4.3 Designing Gift Boxes: Finding Surface Area

Focus Question What is a strategy for finding the surface area of a three-dimensional object? Explain why the strategy works.

Launch

Have students use the nets in their books or on Labsheet 4.3A.

- *If we were to fold these nets to make prisms, what would the prisms look like?*

Have the students describe the various features of each box.

- *What is the same? What is different?*

Tell the students about the design contest. Ask the class to examine the designs constructed by Star Middle School.

Explore

For Question A, encourage students to try more than one method for finding the surface area.

- *How can you find the dimensions of edges that don't align with the vertical or horizontal lines of the grid paper?*
- *How did you choose which designs to submit?*
- *How did you keep track of the edges to decorate with tape?*
- *Would it work to count every "edge" shown on the net?*

For Question B, students may need guidance on selecting the faces and the appropriate dimensions.

- *How many faces will each of these boxes have?*
- *What shapes do the faces of each box have?*
- *Are any of the faces congruent? Does this help you organize your calculation of the surface area?*
- *What are the dimensions of the rectangular prism's faces?*
- *What are the dimensions of the triangular prism's faces?*

Summarize

Share student strategies for finding the surface area. Display the prisms and have students use them to explain their strategies.

- *How did you find the surface area of rectangular prisms? Triangular prisms? Pyramids?*
- *Are there any similarities among finding the surface areas of rectangular prisms, triangular prisms, and pyramids? Are there any differences?*

Key Vocabulary

- base
- prism
- pyramid

Materials

Labsheets
- 4.3: Nets for Contest Boxes
- 4ACE: Exercise 31
- Centimeter Grid Paper

Accessibility Labsheet
- 4ACE: Exercise 71

Teaching Aid
- 4.3: Submitted Box Nets

Assessments
- Self-Assessment
- Notebook Checklist
- Unit Test

- centimeter cubes
- examples of prisms (optional)
- Virtual Box Activity
- 3D Geometry Tool

ACE

Assignment Guide for Problem 4.3

Applications: 31–46 | Connections: 52–55
Extensions: 66–71

Answers to Problem 4.3

A. **1.** Box 1: Rectangular prism
Faces are rectangles
Dimensions: four faces—1 cm × 8 cm; two faces—1 cm × 1 cm

Box 2: Pyramid (tetrahedron)
Faces are equilateral triangles
Dimensions: four faces—each edge = 4 cm, height is about 3.5 cm

Box 3: Triangular Prism
Faces are isosceles triangles and rectangles
Dimensions: two isosceles triangles—base = 6 cm, height = 4 cm;
one rectangular face—2 cm × 6 cm;
two rectangular faces—2 cm × 5 cm

Box 4: Rectangular prism.
Faces are rectangles
Dimensions: two faces—3 cm × 4 cm;
two faces—2 cm × 3 cm;
two faces—2 cm × 4 cm

2. Box 1: 34 cm^2; Box 2: about 28 cm^2; Box 3: 56 cm^2; Box 4: 52 cm^2

3. One method for finding the surface area of each box is to find the area of each face of the three-dimensional figure. Another method is to find the area of the net, either by finding the area of each face or by finding areas of larger combined shapes (e.g., for Box #3, calculate the combined area of the three rectangles, then double the area of one of the triangular faces, then add those amounts together).

4. Box 1: 40 cm; Box 2: 24 cm; Box 3: 38 cm; Box 4: 36 cm

Method #1: Fold up the net and measure each edge using grid paper or a centimeter ruler.

Method #2: Mark each segment that is an outside edge, but be careful not to double-count edges. Then, mark each segment in the interior of the net. Add the lengths of the marked edges.

Method #3: Find the perimeter of each face. Add all the perimeters, and then divide by 2. Every edge on the object will be the edge of exactly two shapes of the net, so adding all the perimeters is the same as adding the lengths of all the edges twice. Dividing by 2 gives the amount of tape needed.

5. Answers will vary. Students may state advantages or disadvantages related to appearance, volume, how many boxes fit on a single sheet of grid paper (for example, many pyramids can be made from the same sheet), how much material is needed to construct the box, the strength of the box's structure, etc.

B. **1.** To find the surface area, students might draw a net, and then find the area of the net. Another way students might find the surface area is to find the area of each of the faces separately and then add the areas together. The surface area of the right rectangular prism (on the left) is 94 cm^2. The surface of the right triangular prism is 72 cm^2.

2. Nets will vary. Samples: