Illustrative Mathematics

8.G Shipping Rolled Oats

Alignments to Content Standards

- Alignment: 8.G.C.9

Tags

• *This task is not yet tagged.*

Rolled oats (dry oatmeal) come in cylindrical containers with a diameter of 5 inches and a height of $9\frac{1}{2}$ inches. These containers are shipped to grocery stores in boxes. Each shipping box contains six rolled oats containers. The shipping company is trying to figure out the dimensions of the box for shipping the rolled oats containers that will use the least amount of cardboard. They are only considering boxes that are rectangular prisms so that they are easy to stack.

a. What is the surface area of the box needed to ship these containers to the grocery store that uses the least amount of cardboard?

b. What is the volume of this box?

Commentary

Students should think of different ways the cylindrical containers can be set up in a rectangular box. Through the process, students should realize that although some setups may seem different, they result in a box with the same volume. In addition, students should come to the realization (through discussion and/or questioning) that the thickness of a cardboard box is very thin and will have a negligible effect on the calculations.

Given the different setups, students will generate the dimensions of the boxes and calculate the different surface areas. To accomplish this, students will build on their work in geometry from previous grades. Using this understanding, students can find the area of all six faces and then add them together. This work should lead students to realize that each face has another that is identical in measure which could help in the development of the surface area formula for a rectangular prism. In addition, there is an opportunity to discuss how it is possible for the volume for two boxes to be the same even though the surface area of the boxes is different.

The teacher may want to provide students with a table in order to organize their work. In addition, students may benefit from manipulatives in order to model the problem. This can be done with actual rolled oats containers in a whole class setting or with small cylinders in groups (cylindrical blocks or foam shapes).

Submitted by Kevin Rothman from Heritage Middle School, Newburgh Enlarged City School District, for the fourth Illustrative Mathematics Task Writing Contest 2012/02/13.</p

Solutions

Solution: Solution

a. i.

Setup of box	Dimensions
1 cylinder wide by 1 cylinder high by 6 cylinders long	5 in. wide by 9.5 in. high by 30 in. long

At first students may find the sum of all the areas of the faces.

$$\begin{array}{rrr} \text{Front: } (5)(9.5) = 47.5 \text{ in}^2 & \text{Top: } (5)(30) = 150 \text{ in}^2 & \text{Right side: } (9.5)(30) = 285 \text{ in}^2 \\ \text{Back: } (5)(9.5) = 47.5 \text{ in}^2 & \text{Bottom: } (5)(30) = 150 \text{ in}^2 & \text{Left side: } (9.5)(30) = 285 \text{ in}^2 \end{array}$$

Sum of the areas of the 6 faces: $SA = 47.5 + 47.5 + 150 + 150 + 285 + 285 = 965 \text{ in}^2$

Using the surface area formula:

$$\begin{aligned} SA &= 2wl + 2lh + 2wh \\ SA &= 2(5)(30) + 2(30)(9.5) + 2(5)(9.5) \\ SA &= 965 \text{ in}^2 \end{aligned}$$

Students may continue to use the sum of all the areas of the faces to find the surface area which gives the same value as using the surface area formula which is shown below.

ii.

Setup of box	Dimensions
2 cylinders wide by 1 cylinder high by 3 cylinders long	10 in. wide by 9.5 in. high by 15 in. long

$$SA = 2wl + 2lh + 2wh$$
$$SA = 2(10)(15) + 2(15)(9.5) + 2(10)(9.5)$$
$$SA = 775 \text{ in}^2$$

iii.

Setup of box	Dimensions
1 cylinder wide by 2 cylinders high by 3 cylinders long	5 in. wide by 19 in. high by 15 in. long

$$SA = 2wl + 2lh + 2wh$$
$$SA = 2(5)(15) + 2(15)(19) + 2(5)(19)$$
$$SA = 910 \text{ in}^2$$

iv.

Setup of box	Dimensions
1 cylinder wide by 3 cylinders high by 2 cylinders long	5 in. wide by 28.5 in. high by 10 in. long

$$SA = 2wl + 2lh + 2wh$$
$$SA = 2(5)(10) + 2(10)(28.5) + 2(5)(28.5)$$
$$SA = 955 \text{ in}^2$$

v.

Setup of box	Dimensions
1 cylinder wide by 6 cylinders high by 1 cylinders long	5 in. wide by 57 in. high by 5 in. long

$$SA = 2wl + 2lh + 2wh$$
$$SA = 2(5)(5) + 2(5)(57) + 2(5)(57)$$
$$SA = 1190 \text{ in}^2$$

The best solution is a setup of 2 cylinders wide by 1 cylinder high by 3 cylinders long. This is the same as 3 cylinders wide by 1 cylinder high by 2 cylinders long.

b. The **volume** of this and all of the boxes needed to ship the containers is 1425 in^3.