PBS Lesson Series

Math: Grade 7, Lesson 19, Solving Surface Area Problems

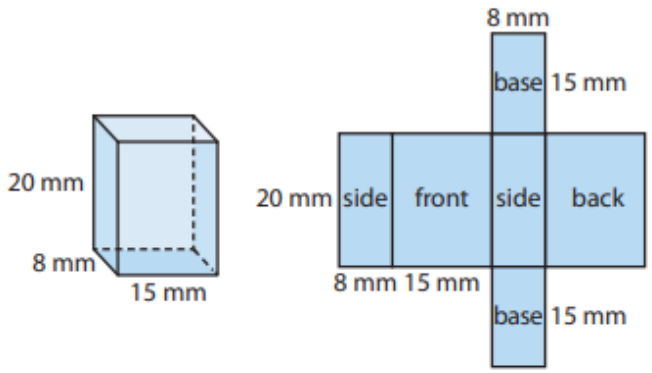
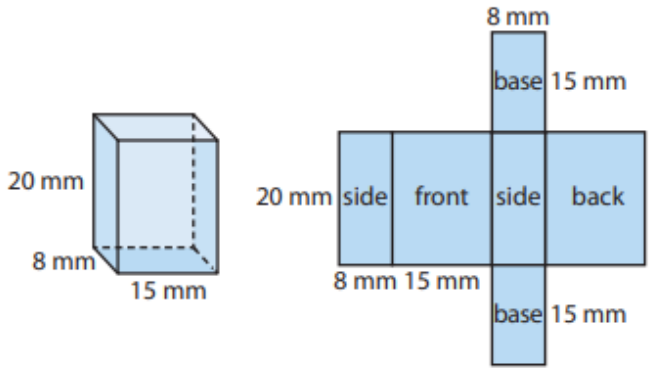
Lesson Focus: Solve problems dealing with surface area.
Practice Focus: Students will focus on how to find the surface area of rectangular prisms and right triangular prisms.
Objective: Find the surface area of a rectangular prism. Solve real-world problems involving surface area. Find the surface area of a right triangular prism.
Key Vocabulary: surface area, lateral area, solid, base, area of the base
TN Standards: 7.G.B.5
Teacher Materials:

- Paper/white board, pen/pencil/marker
- All the examples written out (to save time)
- Student Practice Packet

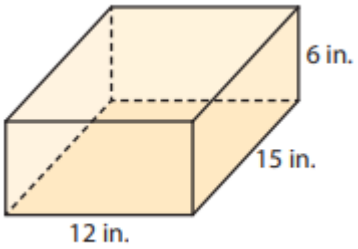
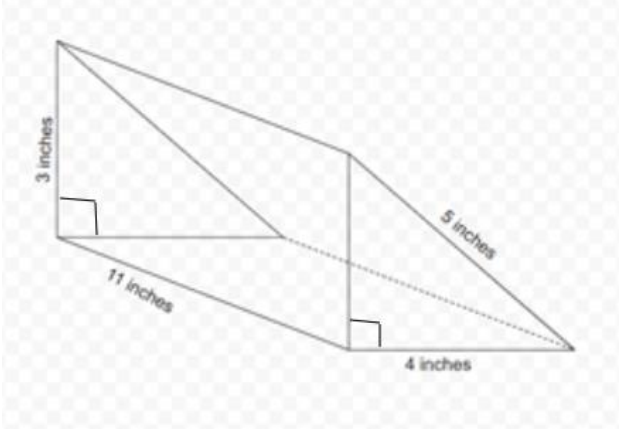
Student Materials:

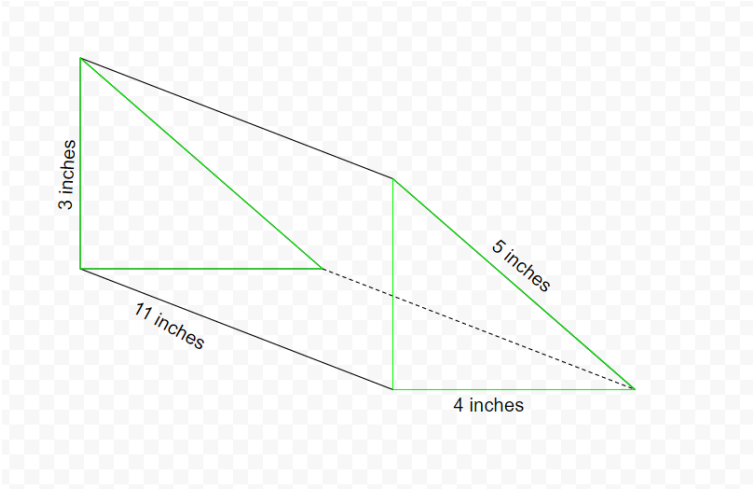
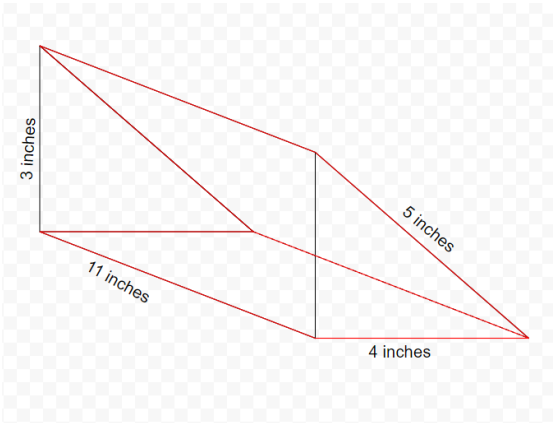
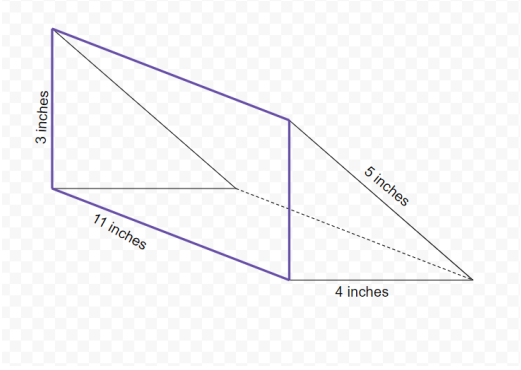
- Paper and a pencil, and a surface to write on

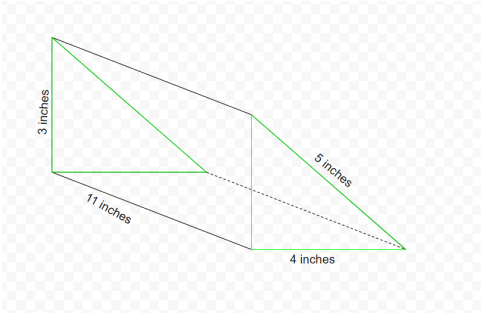
Teacher Do	Student Do
Opening (1 min) **Hello! Welcome to Tennessee's At Home Learning Series for math! Today's lesson is for all our 7th graders out there, though all children are welcome to tune in. This lesson is the nineteenth in our series.** **My name is ____ and I'm a ____ grade teacher in Tennessee 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 solve problems dealing with surface area 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** **Ok, let's begin!**	Students get materials ready for the lesson.
Intro (3 minutes) **Today we are going to explore surface area. Let's take just a minute to review some vocabulary. Two-dimensional objects are called "shapes". Rectangles, triangles, circles, squares, etc. are two-dimensional shapes. Recall that the "area" is the space that a two-dimensional shape occupies, or we can think of it as a measure of the surface. Three-dimensional**	Students think about the definitions of shape, solid, area, surface area, net, and base.

objects are called "solids". Cubes, prisms, and pyramids are examples of solids. Today we are going to discuss "surface area" of three-dimensional objects. Surface area is the sum of the areas of all of a solid's surfaces. **Let's start with this rectangular prism. We will look at the solid and the net. Recall that if we took the solid apart and folded it out flat that would be the net. Here is an example:**  **You can see that the rectangular prism is constructed of rectangles.** [Point out the rectangles in the net**.] Rectangles form the bases and the faces. Remember that the bases of a prism are the two parallel, congruent faces. The bases are here and here.** [Point to the bases on the solid and on the net.] **How can we find the surface area of this rectangle?** [Pause] **Remember that we said the surface area is the sum of the areas of the all the surfaces of a solid. Let's find the surface area of this rectangular prism!**	Students study the solid and its net. Students think about how to find the surface area of this rectangular prism.
<u>Teacher Model</u> (12 minutes) Objective 1: Students will find the surface area of a rectangular prism.  **Again, notice that this three-dimensional solid is constructed of two-dimensional shapes. We can find the surface area of**	Objective 1: Students will find the surface area of a rectangular prism. Students will relate area of a shape to the surface area of a solid made up of shapes. Students notice the way the solid is constructed.

the solid by finding the area of all the shapes that make up the solid! For this rectangular prism, all the shapes are rectangles. How do we find the area of a rectangle? [Pause] **Good! We find the product of the rectangles length and width. The area of a rectangle is length times width.**	Students recall how to find the area of a rectangle.
First let's find the area of all faces except the bases. We call this area of the faces without the bases the "lateral area". We sometimes use L to indicate the lateral area. **We have 2 sides that are the same size and a front and back that are the same size. The sum of the areas of these faces is the lateral area.** **L = 2 (area of side) + 2 (area of the front/back).**	Students think about the area of the faces (except bases) as the lateral area.
Notice the sides have dimensions of 20 by 8. What is the area of one side? [Pause] **Good! 20 x 8 = 160. What about the front and back?** [Pause]	Students think about how to find the area of a side.
Yes! The dimensions of the front and back are 15 by 20. What is the area of one of these faces? [Pause] **Did you say 300? 15x20 = 300.**	Students think about how to find the area of the back and front.
So the lateral area is **L = 2(160) + 2(300)** **L = 320 + 600** **L = 920 square mm**	Students see that the lateral area is the sum of the area of the faces except the bases.
Now let's find the area of the bases. **Recall that the bases are the parallel congruent sides. We use a capital B to indicate the area of each base. What are the dimensions of a base of this solid?** [Pause]	Students think about how to find the area of a base.
Good! The bases have dimensions of 8 by 15. What is the area of a base? [Pause] **B = 8x15 = 120 square mm**	
Now let's find the sum of all the areas to find the surface area, S. **S = the sum of the lateral area plus the area of the bases** **S = L + 2B** **S = 920 + 2(120) = 1,160 square mm** **The surface area of this rectangular prism is 1,160 square mm.**	Students see that the surface area is the sum of the areas of all the faces including the bases.
Objective 2: Students will solve a real-world problem using surface area of a rectangular prism.	Objective #2: Students will solve a real-world problem using surface area. This will lead to a deeper understanding of surface area.
Let's see how we can use surface area to solve a real-world problem! **Erin is making a jewelry box of wood in the shape of a rectangular prism. The jewelry box will have dimensions of 12 inches long x 15 inches wide x 6 inches high. Erin plans to paint the exterior of the box. How many square inches will she have to paint?**	Students think about what this box looks like.
What is the problem asking for? [Pause]	Students think about what the problem is asking.

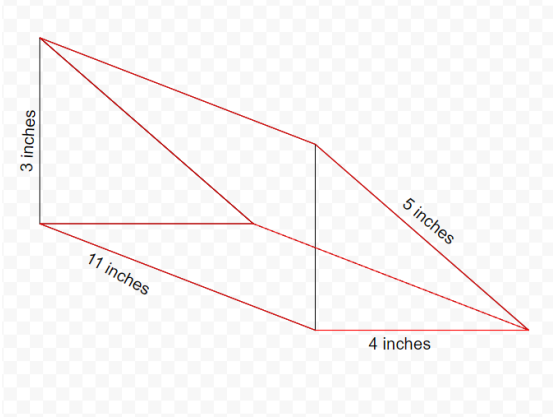
Yes! We need to find the surface area of the box! Drawing a diagram always helps! Let's draw the box.	Students think about how to draw the box.
	
Let's identify the bases and the faces. **Any pair of parallel congruent faces can be the bases. Let's choose the top and bottom of Erin's jewelry box to be the bases.** **The area of a base, B, is 12x15. There are two of these bases.** **The area of the faces (that are not bases) are called the lateral area, L. There are two faces that have an area of 15x6 and two faces that have an area of 12x6.**	Students identify the faces and bases and their dimensions.
So the surface area, S, is **S = 2(12x15) + 2(15x6) + 2(12x6)** **S = 2(180) + 2(90) + 2(72)** **S = 360 + 180 + 144** **S = 684 square inches**	Students think about how to find the surface area of the solid from the areas of the faces and bases.
What does this mean? [Pause] **Erin has to paint 684 square inches of wood.**	Students interpret the answer.
Objective 3: Students will find the surface area of a right triangular prism. **We have found the surface area of a rectangular prism. Now let's find the surface area of a right triangular prism!**	Objective 3: Students will find the surface area of a right triangular prism.
	
First let's think about the shapes that form this solid.	Students think about the composition of a right triangular prism.

[Point to each face as you talk about it.] **We have two right triangular faces, seen here outlined in green. They have a base of 4 inches and a height of 3 inches.**  **We have two rectangular faces that are 5 inches by 11 inches seen here outlined in red.**  **We have one rectangular face that is 11 inches by 3 inches, seen here outlined in purple.**  **Remember that the surface area is the sum of the area of all the faces, so let's find the area of each face.** **First let's look at the triangular faces.**	Students think about how to find the surface area, recognizing that they must find the areas of all the faces.



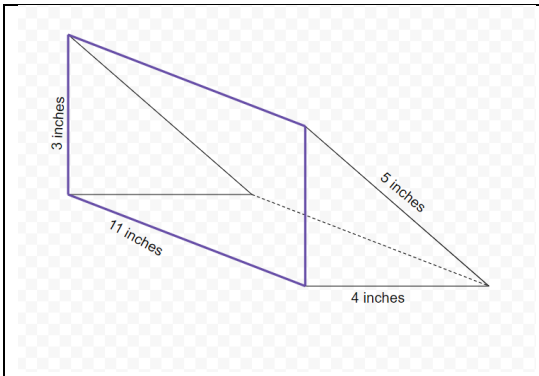
The area of a triangle is found by multiplying
$\frac{1}{2}$ x $base$ x $height$
We have a base of 4 inches and a height of 3 inches.
There are TWO of these, so we will multiply the area by 2.
Area of the triangular faces = $2(\frac{1}{2}(4)(3))$
Area of the triangular faces = $2(2)(3)$
Area of the triangular faces = 12 square inches

Now let's find the area of the two identical rectangular faces.

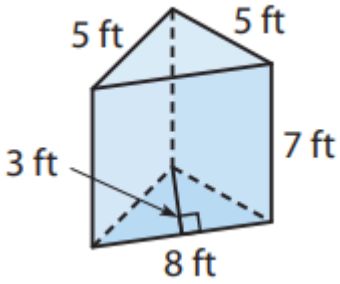


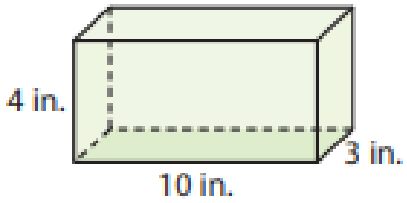
The area of a rectangle is length x width. These identical rectangles have a length of 11 inches and a width of 5 inches.
There are TWO of these, so we will multiply the area by 2.
Area of the identical rectangular faces = $2\ (11)(5)$
Area of the identical rectangular faces = 110 square inches

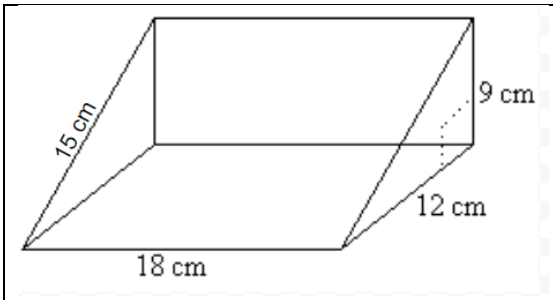
One more! Let's find the area of the one purple rectangle.

 **The dimensions of this rectangle are 11 inches by 3 inches. There is only one of these. The area is (11)(3) or 33 square inches.** **Now let's find the sum of the areas of all the faces.** **12 square inches + 110 square inches + 33 square inches** **12 + 110 + 33 = 155 square inches.** **The surface area of this right triangular prism is 155 square inches.** Tying the learning together: **We have talked about solids. We said that solids are three-dimensional and are composed of two dimensional shapes we call faces and bases. We learned that the surface area of a solid is the sum of the areas of all the faces and bases. Using what we already know about area of shapes, we found the surface area of rectangular prisms and a right triangular prism. Are you ready for some practice? Let's do this!**	Students think about the sum of all the areas of all the faces. Tying the learning together: Students think about the definition of surface area.
Guided Practice (12 minutes) [I do] **A brand of uncooked spaghetti comes in a box that is a rectangular prism with a length of 9 inches, a width of 3 inches and a height of 2 inches. Find the surface area of the box.** **First let's draw and label the picture.** **You draw it on your paper with me please.** [Draw and label the figure below.]	Students thinks about the shape of the spaghetti box. Students draw and label a sketch of the box.

 **In order to find the surface area we will need to find the area of all the faces of this rectangular prism. What shapes make up this solid?** [Pause] **All the faces are rectangles! Good job!** **How do we find the area of a rectangle?** [Pause] **Good! We find the product of the length and width!** **How will we organize our work?** [Pause] **Let's find the area of the top and bottom of the box first. These rectangles have dimensions of 3 inches by 9 inches. Find the area.** [Pause] **There are TWO of these, so the area is …** **2(3)(9).** **The area is 54 square inches. Did you get 54 square inches?** **Next let's find the areas of the ends of the box.** [Pause] **The dimensions are 3 inches by 2 inches. There are TWO of these. Find the area of the ends.** [Pause] **2 (3)(2) = 12 square inches** **Did you get 12 square inches? Great!** **What is left?** [Pause] **Yes! We need to find the area of the 2 inch by 9 inch rectangles.** [Pause] **There are TWO of these, so the area is 2(2)(9) = 36 square inches.** **Now that we have all the areas, let's find the surface area of the solid. How do we do that?** [Pause] **Yes! We find the sum of all the areas of the faces.** **54 + 12 + 36 = 102 square inches.** [Pause] **The surface area for the spaghetti box is 102 square inches.** **You did great! Let's try another one!**	Students think about what shapes compose the solid. Students think about how to find the area of a rectangle. Students find the areas of all the faces. Students find the surface area.

[We do]  **What is this solid called?** [Pause] **Yes! This is a triangular prism. Find the surface area. I'll give you time to sketch the drawing.** [Pause] **What should we do first?** [Pause] **Identify the shapes that make up the solid. Good!** [Pause] • **There are two triangles that have a height of 3 feet and a base of 8 feet.** • **There are two rectangles that have a length of 3 feet and a width of 5 feet.** • **There is one rectangle with a length of 7 feet and a width of 8 feet.** **Find the areas of all the faces. I'll give you time to do that!** [Pause for students to find the areas of the faces.] **Ready?** **The area of the two 3 feet by 8 feet triangles is** $2\left[\frac{1}{2}(3)(8)\right] = 2[12] = 24$ **square feet** **The area of the two rectangles with dimensions 3 feet by 5 feet is** $2\,[(3)(5)] = 2(15) = 30$ **square feet** **Finally, the area of the 7 feet by 8 feet rectangle.** **(7)(8) = 56 square feet.** **Now we are ready to find the surface area. How do we do that?** [Pause for the students to find the surface area.] **The surface area is the sum of the areas of the faces.** **24 + 30 + 56 = 110 square feet** **The surface area of the right triangular prism is 110 square feet.** **Great job!!** [You do] **One more! You are doing so well!** **I'll give you time to do this one individually then we will do it together.**	Students sketch the drawing. Students identify the faces. Students find the areas of the faces. Students find the surface area.

	Students sketch the drawing.
Rob is covering this box with 1-square inch tiles. How many tiles will he need to cover the box with no overlap? [Pause for the students to work the problem.] **Let's see how you did!** **First, let's determine what shapes make up this rectangular prism.** **There are…** • **Two rectangles with dimensions 10 inches by 4 inches.** • **Two rectangles with dimensions 3 inches by 4 inches.** • **Two rectangles with dimensions 10 inches by 3 inches.**	Students work the problem.
We must find the areas of all these faces. **The area of the 10 x 4 rectangles is 2(10)(4) = 80 square inches.** **The area of the 3 x 4 rectangles is 2(3)(4) = 24 square inches.** **The area of the 10 x 3 rectangles is 2(10)(3) = 60 square inches.** **Is that what you got?** [Pause] **Yay!**	Students compare their work to the teacher's work.
The surface area is the sum of the areas of the faces. **80 + 24 + 60 = 164 square inches.** **What does this mean?** [Pause] **This means that Rob will need 164 of the one-inch square tiles to cover the box.**	Students interpret the answer.
Way to go!! **I think you are ready for some independent practice!**	
Additional Problems (if needed): **Find the surface area of this right triangular prism.**	

 **Answer: 756 square cm**	
Independent Practice (1 minute) **Great work, 7th grade! Today, we learned how to find the surface area of rectangular prisms and right triangular prisms. 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 learning how to find the surface area of rectangular prisms and right triangular prisms 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!**	