, the height is 20 feet. How do we find the area of the parallelogram?** [Pause**] That's right area = the product of the base and height. Find the area.** [Pause]	Students solve the problem.
A= 18 x 20 **A= 360**	
What is the relationship between the parallelogram and the shaded triangle? [Pause] **That's it – the shaded triangle is $\frac{1}{2}$ of the parallelogram. So, $\frac{1}{2}$ time 360 equals 180 sq feet or ft²**	
Problem 2: Find the area of the shaded portion.	
How do we find the area? [Pause] **Correct! Because the shaded portion is a triangle, we can use the formula A = $\frac{1}{2}$ bh. Solve them problem, and then we'll check it.** [Pause]	Students solve the problem.
	
What did you get for the area? [Pause] **I heard 112 sq. cm and 56 sq. cm. Let's check it together. What is the formula for the area of a triangle?** [Pause] **That's right! A= $\frac{1}{2}$ bh. What's the base?** [Pause] **14 cm. What is the height?** [Pause] **8 cm. Let's solve the formula.**	Students respond. Students respond. Students respond.
A = $\frac{1}{2}$ bh **A= $\frac{1}{2}$ x 14 x 8** **A= 56 sq cm**	
So, I heard someone say 112 sq. cm. What is wrong with this answer? [Pause] **That's right. This person found the area of the parallelogram, not the area of the triangle. So, we need**	Students respond.

to multiply by $\frac{1}{2}$ or divide by 2 to get 56 sq. cm. Students, this is a common error when solving for the area of a triangle. If you will remember the relationship of a parallelogram and a triangle, you will remember that the triangle is half of the size of a parallelogram.	
Example 3: **Let's work another problem. I'm going to let you work this one, then we'll go over it. Before you get started, think about the following: What are we given?** [Pause] **We area given the area and the base. What do we need to find? You're right. We're trying to find the height. Why don't you take a stab at this one and we'll check our answers in a moment.** [Pause for students to solve.]	Students respond. Students solve this problem on their own, and the teacher will discuss the answer.
	
What did you get when you solved the problem? [Pause] **Let's check your work.**	
What do we know about this problem? [Pause] **Exactly, we have the area and the base. Let's substitute and solve.**	Students respond.
A= $\frac{1}{2}$ bh **52.5= $\frac{1}{2}$ x 5 x h**	
What did you do first? [Pause] **Excellent $\frac{1}{2}$ x 5 = 2.5.**	Students respond.
52.5 = 2.5h	
Let's use the division property of equality to solve.	
$\frac{52.5}{2.5} = \frac{2.5h}{2.5}$	
21 = h	
The height of the triangle is 21 inches.	
Additional problems (if needed):	

1. Find the area of the shaded triangle. (Answer is 925 cm^2)  2. Find the area of the triangle. (Answer is 11 mm^2)  3. Find the unknown measurement for the triangle. A = 4.86 yd^2 b= _____ h= 1.8 yd	
Independent Practice (1 min) **Woo hoo! We made it! Today, we reviewed finding the area of a triangle. I hope you're seeing some connections to area of a parallelogram! 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 triangle 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!**	