Slam Dunk!

Overview

Students will use radius, diameter, length, width, and height to find volume of spheres and prisms as well as area of circles and rectangles. They will discuss when to use a two-dimensional measurement vs. a three-dimensional measurement using spatial reasoning.

Math Concepts

- Geometry
- Measurement
- Problem solving
- Order of operations
- Spatial reasoning
- Rounding

Materials

- TI-34 MultiView™
- Basketball
- Pencil
- Paper
- Ruler

Activity

Review area, volume, and length first.

Give me an example of length. When would you use length? How many dimensions does length measure?

Possible student responses include “the length of a shoe,” “the distance between two houses,” and “anything you can measure with a ruler.” Length measures one dimension in units such as yards, centimeters, or miles.

Now let’s review area. When would you need to find the area of an object? How many dimensions does area measure?

Student responses may include “when you are painting a wall” and “when you are planting grass in your yard.” Area measures two dimensions, such as length and width, or height and length. Area is denoted in square units because there are two dimensions. Examples include square inches, square miles, and square meters.

One last concept to review is volume. What does volume measure? Give me an example of when you would find the volume of an object. How many dimensions does volume measure?

Feedback from the students may include “the amount of water in a swimming pool” and “the volume of crackers or chips in a package.” Another appropriate response would be “the amount of space something takes up.” They may need more review on volume than on the other measures. Volume measures three dimensions in units such as cubic centimeters, cubic feet, and even ounces.

Go through an example of each so students can practice. Write the formulas $P_{\text{rect}} = 2l + 2w$, $A_{\text{rect}} = lw$, $A_{\text{circle}} = \pi r^2$, $V_{\text{rectprism}} = Bh$ where B is the area of the base, and $V_{\text{sphere}} = \frac{4}{3}\pi r^3$ on the board for students to use.

Let’s work through the following examples. Write down each problem and attempt it at your seat:

1. *Find the area of a floor that measures 13 feet by 15 feet.*
2. *What is the perimeter of a yard that is 42 meters long and 35 meters wide?*
3. *What is the volume of a sphere with a radius of 6 centimeters?*

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Discuss how to calculate each, and discuss the appropriate units. Show the students how to use the Exact pi feature of the TI-34 MultiView. Discuss *exact* vs. *estimated* with regard to π.

The answers are as follows:

1. $A = l \cdot w = 13 \text{ ft} \cdot 15 \text{ ft} = 195 \text{ ft}^2$
2. $P = 42 \text{ m} + 42 \text{ m} + 35 \text{ m} + 35 \text{ m} = 154 \text{ m}$
   or $P = 2(42) + 2(35) = 154 \text{ m}$
3. $V = \frac{4}{3}\pi r^3 = = \frac{4}{3}\pi\left(6\,\text{cm}\right)^3 = \frac{4}{3}\pi\ (216\ \text{cm}^3) = 288\pi\ \text{cm}^3$

Now, present this scenario to the class:

Adam is the manager of the varsity basketball team and is in charge of transporting all equipment to away games. He needs 10 basketballs for the playoff game next week and is shipping them to the other team's school so they are sure to arrive on time. He found a box in the coach's office that was $3\frac{1}{2}$ feet long, 1 foot wide, and $1\frac{1}{2}$ feet tall. Is this box large enough for the 10 basketballs?

Have students offer their ideas, and encourage them to brainstorm aloud. Hopefully, you will hear suggestions such as "we need the dimensions of a basketball" or more-specific ideas like "we would need to know the radius/diameter of each basketball so we could find the space each basketball would occupy." Discuss all suggestions heard, including whether this situation requires us to find the area or the volume, or possibly neither.

We heard several suggestions, so let's try one of them. If we can find the volume of the box, then divide that by the volume of one basketball, will that tell us how many basketballs will fit? Let's try.

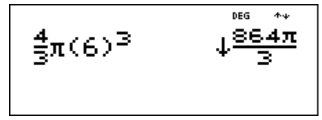
Step 1: Find the volume of the box in cubic inches.

Discuss the fact that you need to use cubic inches so the units are the same throughout the problem.
$V_{crate} = Bh = lwh = 42 \text{ inches} \cdot 12 \text{ inches.} \cdot 18 \text{ inches} = 9{,}072 \text{ cubic inches}$

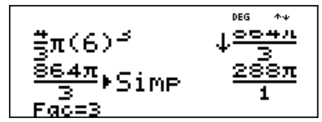
Step 2: Determine the measurement needed from the basketball in order to use the volume formula. (We need either the radius or the diameter.)

Follow these steps:

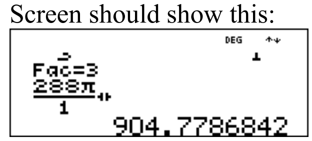
1. Press 4 Π 3 ∀ γ Δ 6 Eδ 3 <.
2. Screen should show this:



3. Press } < to simplify the fraction.
4. Screen should show this:



5. To demonstrate the difference between an "exact" answer and an estimated answer, now press ρ.
   Screen should show this:



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Have the students take a basketball and measure either the radius or the diameter so you can ultimately have the radius. Nine inches was used below for the diameter.

Step 3: Find the volume of one basketball in cubic inches:

$$V_{basketball} = \frac{4}{3}\pi r^3 = \frac{4}{3}\pi\left(4.5 \text{ inches}\right)^3 \approx 381.7 \text{ cubic inches}$$

Step 4: Divide the volume of the box by the volume of one basketball:

$$\frac{9{,}072 \text{ inches}^3 \div 381.7 \text{ inches}^3}{1 \text{ basketball}} \approx 23.7 \text{ basketballs}$$

With this process, we've concluded 23 basketballs will fit in the box. Since we only need 10, this particular box is large enough.

Now, as a class, discuss two things: Does this answer makes sense, not just mathematically but also in practice; if not, why not.

The model we just tried assumes that all available volume in the box is occupied. Is that realistic? Why or why not?

The students may not be able to visualize that there is unoccupied space around each basketball without seeing a three-dimensional drawing or physically seeing an example. You can use tennis balls in a clear plastic can to illustrate the concept of unoccupied space. This works well since the plastic is transparent. In addition, a graphic is included at the end of the activity for classroom projection.

Even though the basketballs are three-dimensional, volume is not the appropriate measure to use in this situation, because not all available space within the box can be occupied. As a matter of fact, we need to consider only the diameter of the basketballs to decide whether this box is large enough.

See the graphic provided for explanation. Work through it with the students. Help them understand that, while there is, mathematically, enough space in the box if we consider only the volumes of the balls and box, there is physically no way to fit 10 balls in this particular box.

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Name ______________________

Date ______________________

Directions: In Problems 1–5, find the area of the described figure using your TI-34 MultiView™. Your answers should be exact, rather than estimated, and should include appropriate units. Sketch the figure, and label all measurements. Problems with (lightbulb) should be calculated using mental math rather than the calculator.

1. Area of a circle with radius 3 cm

2. Area of a rectangle with length 8 in. and width 6.5 in.

3. Area of a square with one side 12 mm long

4. Area of a circle with diameter 4.5 ft

5. Area of a rectangle with length 1 ft and width 6 in.

Directions: In Problems 6–10, find the volume of the figure described using your TI-34 MultiView. Your answers should be exact, rather than estimated, and should include appropriate units. Sketch the figure, and label all measurements.

6. Volume of a rectangular prism with length 3 cm, width 5 cm, and height 10 cm

7. Volume of a sphere with radius 6 in.

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Name ______________________

Date ______________________

8. Volume of a cube with side length 5 dm

9. Volume of a sphere with diameter 24 mm

10. Volume of a rectangular prism with base area 130 in^2 and height 1 ft

11. You work for a sporting goods supply company and are in charge of shipping basketballs to the U.S. Olympic Complex for their practice gym. Since the basketballs are being purchased in bulk, they are unboxed. You will be putting them in a special crate and shipping them in a large delivery truck. The crate measures 12 ft long, 8 ft wide, and 10 ft high. If the basketballs are loaded from the top, how many will fit? Each basketball has a diameter of 9 in.

    Explain how you arrived at your answer.

    Draw a sketch of this scenario. Make your sketch to scale using 1 in. = 1 ft.

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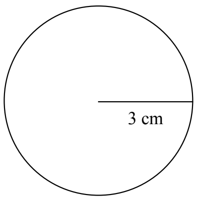
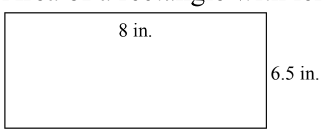
Answer Key

Directions: In Problems 1–5, find the area of the figure described using your TI-34 MultiView™. Your answers should be exact, rather than estimated, and should include appropriate units. Sketch the figure, and label all measurements. Problems with 💡 should be calculated using mental math rather than the calculator.

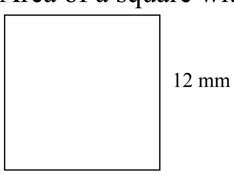
1. Area of a circle with radius 3 cm $A = \pi r^2 = 9\pi$ cm^2



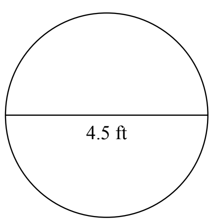
2. 💡 Area of a rectangle with length 8 in. and width 6.5 in. $A = lw = 52$ in^2



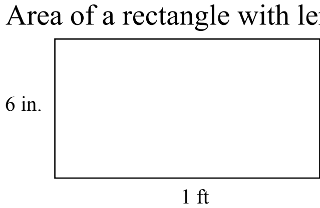
3. 💡 Area of a square with one side 12 mm long $A = lw = 12 \cdot 12 = 144$ mm^2



4. Area of a circle with diameter 4.5 ft $A = \pi r^2 = \pi\left(\frac{4.5}{2}\right)^2 = 5.0625\pi$ ft^2



5. 💡 Area of a rectangle with length 1 ft and width 6 in. $A = lw = 12 \cdot 6 = 72$ in^2



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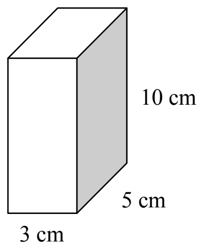
Directions: In Problems 6–10, find the volume of the figure described using your TI-34 MultiView. Your answers should be exact, rather than estimated, and should include appropriate units. Sketch the figure, and label all measurements.

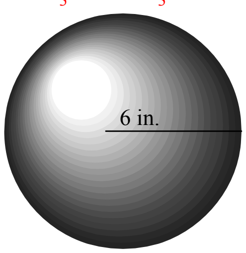
6. Volume of a rectangular prism with length 3 cm, width 5 cm, and height 10 cm

$V = Bh = lwh = 3 \cdot 5 \cdot 10 = 150 \text{ cm}^3$



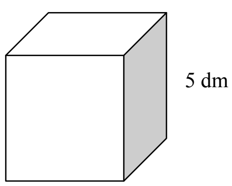
7. Volume of a sphere with radius 6 in.

$V = \frac{4}{3}\pi r^3 = \frac{4}{3}\pi 6^3 = \frac{4}{3}\pi(216) = 288\pi \text{ in}^3$



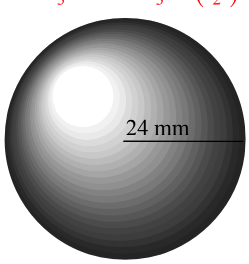
8. Volume of a cube with side length 5 dm

$V = Bh = lwh = 5 \cdot 5 \cdot 5 = 125 \text{ dm}^3$



9. Volume of a sphere with diameter 24 mm

$V = \frac{4}{3}\pi r^3 = \frac{4}{3}\pi\left(\frac{24}{2}\right)(12)^3 = \frac{4}{3}\pi(1{,}728) = 2{,}304\pi \text{ mm}^3$



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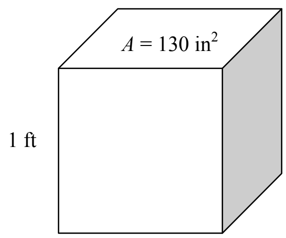
10. Volume of a rectangular prism with base area 130 in^2 and height 1 ft

$V = Bh = 130\ in^2 \cdot 1\ ft =$
$= 130\ in^2 \cdot 12\ in. = 1{,}560\ in^3$



11. You work for a sporting goods supply company and are in charge of shipping basketballs to the U.S. Olympic Complex for their practice gym. Since the basketballs are being purchased in bulk, they are unboxed. You will be putting them in a special crate and shipping them in a large delivery truck. The crate measures 12 ft long, 8 ft wide, and 10 ft high. If the basketballs are loaded from the top, how many will fit? Each basketball has a diameter of 9 in.

V_{box} = 12 ft · 8 ft · 10 ft = 144 in. · 96 in. · 120 in.

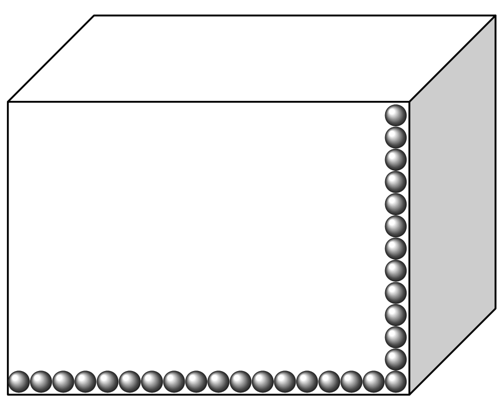
We can fit 2,080 basketballs in the crate. See below for complete explanation.

Explain how you arrived at your answer.

Since each basketball measures 9 in. in diameter, divide 144 in. by 9 in. to see we can fit 16 basketballs across the front. Similarly, divide 96 in. by 9 in. to see how many basketballs will fit along the width. We get $10\frac{2}{3}$, which is not a realistic answer, so we can fit 10 basketballs along the width. For the height, we can stack $13\frac{1}{3}$ basketballs according to the math, but again, this is unrealistic, so we can go 13 basketballs high.

16 · 10 · 13 = 2,080 basketballs

Draw a sketch of this scenario. Make your sketch to scale using 1 in. = 1 ft.



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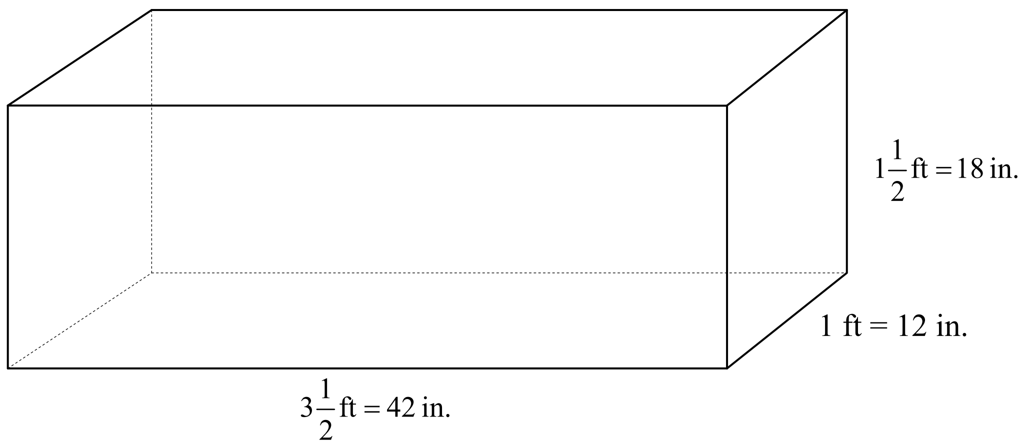
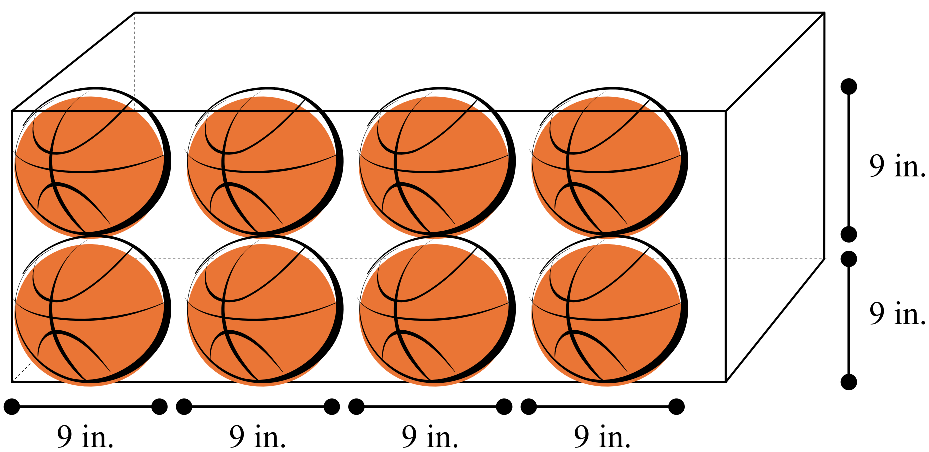
Transparency





Each basketball has a diameter of 9 in. Five basketballs placed side by side would require $9 \cdot 5 = 45$ in. Since our box is only 42 in. long, the 10 basketballs WILL NOT FIT in this box.

There is enough width and enough height, just not enough length.