

# Calculate Area and Volume

## Construction Math

How do we calculate area and volume?

**Timing:** < 1 minute

**DO:**

- Introduce yourself to the group.
- Explain this lesson will teach learners how to calculate area and volume of various shapes.

**SAY:**

- For today's lesson we will discuss how to calculate area and volume of various shapes

**[ADVANCE SLIDE]**

## Topic Overview



Today we will learn how to calculate area and volume of various shapes.

It's important to know how to calculate area and volume before working with concrete.

Terms to know:

- Area
- Volume
- Cubic feet
- Cubic yards

**Timing:** < 1 minute

**DO:**

- Explain why it is important to know how to calculate area and volume when working with concrete.

**SAY:**

- Today we will review what area and volume are and apply our knowledge to calculate area and volume of various shapes. A few key terms are area, volume, cubic feet, and cubic yards. It is important to know how to calculate area and volume when working with concrete to avoid costly mistakes. Take a look at this concrete failure that happened on a job site. We will learn how to ensure this doesn't happen when we are working.

**DO:**

- Play video.

**[ADVANCE SLIDE]**

## Outcomes



By the end of this lesson you will be able to:

- Calculate area for various shapes
- Calculate volume for various shapes

**Timing:** < 1 minute

**DO:**

- Review the content on the slide.

**SAY:**

- In this lesson you will learn how to calculate area and volume for various shapes.

**[ADVANCE SLIDE]**

# How do you calculate area for various shapes?



**Timing:** < 1 minute

**DO:**

- Read the question on the slide.

**SAY:**

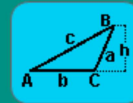
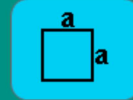
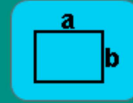
- How do you calculate area for various shapes? First let's discuss what area is.

**[ADVANCE SLIDE]**

# What is area?

Area is the amount of space a flat or 2D shape takes up.

| Shape     | Formula                        | Explanation                |
|-----------|--------------------------------|----------------------------|
| Rectangle | $\text{Area} = l \times w$     | $l$ = length $w$ = width   |
| Square    | $\text{Area} = a^2$            | $a$ = sides of the square  |
| Triangle  | $\text{Area} = 1/2 b \times h$ | $b$ = base $h$ = height    |
| Circle    | $\text{Area} = \pi r^2$        | $r$ = radius of the circle |



**Timing:** 1 minute

**DO:**

- Explain what area is and review formulas.

**SAY:**

- Area is the amount of space a flat of two dimensional shapes takes up. There are many different shapes but the ones we will discuss are rectangle, square, triangle, and circle.

**[ADVANCE SLIDE]**

**Additional Resources:**

Video: Calculating Area (14:51 minutes)

<https://www.youtube.com/watch?v=eLMjmWTI5jk&list=PLfZcU0E-cRgA8UeD3HJxxV3tsf4-VF4N0&index=6>

Video: Calculating Area-Triangle, Circle, Part of Circle (9:38 minutes)

<https://www.youtube.com/watch?v=eqkcyEu9W4M&list=PLfZcU0E-cRgA8UeD3HJxxV3tsf4-VF4N0&index=8>

Video: Calculating Area in Construction (5:28 minutes)

[https://www.youtube.com/watch?v=IA3hl\\_i5j4Y&list=PLfZcU0E-cRgA8UeD3HJxxV3tsf4-VF4N0&index=9](https://www.youtube.com/watch?v=IA3hl_i5j4Y&list=PLfZcU0E-cRgA8UeD3HJxxV3tsf4-VF4N0&index=9)

[cRgA8UeD3HJxxV3tsf4-VF4N0&index=12](#)

Time: 2 minutes

# When would you be required to calculate area in real life?

## Think - Pair - Share

1 minute: Think about a time you might need to calculate area.

1 minute: Share your response with the person to your left or right.

Be prepared to share with the class.



**Timing:** 2 minutes

### DO:

- Explain the think-pair-share activity. Time learners. Allow one minute for learners to reflect and write down a response. Allow one minute to share with the person to the left or right. Learner answers will vary.

### SAY:

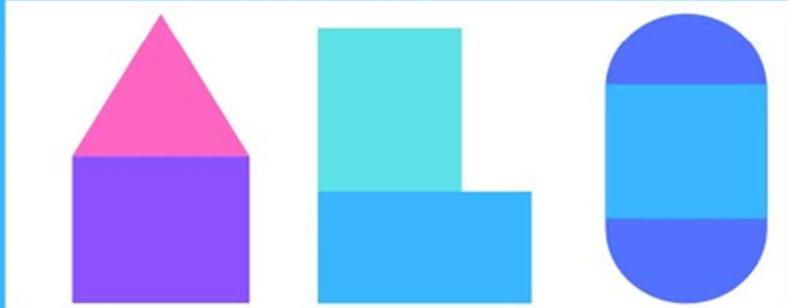
- For the next two minutes you will reflect and share your response with the person to your left or right. Be prepared to share with the class if you are asked to do so. You have one minute to think about a time you might need to calculate area. Let's get started. You can think about it or write your response in your notebook.

**[ADVANCE SLIDE]**



## Let's Practice

### Find the Area



#### Composite Figure

- Made up of two or more shapes.
- Look for shapes you know (rectangle, square, circle, triangle).
- Find area of each shape and add area of each shape to get total area.

**Timing:** 5 minutes

**DO:**

- Explain that learners will watch a short video to review area and see practice examples for calculating area. Later in the lesson, learners will work with others, and independently to calculate area.

**SAY:**

- Let's watch a short video to practice calculating area of various shapes. Make sure you are watching closely because later in the lesson, you will work with others, then by yourself to calculate area.

**DO:**

- Play the video.

**SAY:**

- Now let's work with our partner to the left or right to practice.

**[ADVANCE SLIDE]**



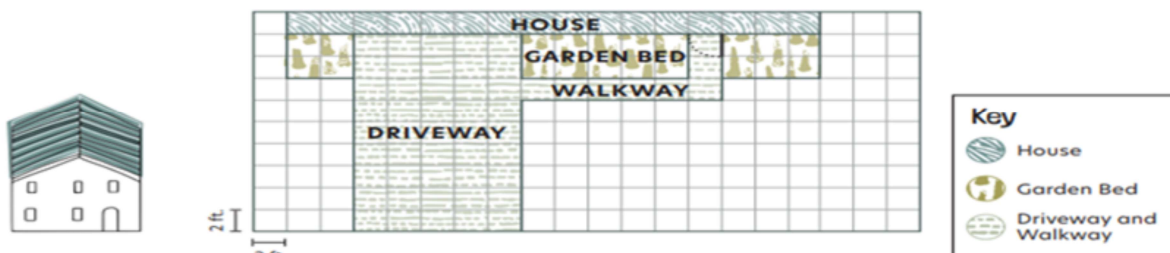
## Think-Pair-Share

Work with your partner to answer the questions.

Use this formula:  $\text{Area} = \text{length} \times \text{width}$

Time: 3 minutes

Riley's family is making some renovations to their front yard. Use the scale drawing below to help them plan! Each of the small squares on the drawing has side lengths of 2 feet. Follow the directions and answer each question.



1. Riley is helping her mom refresh the garden beds in the front of the house.

- Riley's mom is going to replace the mulch in each of the three garden beds. How much area will she need to cover with mulch?
- Riley will line the garden bed edges that do not touch the house with plastic landscape edging. How many feet of edging will she need for this?

Timing: 4 minutes

### Materials Needed:

- Worksheet, worksheet key

### DO:

- Give learners 3 minutes to complete this activity. Assign partners. Tell one person to work on question 1A and another to work on 1B. Explain they have 2 minutes to answer the question and one minute to share with each other.
- Set timer for 3 minutes. After 3 minutes have lapsed, facilitate discussion to share correct answers with class.

### SAY:

- You have 3 minutes to work with your partner to answer these two questions. One person will answer question 1A and the other 1B. Then you will share your answers with each other. Be prepared to share with the class if you are asked to do so.

### DO:

- Use answer key to provide correct answers to class when three minutes have lapsed.

### SAY:

- Let's check our work. The correct answer to 1A is \_\_\_\_\_. The correct answer to 1B is \_\_\_\_\_. (see answer key)

**[ADVANCE SLIDE]**



## Test Your Knowledge

Time: 10 minutes

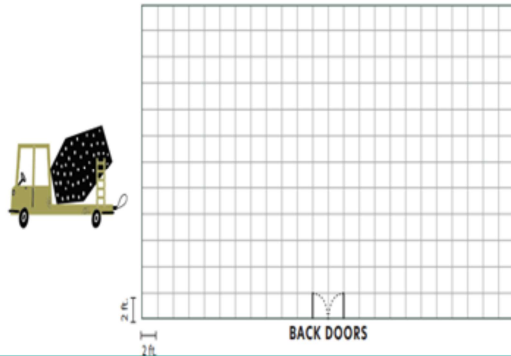
Complete this short quiz to show what you know.  
When you are finished, raise your hand so your quiz can be collected.

Use these formulas:

Rectangle/Square:  $A = l \times w$

Circle:  $A = \pi r^2$   $C = \pi d$   $C = 2\pi r$

Riley's family is also making some renovations to their backyard. Use the scale drawing below to help them plan. Follow the directions and answer each question.



### Question #3

Riley's dad wants to add a rectangular patio that he can walk onto from the back doors of the house. The patio should fit a square table with 6-foot side lengths. The table will have chairs on each side that should be able to push back 2 feet from the table without blocking the back doors or going off of the patio. Draw a patio on the scale drawing that will fit the table and chairs but have an area of less than 220 square feet. Then draw the table on the patio.

- Riley's dad will pour concrete to create the patio. How much area will he need to cover with concrete?
- Riley's mom will add a rectangular garden along the back of the patio. It will be the length of the patio and 4 feet wide. Draw the garden on the scale drawing. What is the area of the garden?

### Question #4

Riley and her mom want to build a circular fire pit with a diameter of 4 feet. They want the fire pit to be at least 6 feet from the patio. Draw a fire pit on the scale drawing.

- Riley and her mom will fill the bottom of the fire pit with a layer of crushed stone. Determine about how much area they will need to cover with crushed stone, using 3.14 as an approximation for  $\pi$ .

**Timing:** 10 minutes

### Materials Needed:

- Worksheet, worksheet key

### DO:

- Explain that learners will work independently to answer two questions. When they are finished, they will raise their hand for quiz to be collected.

### SAY:

- Now that you have practiced with your partner, it is time to test your knowledge with a short quiz. You have 10 minutes to complete questions three and four on page two of your worksheet. When you are finished, raise your hand and I will collect your quiz for it to be graded. Make sure to use these formulas listed on this slide. Good luck and do your best.

### DO:

- Set a timer for ten minutes. Walk around the room to monitor learners and collect quizzes. If learners have questions, provide clarification but avoid providing any answers to the questions so their knowledge can be accurately assessed. When learner raises hand, collect the quiz so it can be graded. Give learners a five minute warning when five minutes remain.

**SAY:**

- (5 minutes have lapsed) You have five more minutes to complete the quiz.
- (10 minutes have lapsed) Time is now up. If you have not already turned in your quiz, I will collect your quiz now.

**[ADVANCE SLIDE]**

**Additional Resources:**

Website: Area of a Circle

<https://tutors.com/math-tutors/geometry-help/area-of-a-circle>

## Summary



Area is the amount of space a flat shape takes up.

You use area in the real world to calculate the right quantity of materials you need. For example, how much tile is needed to renovate your bathroom.

**Timing:** < 1 minute

**DO:**

- Summarize the lesson on area.

**SAY:**

- Let's review what we just learned. Area is the amount of space a flat or 2D shape takes up. You calculate area in real life more times than you might be aware. For example, we determined how much mulch to use or maybe how many tiles to buy to remodel your bathroom. Let's now discuss how to calculate volume.

**[ADVANCE SLIDE]**

# How do you calculate volume for various shapes?



**Timing:** < 1 minute

**DO:**

- Read the question on the slide.

**SAY:**

- How do you calculate volume for various shapes? First let's discuss what volume is.

**[ADVANCE SLIDE]**

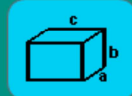
# What is volume?

Volume is the amount of space a 3D object takes up.

cube =  $a^3$



rectangular prism =  $a \times b \times c$



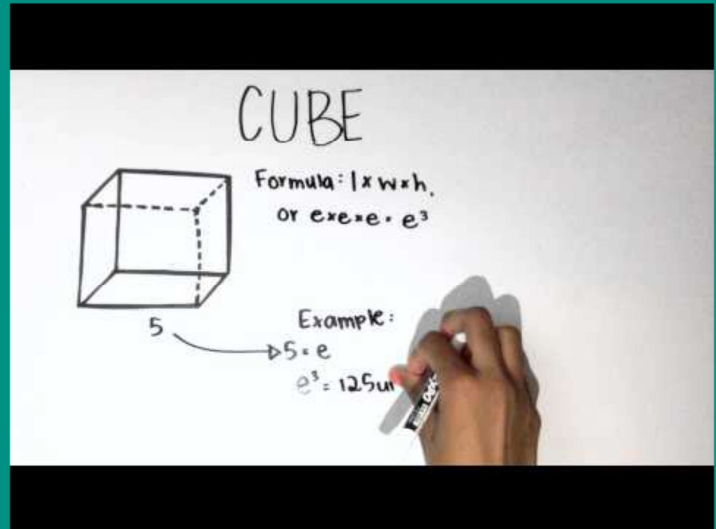
pyramid =  $(1/3) \times b \times h$



cone =  $(1/3) \times b \times h = 1/3 \times \pi \times r^2 \times h$



sphere =  $(4/3) \times \pi \times r^3$



**Timing:** 2 minutes

**DO:**

- Explain what volume is and review formulas.

**SAY:**

- Volume is the amount of space a three dimensional object takes up. Like area, there are many different shapes, but we will discuss these shapes: cubes, rectangular prism, pyramid, cone, and sphere. Let's view this short video to review what volume is.

**DO:**

- Play the video.

**SAY:**

- Now that you have a better understanding of what volume is, let's take a few minutes to reflect on what we have learned so far.

**[ADVANCE SLIDE]**

**Additional Resources:**

Video: Calculating Volume (6:34 minutes)

<https://www.youtube.com/watch?v=luxaaxoxoLA&list=PLfZcU0E->

[cRgA8UeD3HJxxV3tsf4-VF4N0&index=11](#)

Video: Calculating Volume (4:24 minutes)

<https://www.youtube.com/watch?v=YYs2FKzd9j4&list=PLfZcU0E-cRgA8UeD3HJxxV3tsf4-VF4N0&index=13>

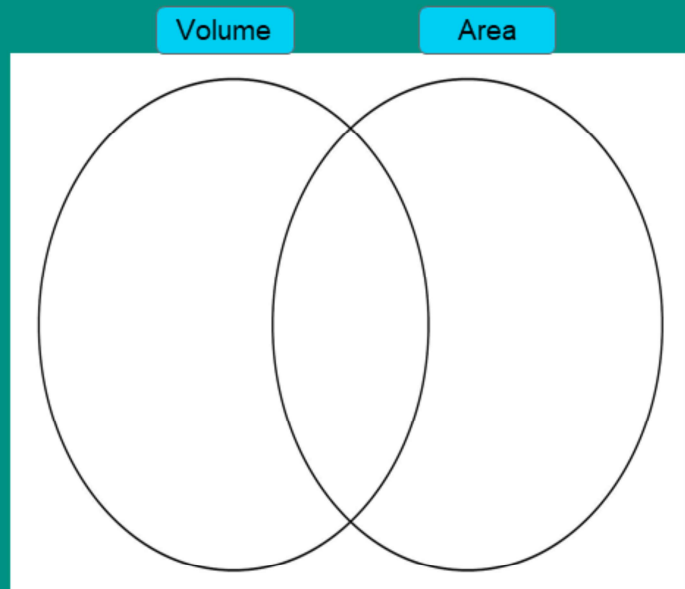
# How are area and volume alike and different?

Time: 2 minutes

Draw a Venn Diagram on your paper.

- Explain how area and volume are alike in the circles that overlap.
- Explain how area and volume are different in each circle.

Tip: Include the definition in your answer.



**Timing:** 3 minutes

**DO:**

- Explain that learners will draw a Venn Diagram on their paper and compare and contrast area and volume.

**SAY:**

- We have reviewed what area and volume is. Take two minutes to compare and contrast area and volume. Draw two overlapping circles on your paper, like the ones you see here. In the left circle explain what you know about volume. In the right circle explain what you know about area. Where the circles overlap, explain how area and volume are alike.

**DO:**

- Set a timer for two minutes. When two minutes have lapsed, explain to learners time is up.

**SAY:**

- (two minutes have lapsed) Time is now up. Let's discuss your responses.

**DO:**

- Facilitate class discussion for one minute. Answers vary. Make sure students share answers similar to these:

Alike: both measure objects/shapes

Different: Volume measures 3D object, area measures 2D, formulas are different

**[ADVANCE SLIDE]**



## Let's Practice



**Timing:** 5 minutes

**DO:**

- Explain that learners will view a video to see how a construction worker calculates cubic yards of concrete needed.

**SAY:**

- Now that we have discussed volume and area, it's time to see what these calculations look like on a construction site. Let's watch a video to see how a construction worker calculates cubic yards of concrete needed. First he finds the square footage by multiplying length times width. In our examples, we will first find the volume by multiplying length, width, and height. Either method can be used.

**DO:**

- Play the video.

**SAY:**

- Let's practice to check our understanding.

**[ADVANCE SLIDE]**

**Additional Resource:**

Website: How to Figure Concrete Yardage  
<https://www.wikihow.com/Figure-Concrete-Yardage>

**Job Aid:**

Share handout with learners to help them practice calculating concrete yardage.



## Work with Others

### Directions:

- Use formulas to answer the questions on your paper.
- Share your answers with others in your group to check your work.
- Your group selects one person to write the correct answer on the chart paper to share with the class.
- Participate in the gallery walk.



**Timing:** <1 minute

### DO:

- Explain that learners will answer questions independently, then share their answers with their group and then walk around the room to see other group's answers.

### SAY:

- For our next activity you will answer a question by yourself, then you will work with your assigned group to check your work, then you will walk around the room for a gallery walk to see other group's answers to different questions. This will help you check your understanding of what we have learned and learn from others. Let's get started.

**[ADVANCE SLIDE]**



## Time to Work

Time: 5 minutes

Complete the question  
you are assigned.

Use the formulas.  
Round up your answer.

1 foot = 12 inches  
1 yard = 3 feet  
 $V = L \times W \times H$   
Divide by 27 to convert to cubic yards.  
Convert to same measurement.  
(inches to feet)

### Question #1

Find the number of cubic yards of concrete needed for cellar floor in a house having outside dimensions of 30 ft x 34 ft if the floor is to be 4 in. thick.

### Question #2

A typical ratio of cement, sand, and gravel is 1:2:3. Using this ratio, determine volume in cubic feet of amounts needed for each of the following.

a. 1 cubic yards concrete.    b. 20 cubic yards concrete.

### Question #3

Find the number of cubic yards needed for each of the following slabs.

a. 12 ft x 65 ft x 3 in.    b. 25 ft 28 ft 6 in.

### Question #4

Estimated 15 yds<sup>3</sup> of concrete are needed to fill forms for a slab. Using 1:2:3 ratio, find number of yds<sup>3</sup> of cement, sand, and aggregate needed.

**Timing:** 6 minutes

### Material Needed:

Chart paper, tape, markers

Answer key:

1. 12.59 yd<sup>3</sup> Round up: 13yd<sup>3</sup>

|    | Cement             | Sand                | Aggregate           |
|----|--------------------|---------------------|---------------------|
| 2  |                    |                     |                     |
| a. | 4 ft <sup>3</sup>  | 9 ft <sup>3</sup>   | 13 ft <sup>3</sup>  |
| b. | 90 ft <sup>2</sup> | 180 ft <sup>3</sup> | 270 ft <sup>3</sup> |

Note: learners should round up each number

3.

a. 7.22 yd<sup>3</sup> Round up: 8 yd<sup>3</sup>

b. 12.96 yd<sup>3</sup> Round up: 14 yd<sup>3</sup>

4. 15 yd<sup>3</sup> Round up: 16 yd<sup>3</sup>

### DO:

- Explain that learners will work on the one question they are assigned for five minutes. When five minutes have lapsed, they will share with their group.

**SAY:**

- You will be assigned a group number. First you will work by yourself to answer your assigned question. After five minutes, you will work with your group to check your understanding, then you will walk around the room to see the other group's answers to the other questions. Let's start by assigning your group numbers. Once all people have been assigned a group, I will let you know when you can start working on your question.

**DO:**

- Assign learners a number by counting 1, 2, 3, 4, repeating 1, 2, 3, 4, until all learners have a number. Or you have assigned learners a number by each row. Try to have an equal number of learners in each group. Once all learners have a number, set a timer for five minutes and tell learners to get started. While learners are working, tape one piece of chart paper on a wall for each group (there should be four groups). Place several color markers beside the chart paper.

**SAY:**

- You can begin working. You have five minutes to answer your assigned question. If you finish early, begin working on the other questions.
- (after five minutes have lapsed) Time is now up. It's time to work with your group to check your understanding.

**DO:**

- Facilitate learners moving to assigned groups and beginning to work together to share answers.

**[ADVANCE SLIDE]**



# Gallery Walk

Time: 10 minutes

## Directions:

### 5 Minutes:

- Find the chart of the number you were assigned.
- Share your answers with the group to check your work.
- Your group selects one person to write the correct answer on the chart paper to share with the class.

### 5 Minutes:

- Participate in the gallery walk.



**Timing:** 11 minutes

## Materials Needed:

Chart paper, tape, markers

Answer key:

1. 12.59 yd<sup>3</sup> Round up: 13yd<sup>3</sup>

Cement Sand Aggregate

2

a. 4 ft<sup>3</sup> 9 ft<sup>3</sup> 13 ft<sup>3</sup>

b. 90 ft<sup>2</sup> 180 ft<sup>3</sup> 270 ft<sup>3</sup>

Note: learners should round up each number

3.

a. 7.22 yd<sup>3</sup> Round up: 8 yd<sup>3</sup>

b. 12.96 yd<sup>3</sup> Round up: 14 yd<sup>3</sup>

4. 15 yd<sup>3</sup> Round up: 16 yd<sup>3</sup>

## DO:

- Remind learners to go to their assigned groups and share their answers, select one person to write the correct answer and move to the gallery walk when told to do so.

**SAY:**

- You have five minutes to work with your group. Share your answers and choose one person to write the correct answer on the chart paper to share with the class. I will remind you of time remaining as you work and when it's time to begin the gallery walk. Good luck. Get started.

**DO:**

- Set a timer for 3 minutes. Walk around to each group to ensure they have the correct answers. When three minutes have lapsed, remind learners they have two more minutes. Set timer for two minutes and remind time is up when two minutes have lapsed.

**SAY:**

- (after 3 minutes have lapsed) You have two more minutes to write your group's answer on the paper.
- (after 5 minutes have lapsed) Time is up. It's time to begin the gallery walk. Move to your right to walk around the room to look at each group's response to each question. You should spend about 1 minute looking at each group and then move on to the next group. I will set a timer to remind you. Okay, let's get moving!

**DO:**

- Set a timer for 1 minute. When one minute has lapsed, remind groups to move to the next group. Repeat 2 more times to ensure each group has visited each of the other group's chart paper.

**SAY:**

- (after 1 minute has lapsed- this is repeated 3 times). It's time to move to the next group.
- (after 5 minutes have lapsed) Time is up. Thanks so much for your hard work and working together. I hope you enjoyed the gallery walk and learned more about volume. Now it's time to test your knowledge with a short quiz.

**[ADVANCE SLIDE]**

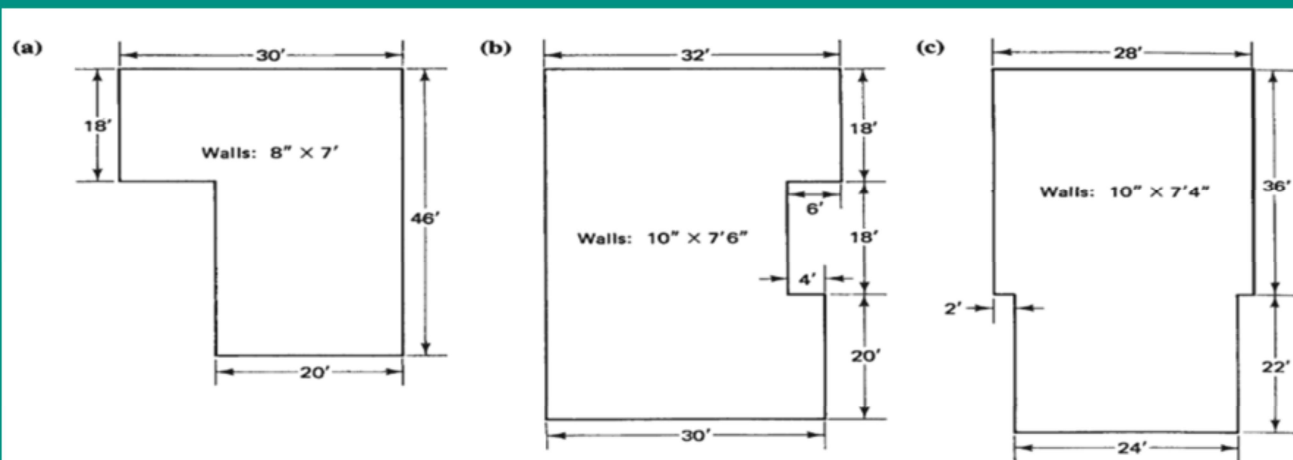


## Test Your Knowledge

Time: 10 minutes

Complete this short quiz to show what you know.  
When you are finished, submit your quiz on Canvas.

See foundations below. Dimensions are noted, including wall thickness and height. Assume footings to be 8 in. high and twice the thickness of the foundation wall; cellar floor is to be 3 in. thick. For each foundation, calculate the amount of concrete needed for footing, walls, and floor. Include a total figure.



**Timing:** 11 minutes

### Materials Needed:

Paper, pencil/pen

Textbook, page 242

Answer key (see page 396 in textbook and below)

a. footing: 5.0; walls: 26.3; slab: 10.2; total: 41.5 yd<sup>3</sup>

b. footing: 7.6; walls: 42.6; slab: 14.6; total: 64.8 yd<sup>3</sup>

c. footing: 7.1; walls: 38.9; slab: 14.2; total: 60.2 yd<sup>3</sup>

### DO:

- Explain that learners will work independently to answer three questions. When they are finished, they will raise their hand for quiz to be collected.

### SAY:

- Now that you have practiced with your group and reviewed other's answers, it's time to test your knowledge with a short quiz. Get out a piece of notebook paper and pencil or pen. Make sure to write your name on your paper and number your answers. You will answer these questions using the three foundations you see here. You can also find this question in your textbook on the bottom of page 242. You have ten minutes to complete this quiz. When you are finished, raise your hand and I will collect your quiz to be graded. Good luck. Get started.

**DO:**

- Set a timer for 10 minutes. Walk around the room to monitor learners and collect quizzes. If learners have questions, provide clarification but avoid providing any answers to the questions so their knowledge can be accurately assessed. When learner raises hand, collect the quiz so it can be graded. Give learners a five minute warning when five minutes remain.

**SAY:**

- (5 minutes have lapsed) You have five more minutes to complete the quiz.
- (10 minutes have lapsed) Time is now up. If you have not already turned in your quiz, I will collect your quiz now.

**[ADVANCE SLIDE]**

# Calculating area and volume helps you perform work tasks correctly and avoid costly mistakes.

## **Too little concrete**

may cause you to install concrete in two separate steps, which will create a structurally weak seam between the two placements.

## **Too much concrete**

is a waste of money.



**Timing:** <1 minute

## **DO:**

- Review the content on the slide.

## **SAY:**

- In today's lesson we learned how to calculate area and volume. This helps you perform your work tasks correctly and know the correct amount of materials to use to avoid wasting time and money. Let's review our lesson's key takeaways.

**[ADVANCE SLIDE]**

# Lesson Summary



- **Area** is the measurement of 2D objects.
- **Volume** is the measurement of 3D objects.
- Use the correct formula when calculating (volume or area).
- Convert all measurements to the same measuring system or units (feet, yards, etc.).
- Round up when making calculations. Too much concrete is better than too little.



How will you use what you learned when working on a construction site?

**Timing:** 2 minutes

**DO:**

- Review the content on the slide.
- Ask if learners have any questions.
- Ask learners to share how they will apply what they have learned to their daily work practices.

**SAY:**

- We have learned how to calculate area and volume for various shapes and apply what we have learned when working with concrete. The key takeaways are:  
Area measures 2D objects, volume measures 3D objects, make sure you use correct formulas when calculating, convert all measurements to the same units, and round up when making calculations.
- Take a minute to reflect and answer this question: How will you use what you learned in this lesson when working on a construction site? Be prepared to share with the class if asked to do so.

**DO:**

- Set a timer for 1 minute. Once a minute has lapsed, ask learners to share their response.

**SAY:**

- (after a minute has lapsed) Who would like to share with the class how you will use what you have learned?

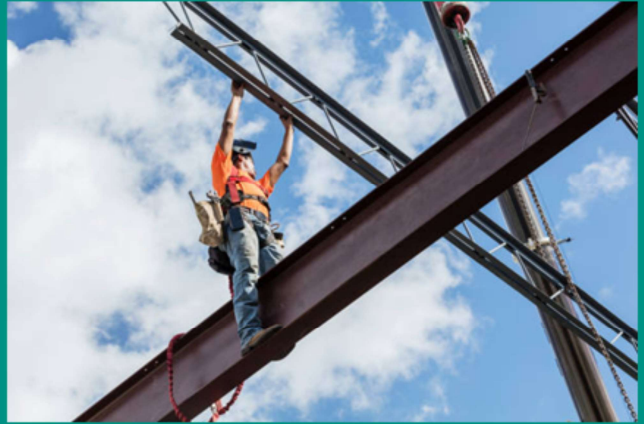
**DO:**

- For one minute facilitate class discussion by calling on students that volunteer to share.

**[ADVANCE SLIDE]**

Next...

- We will discuss what a girder is and how it is built.



**Timing:** <1 minute

**DO:**

- Thank learners for participating.

**SAY:**

- Thank you all for your hard work and working together today to learn about volume and area. In the next lesson we will discuss what a girder is and how it is built.

**[END OF PRESENTATION]**