Math Objectives

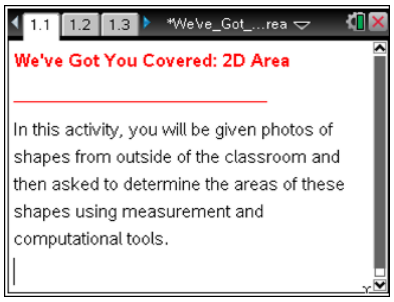
- Students will solve real-world and mathematical problems involving area of two-dimensional objects composed of triangles, quadrilaterals, and polygons (CCSS).
- Students will make sense of problems and persevere in solving them (CCSS Mathematical Practice).
- Students will reason abstractly and quantitatively (CCSS Mathematical Practice).

Vocabulary

- area
- scale
- base and height
- triangle
- quadrilaterals
- polygons

About the Lesson

- This lesson involves using the geometry tools to measure the area of two-dimensional shapes from the faces of three-dimensional objects they see in pictures taken outside of the classroom.
- As a result, students will:
  - Further develop visualization skills as they search for 2D faces in the 3D shapes in the pictures.
  - Further develop approximation skills as they adjust the size of the default scale provided so that the measures they find from the 2D faces will be appropriate.
  - Solve real-world and mathematical problems involving the area of 2D shapes, possibly of their own creation if time permits students to take their own pictures.



TI-Nspire™ Technology Skills:

- Download a TI-Nspire document
- Open a document
- Move between pages
- Grab and drag a point

Tech Tips:

- Make sure the font size on your TI-Nspire handhelds is set to Medium.

Lesson Files:

Student Activity

We've_Got_You_Covered_2D_Area.pdf

We've_Got_You_Covered_2D_Area.doc

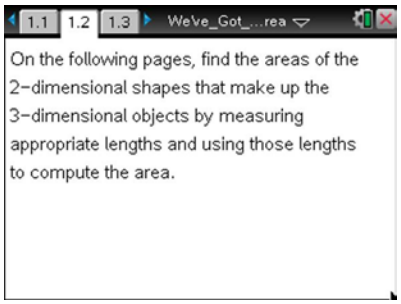
TI-Nspire document

We've_Got_You_Covered_2D_Area.tns

Visit www.mathnspired.com for lesson updates and tech tip videos.

Discussion Points and Possible Answers

Move to page 1.3.



1. In each picture of items from outside of the classroom, you will construct and measure the line segments you need to calculate the area of the 2D shape that you choose. Follow these steps:
   - Use only the Segment tool and the Perpendicular tool when drawing on the pictures.
   - Double-click on the value of the scale and change it until the measures are more appropriate for the object. Look at a meterstick, ruler, or items in your classroom to help you estimate.
   - When the measurements are more realistic for the object, calculate its area by inserting a Calculator Page (ctrl [+page] enter)
   - Enter your results into the table below.

Teacher Tip: Due to the length of class time, you might want to suggest particular pictures that all students work on or use a jig-saw strategy where certain groups work on certain pictures and then share findings with the whole class, so that they can all continue with the additional problems in Question 2. The instructions suggest that students only find one 2D shape to measure in each picture, again, to save time. However, for pictures 1.3, 1.4, and 1.7, multiple shapes are needed to respond to the additional problems, so again you might want the same group to be finding all needed shapes in one picture or have two groups working together on the same picture but choosing different shapes, ensuring both groups use the same scales. Alternatively, you might just want to use more than one class session if you have students take their own pictures, upload, and then create measurement problems of their own.

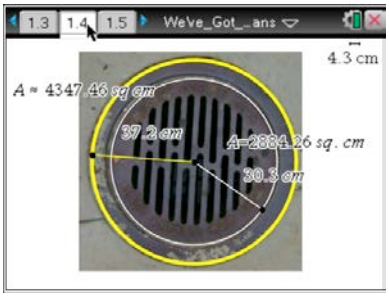
Teacher Tip: The intent is that students use the segment tool versus using the shapes tool to trace the 2D shapes so that they will apply area rules of 2D shapes and understand what dimensions are needed to find the areas.

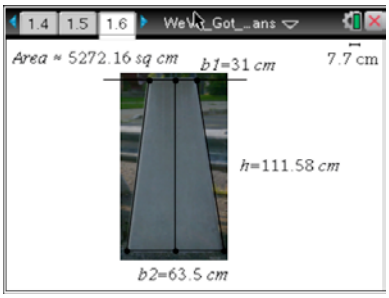
Sample Answers:

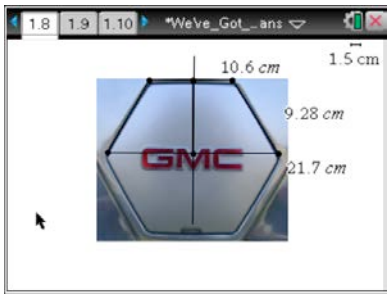
Draw your shape with measurements:	Area formula(s) used:	Calculated Area: (show your work)
 Long Brick	Area of rectangle = length * width **OR** $A = L \times W$	A ≈ 5.53 cm x 19.9 cm ≈ 110 sq. cm
 The Grate	Area of a circle = pi x radius squared **OR** $A = \pi r^2$	$A \approx \pi(30.3\text{ cm})^2 \approx 2884.26\text{ cm}^2$
 The Emblem	Area of a circle = pi x radius squared **OR** $A = \pi r^2$	$A \approx \pi(8.39\text{ cm})^2 \approx 221.143\text{ cm}^2$
 The face of the parking barrier	Area of a trapezoid = one-half the sum of the bases times the height **OR** $A = \frac{1}{2}(b_1 + b_2)h$	$A \approx \frac{1}{2}(31\text{ cm} + 63.5\text{ cm})(111.58\text{ cm})$ $\approx 5272.16\text{ cm}^2$
 The Emblem	Area of a trapezoid = one-half the sum of the bases times the height **OR** $A = \frac{1}{2}(b_1 + b_2)h$	Area of the top (isosceles) trapezoid $A \approx \frac{1}{2}(10.6\text{ cm} + 21.7\text{ cm})(9.28\text{ cm})$ $\approx 1067.29\text{ cm}^2$ Total Area $A \approx 2 \cdot (1067.29\text{ cm}^2) \approx 2134.59\text{ cm}^2$
 The Sign	Area of a triangle= One-half the product of the base and the height **OR** $A = \frac{1}{2}bh$	Area of one triangle $A \approx \frac{1}{2}(30.9\text{ cm})(37.1\text{ cm})$ $\approx 573.195\text{ cm}^2$ Total Area $A \approx 8 \cdot (573.195\text{ cm}^2) \approx 4585.56\text{ cm}^2$

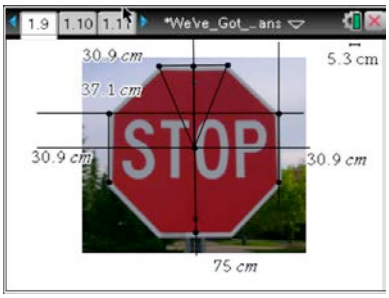
 The Letter A	Area of a trapezoid = one-half the sum of the bases times the height **OR** $A = \frac{1}{2}(b_1 + b_2)h$ **AND** Area of a parallelogram = base x height **OR** $A = bh$	Area of top trapezoid $A \approx \frac{1}{2}(2.92\text{ cm} + 3.74\text{ cm})(2.11\text{ cm})$ $\approx 7.0263\text{ cm}^2$ Area of middle trapezoid $A \approx \frac{1}{2}(1.86\text{ cm} + 2.55\text{ cm})(1.81\text{ cm})$ $\approx 3.99105\text{ cm}^2$ Area of the two parallelograms $A = 2 \cdot (7.71\text{ cm} \cdot 1.75\text{ cm})$ Total area $A \approx 7.0263\text{ cm}^2 + 3.99105\text{ cm}^2$ $+2 \cdot (7.71\text{ cm} \cdot 1.75\text{ cm})$ $\approx 38.0024\text{ cm}^2$

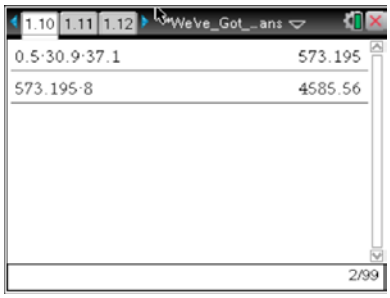
Sample Measurements:

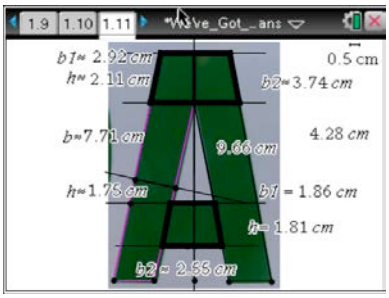


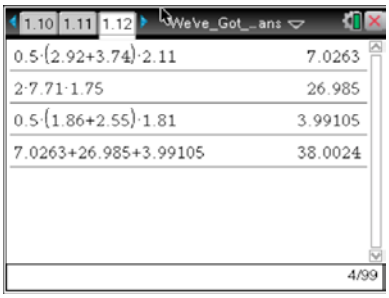












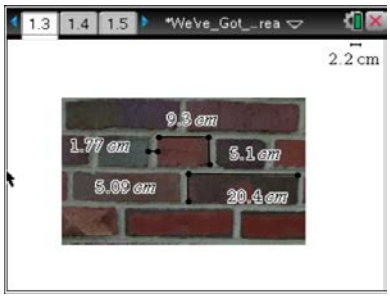
TI-Nspire Navigator Opportunity: *Live Presenter*
See Note 1 at the end of this lesson.

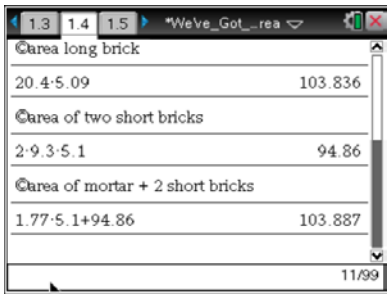
2. For picture 1.3, there are two different faces of the bricks shown, one long and the other short. Visually, it may appear that the area of two of the shorter brick faces is the same as the area of the longer brick face. Is it true? Explain why or why not.

Sample Answers:

No; based upon my estimates, the area of the face of the longer brick is approximately 110 cm^2 and the area of the face of the shorter brick is approximately 56.3 cm^2. 56.3 * 2 ≠ 110.

Teacher Tip: With different drawings, the area of two short bricks plus the area of the mortar between them adds up very close to the area of a long brick. The variability of possible answers should be expected and can contribute to some good student critiquing of their peers' answers.





3. In picture 1.4, there is a rim around the outside of the drainage cover. What is the area of just the rim? Show your work to justify your answer.

Sample Answers:

4347.46 cm^2 – 2884.26 cm^2 = 1463.2 cm^2.

4. Suppose the identical trapezoidal faces of the parking barriers on picture 1.6 are to be painted with reflective paint. If one can of reflective paint covers approximately 22 square feet, how many cans will be needed to spray all the faces? Show your work.

Sample Answers: 5272.155 cm^2 /929.03cm^2 ≈ 5.67 ft^2 on one face. (5.67)4 = 22.68 ft^2 for all 4 faces. You should buy more than one can to be safe.

Wrap Up

Upon completion of the lesson, the teacher should ensure that students are able to understand:

- 2D shapes occur in the real world as faces of 3D objects.
- That to calculate the area of a shape composed of triangles, quadrilaterals, and polygons you might have to combine area formulas to determine the total area of the shape.

Extension Activity

Have groups take pictures of objects and share them with the class to determine a set of "best pictures" to be added to the existing document (or create a new document). Students then suggest problems to accompany each picture and solve.

Tech Tip: Students need to be at a "right angle" to the picture so that dimensions are distorted as little as possible. USB cables from cameras or cell phones to a computer will be needed for uploading and saving picture files to the teacher's computer to share with the whole class.

Assessment

Make needed and appropriate measures to find the area of the "arrowhead" on the parking sign on p. 1.10.

Sample Answer:

0.5(14.4 cm)*14.3 cm ≈ 103 cm^2.

TI-Nspire Navigator Opportunity: *Quick Poll*
See Note 2 at the end of this lesson.

TI-Nspire Navigator

Note 1

Question 1, Name of Feature: Live Presenter

Have students share their process for finding the area for some of 2D shapes, along with justifying their approximations for the dimensions. Why do they believe their choices of scale are reasonable?

Note 2

Assessment, Name of Feature: Quick Poll

You can use Quick Poll to see if students can determine the area of the arrowhead using the draw and measurement tools.