Grade 8 Surface Area of prism

8.SS.3	
Determine the surface area of • right rectangular prisms • right triangular prisms • right cylinders to solve problems.	1. Explain, using examples, the relationship between the area of 2-D shapes and the surface area of a 3 D object. (ONLY FOR RECTANGULAR PRISM) 2. Identify all the faces of a prism, including right rectangular and right triangular prisms. (ONLY FOR RECTANGULAR PRISM) 3. Describe and apply strategies for determining the surface area of a right rectangular or right triangular prism. (ONLY FOR RECTANGULAR PRISM) 4. Describe and apply strategies for determining the surface area of a right cylinder. (NOT DEVELOPED) 5. Solve a problem involving surface area. (RECTANGULAR PRISM ONLY)

Clarification of the outcome:

- ✦ The outcome is unpacked into three parts: (1) surface area of right rectangular prism, (2) surface area of right triangular prism, and (3) surface area of cylinder. The reason is that each object has a distinct surface area formula that is not well related to the other formulas.
- ✦ The focus here is the surface area of a right rectangular prism (technical language for a cardboard box type of object). Surface area is equivalent to the area of the skin of the box (the cardboard sides that compose it). Another way to say this is that surface area is the area of the faces of an object, in this case a box.

Required close-to-at-hand prior knowledge:

- ✤ Understand area as a count of identical squares that cover a surface.
- ✤ Understand the area formula for a rectangle as base x height (not length x width).
- ✤ Comfortable with faces, edges, and vertices (particularly faces).

SET SCENE stage

The problem task to present to students:

Organize students into groups of 2. Provide each group with a small cardboard box (e.g. tissue paper box). Ask students to figure out the total area of cardboard that makes up the box.

Comments:

The main purpose of the task is to engage students in thinking about the surface area of a right rectangular prism (a box).

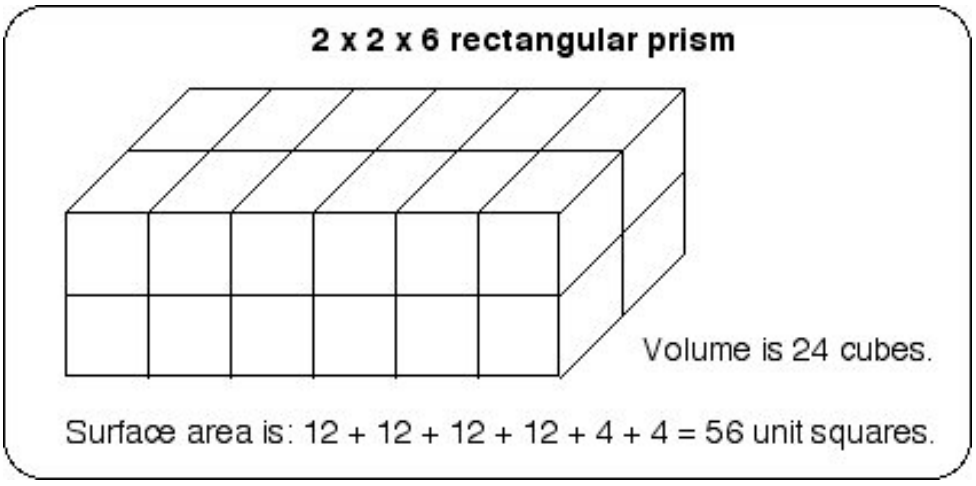
DEVELOP stage

Activity 1: Revisits SET SCENE, and addresses achievement indicators 1, 2, 3, and 5.

- Ask selected groups to present their strategy for determining the total area of cardboard needed to make the box. Accept all responses. [Note: If a student sees a short cut, acknowledge that but say that we need to look at matters more deeply before using a short cut.] Tell students the total area of the box is its surface area.
- Provide students with a variety of 3-D objects (e.g. box, cone, sphere, etc.). Discuss the surface area of the objects in relation to the faces of the objects. [NOTE: The face of a curved object is tricky. In general, have students understand that face is equivalent to skin.] Ensure that students experience surface area by touching the faces that comprise each object. Discuss why it might be important to determine surface area (e.g. painting the outside of a house involves surface area of the walls; cooling rate of an animal such as an elephant involves surface area of its skin).

Activity 2: Addresses achievement indicators 1, 2, 3, and 5.

- Organize students into groups. Provide each group with 24 unit cubes (e.g. multi-link cubes). Ask each group to construct a right rectangular prism using all 24 cubes (three possible prisms are: 1 x 2 x 12, 2 x 2 x 6, 2 x 3 x 4). Ask each group to determine the surface area of their prism by thinking about the rectangular faces of the prism. Ask each group to show its prism and describe its volume and surface area (see the example). Discuss that the volume is the same for each prism (24 cubes) but the surface area can vary.



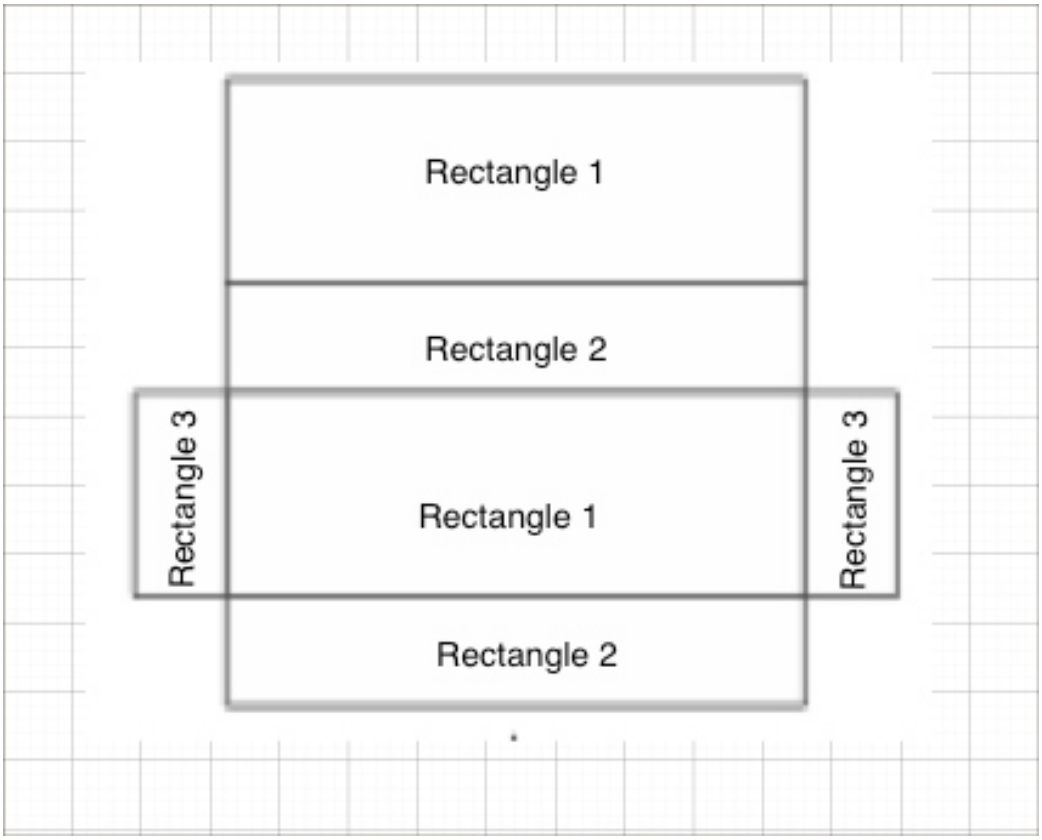
Note:

The reason for including volume (a grade 6 outcome) is to compare and contrast surface area with volume. Some students may have the mistaken notion that surface area is like volume.

ENSURE that students realize that, in this activity, surface area can be obtained by counting squares and volume by counting cubes.

Activity 3: Addresses achievement indicators 1, 2, 3, and 5.

- Organize students into groups. Provide each group with a small box having length, width, and height of different dimensions. Discuss the six faces (rectangles) that comprise the surface of the box and have students make a net of the box (by unfolding the sides of the box - see diagram).



- Ask each group to come up with a strategy for determining the surface area of their box. Discuss the various strategies. ENSURE that students realize that the surface area is twice the sum of the areas of the three distinct rectangles forming the net of the box (see formula below) AND/OR the sum of twice the area of each of the three rectangles forming the net of the box (see formula below).

Surface area = 2 x (rectangle 1 + rectangle 2 + rectangle 3)

Surface area = 2 x rectangle 1 + 2 x rectangle 2 + 2 x rectangle 3

Activity 4: Addresses achievement indicators 1, 2, 3, and 5.

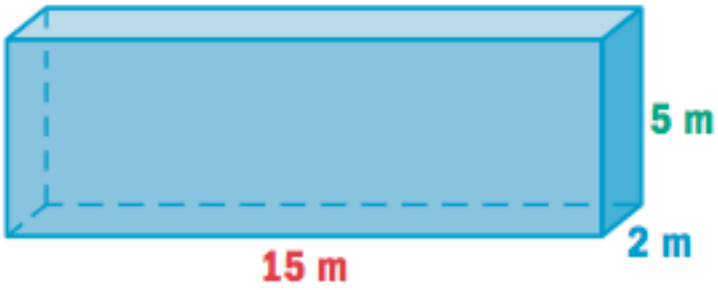
- Organize students into groups. Provide each group with 36 unit cubes (e.g. multi-link cubes). Ask each group to construct four different rectangular prisms using all 36 cubes (four possible prisms are: 1 x 1 x 36, 2 x 3 x 6, 1 x 6 x 6, 3 x 3 x 4). Ask each group to determine the surface area of each of their prisms (encourage formula thinking). Ask them to arrange the areas from smallest to largest.
- Ask students to conclude what type of rectangular prism has the largest surface area and what type has the smallest surface area. Discuss the results. ENSURE students realize that a long and skinny rectangular prism has the largest surface area while a prism that is close to being a cube (a compact prism) has the smallest surface area.

Activity 5: Addresses achievement indicators 1, 2, 3, and 5, and practice.

- Provide problems concerning surface area (see examples). Ask selected students to show their solutions. Discuss the results.

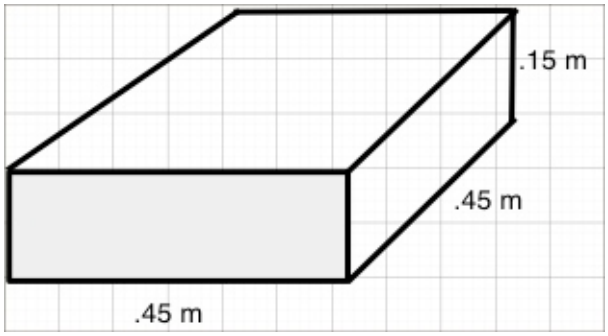
Example 1:

What is the surface area of the box?



Example 2:

You are making the stadium cushion shown in the diagram. The fabric for the cover costs $6.50 per square metre. What is the cost of fabric to make one cushion if the fabric covers the top, and all the sides, but not the bottom of the cushion?



Activity 6: Assessment of teaching.

- Provide each student with a diagram showing a rectangular prism that is 2 x 4 x 5 in size. Ask them to determine the surface area of the prism. Allow a student to use unit cubes to build the prism if he/she desires.

If all is well with the assessment of teaching, engage students in PRACTICE (the conclusion to the lesson plan).

An example of a partially well-designed worksheet follows.

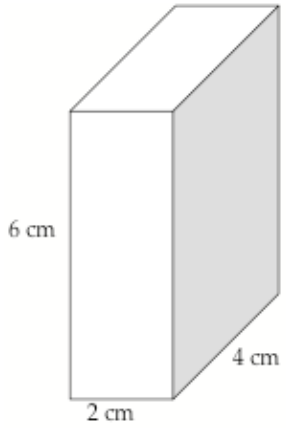
The worksheet contains a sampling of question types. More questions of each type are needed.

The MAINTAIN stage follows the sample worksheets.

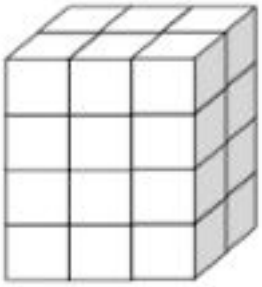
Question 1.

Whats is the surface area of each right rectangular prism (box)?

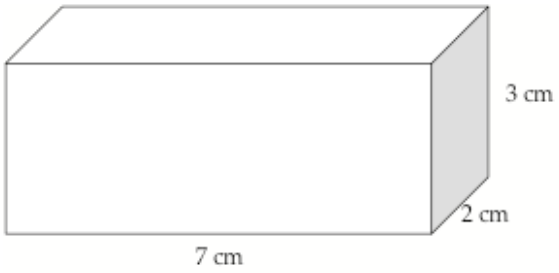
a) _____



b) _____



c) _____



Question 2.

A bungalow has length 12 metres, width 10 metres, and height 3 metres. The windows have a total area of 11 square metres. The exterior walls of the bungalow are going to be painted. What is the total area to be painted?

MAINTAIN stage

Mini-task example

Every so often:

- Present a drawing of a right rectangular prism, with measurements given. Ask students to determine the surface area.

Rich-task example #1

Organize students into groups. Provide each group with about 40 unit cubes that link together (e.g. multi-link cubes). Ask each group to build an animal using all the cubes and to give it a name. Ask them to determine the surface area of their animal. Ask each group to write a report that indicates the name and the volume and surface area of their animal and that discusses whether their animal is better suited to live in a hot or cold climate. Have each groupshow their animal and present their report.

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Rich-task example #2

Organize students into groups. Provide each group with a large number of centimetre cubes. Ask them to build a series of rectangular prisms that are cubes, beginning with a 1 cm by 1 cm by 1 cm cube, then a 2 cm by 2cm by 2cm cube, and so on, and stopping at 8 cm by 8 cm by 8 cm. When it no longer becomes feasible (or too boring) to build large cubes (at about 5 by 5 by 5 in size), have them draw the larger cubes, indicating the dimensions on the drawings. For these larger cubes, students should realize that the surface area of a cube is 6 times the area of one face. Have them record in a table the dimensions, surface area, and volume of each cube. Have them find the dimensions of the cube that, for the first time, its volume is greater than its surface area (see table).

The body design of animals depends on their heating and cooling needs. For example, elephants need extra surface area to cool them because their body volume is too large compared to their skin area. This partly explains why elephants have large ears - to lose excess body heat. Humming birds need to eat a lot to maintain proper body heat because their body volume is very small in relation to their skin area (surface area).

Dimensions of cube (cm)	Volume (cubic cm)	Surface area (sq cm)
1 by 1 by 1	1	6
2 by 2 by 2	8	24
3 by 3 by 3	27	54
4 by 4 by 4	64	96
5 by 5 by 5	125	150
6 by 6 by 6	216	216
7 by 7 by 7	343	294
8 by 8 by 8	512	384

*** volume greater than surface area

Ask students to research the body design of animals in relation to their heating and cooling needs. Ask them to relate the findings to the surface area and volume activity involving the cubes.

Comments

These are a rich-task because each is a complex problem that integrates surface area with other matters.