LEARNING IN PLACE

LESSON PLAN

Subject: Grade 7 Math   **Lesson:** The Black Builders of Salem

Standard Addressed:

- Solve real-world and mathematical problems involving volume and surface area of pyramids, prisms, or three-dimensional objects composed of cubes, pyramids, and right prisms. (NC.7.G.6)

Objectives:

- Students will be able to determine the volume of prisms with polygonal bases.
- Students will be able to analyze the relationship between the volume of a pyramid and the volume of a prism with the same height and base area.

Materials Needed:

- Device for showing *The Black Builders of Salem*.
- "Constructing Surface Area and Volume" activity

Outline:

- Prior to this lesson, students should know how to find area and perimeter by decomposing polygons into triangles and rectangles. Students should also know how to find volume and surface area of rectangular prisms and cubes.
- Show the 6 ½ minute video, *The Black Builders of Salem*. https://youtu.be/rSZ3F_ZPWS4
- Guide students in identifying the various polygonal figurespresent in building designs and construction materials.
- Discuss the activity prompt.
- Students finish the activity independently or with a partner.

Take it Further: Using graph paper or an online 3-D modeling program such as Tinkercad, students design a polygonal prism or pyramid. Students then decompose this shape to find its surface area and volume.

Cross-Curriculum Connection: Students read and discuss *Horace King: From Slave, to Master Builder and Legislator* by J. David Dameron.
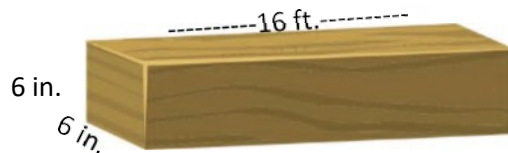
THE BLACK BUILDERS OF SALEM

Student Name:_____   Date: _____

In the video, you saw lots of polygonal figures in the building designs and in the construction materials. Regardless of the time period, builders have always had an intricate knowledge of geometry. Let's see how you "measure up" in applying some of these geometric principles!

Part 1: Reviewing Surface Area and Volume of Rectangular Prisms and Cubes

Use what you know about volume and surface area to answer the questions below.

You are a builder in Salem and are working with a timber beam measuring 6 inches X 6 inches X 16 feet. You will apply linseed oil to this beam before using it in construction. In order to know how much linseed oil you will need, you must first determine the surface area of this beam.

1. What is the surface area of this timber beam <u>in square feet</u>? (REMINDER: Surface area is the sum of the areas of all sides of a figure.)

2. If 1 gallon of linseed oil covers 50 square feet of wood, will 1/2 gallon of linseed oil be enough to thoroughly cover this beam? Explain how you know.

3. You have constructed a box to store woodworking tools. This box is cubed shaped with each side measuring 18 inches. What is the volume of this box?

4. What is one way you could build a rectangular box having the same volume as the cube shaped box above? (What would the length, width and height of this rectangular box be?)
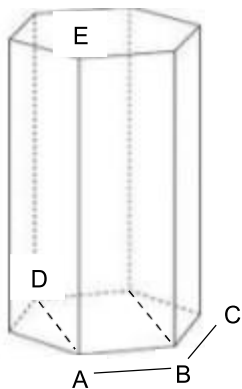
THE BLACK BUILDERS OF SALEM

Student Name: _____   Date: _____

Part 2: Finding the Surface Area and Volume of Rectangular and Triangular Prisms

You saw a few different ways of joining pieces of wood in the video. Some of these joints are composed of polygonal prisms. Below is a diagram of a 3-dimensional shape similar to one of the joints.

Decompose this shape into one rectangular prism and two triangular prisms to help you find the shape's surface area and volume.
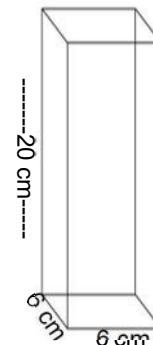
Distance from Point A to Point B = 6 cm
Distance from Point D to Point A = 6 cm
Distance from Point B to Point C = 5 cm
Distance from Point E to Point A = 20 cm

Step 1: Find the surface area and volume of the rectangular prism part.
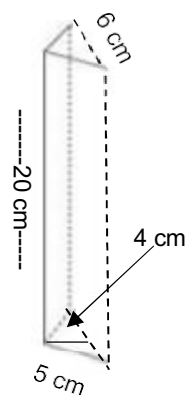
Surface Area: _____

Volume: _____

Step 2: Find the surface area and volume of the triangular prism parts.

Surface Area of 1 triangular prism: _____

Volume of 1 triangular prism: _____

Surface Area of both triangular prisms: _____

Volume of both triangular prisms: _____

Step 3: Put it all together to find the volume of the entire shape:

Volume of entire shape: _____

BONUS: What is the surface area of the entire shape? (HINT: 1 side of each triangular prism and 2 sides of the rectangular prism should not be used in your calculation.)

Surface Area of entire shape: _____

THE BLACK BUILDERS OF SALEM

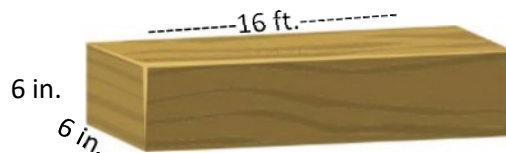In the video, you saw lots of polygonal figures in the building designs and in the construction materials. Regardless of the time period, builders have always had an intricate knowledge of geometry. Let's see how you "measure up" in applying some of these geometric principles!

Part 1: Reviewing Surface Area and Volume of Rectangular Prisms and Cubes

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1. What is the surface area of this timber beam <u>in square feet</u>? (REMINDER: Surface area is the sum of the areas of all sides of a figure.)

2(.5 x .5) + 4(16 x .5) = 32.5 square feet

2. If 1 gallon of linseed oil covers 50 square feet of wood, will 1/2 gallon of linseed oil be enough to thoroughly cover this beam? Explain how you know.

½ gallon will not be enough to thoroughly cover the beam. ½ gallon will cover only 25 square feet. You would need more linseed oil to make sure all 32.5 square feet are covered.

3. You have constructed a box to store woodworking tools. This box is cubed shaped with each side measuring 18 inches. What is the volume of this box?

18 18 x 18 = 5,832 cubic inches

4. What is one way you could build a rectangular box having the same volume as the cube shaped box above? (What would the length, width and height of this rectangular box be?)

Possible answers include: 36" X 9" X 18", 36" X 36" X 4.5", 12" X 12" X 40.5", 9" X 9" X 72"
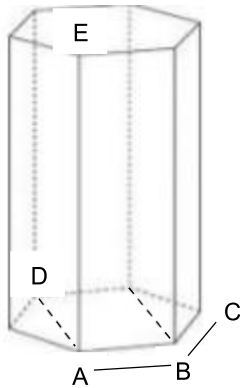
THE BLACK BUILDERS OF SALEM

Answer Key

Part 2: Finding the Surface Area and Volume of Rectangular and Triangular Prisms

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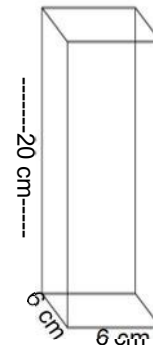
Distance from Point A to Point B = 6 cm
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Distance from Point B to Point C = 5 cm
Distance from Point E to Point A = 20 cm

Step 1: Find the surface area and volume of the rectangular prism part.

Surface Area: 4(20 x 6) + 2(6 x 6) = 552 square centimeters

Volume: 6 x 6 x 20 = 720 cubic centimeters
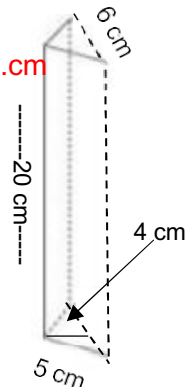
Step 2: Find the surface area and volume of the triangular prism parts.

Surface Area of 1 triangular prism: 2(20 x 5) + (20 x 6) + 2[½ (6 x 4)] = 344 sq.cm

Volume of 1 triangular prism: ½ (6 x 4) x 20 = 240 cubic cm

Surface Area of both triangular prisms: 344 x 2 = 688 sq. cm

Volume of both triangular prisms: 240 x 2 = 480 cubic cm

Step 3: Put it all together to find the volume of the entire shape:

Volume of entire shape: 720 + 480 = 1,200 cubic cm

BONUS: What is the surface area of the entire shape? (HINT: 1 side of each triangular prism and 2 sides of the rectangular prism should not be used in your calculation.)

Surface Area of entire shape: 2(20 x 6) + 2(6 x 6) + 4(20 x 5) + 4[½ (6 x 4)] = 760 sq. cm