Lesson 4: Surface Area

Selected Content Standards

Benchmarks Addressed:
M-1-M Applying the concepts of length, area, surface area, volume, capacity, weight, mass, money, time, temperature, and rate to real-world experiences
M-2-M Demonstrating an intuitive sense of measurement (e.g., estimating and determining reasonableness of measures)
G-2-M Identifying, describing, comparing, constructing, and classifying geometric figures and concepts

GLEs Addressed:
Grade 6
25. Relate polyhedra to their 2-dimensional shapes by drawing or sketching their faces (G-2-M) (G-4-M)

Grade 7
20. Determine the perimeter and area of composite plane figures by subdivision and area addition (M-1-M) (G-7-M)

Grade 8
17. Determine the volume and surface area of prisms and cylinders (M-1-M) (G-7-M)

Lesson Focus:
This lesson is intended as an introduction to surface area. It include the following:
- Defining surface area using models
- Calculating surface area
- Understanding the geometric shapes which create 3-D objects

GEE 21 Connection
The skills that will be addressed in this lesson include the following:
- Calculate the surface area of rectangular solids and cylinders
- Estimate and calculate area, given a diagram or illustration of an object

Translating Content Standards into Instruction

A. The objective of this lesson is for students to understand what is meant by surface area.
1. Show students a cereal box. Have a sheet of paper and ask the students how the sheet of paper and the cereal box are the same and how they are different. (Students should see that one is flat—the paper—and has only two dimensions, while the other—the box—has three dimensions associated with it and is made of several sides).
2. We want students to apply what they have learned about area in the previous lesson, and understand that when a three dimensional object is involved, sometimes the **surface area** needs to be found when the object is being covered or made with material (such as cardboard for a box, labels on cans, or metal for the making of cans).

3. Show students several 3-D objects and point out to students what is meant by **surface area** for each of the figures. Try to find the following shapes to use as models if possible.
   a. Cube
   b. Rectangular prism (box of cereal)
   c. Cylinder (oatmeal box, canned goods, etc.)

4. Ask students to determine what they would do to find the surface area for each of the figures you have models for, and then talk about the approaches they would take. Students should understand that they can add the areas of the sides of an object to find the total **surface area**.

B. Once students understand what is meant by the term **surface area**, they should be able to calculate the surface area of a 3-D figure.

1. Once students understand what is meant by surface area and how to find it, have students work in groups to determine the surface area of each figure. You may want students to work on each shape, and then after all groups have taken a turn with each object, have students present their approaches and answers to the whole class. Talk about the different approaches students took, and make sure that all approaches are mathematically sound. If a particular group is not getting an answer in an acceptable range, talk with the group about where the errors are occurring.

2. After students have been given the opportunity to find surface area for physical models, hand out **Student Worksheet #1**, which involves the students in making a model of the geometric 3-D shape and in finding the surface area of the model. This is intended to help students “see” what is involved in making a figure which is three-dimensional, and how each figure is made up of 2-D shapes. After students figure out the surface area of these models, have them build the 3-D figure for future use (these figures will be used in the next lesson for volume).

**GEE 21 Connection**

On the GEE 21 test, students may be required to calculate the surface area of different three-dimensional figures, as well as to apply the concept of surface area in the context of real-world problems.

**Sources of Evidence about Student Learning**

A. Give students as many opportunities as you can to provide them with real objects to help students “see” what is involved in each three dimensional object they are working with.
B. Have students do student worksheets provided with the lesson and go over them thoroughly as a class.

C. As an extension activity, you may want students to build their own three dimensional objects with a given set of parameters.

**GEE 21 Connection**
See attachment at the end of the Measurement Lessons for sample questions related to the GEE 21.

### Attributes of Student Work at the “Got-It” level

A. When students find the surface area of the models, it is important that all of the groups are within an acceptable range of values, but it is equally important that the students understand that no measurement is exact.

B. When going over student work on the worksheets, provide time for students to compare their answers individually and in groups. Let the students talk about how they got their answers, and if there were any discrepancies between group members, have the members explain what they did to clear up any differences.
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I. Directions: For each of the given figures, use the templates provided to determine the surface area of each of the following 3-D figures.

<table>
<thead>
<tr>
<th>Figure</th>
<th>Surface Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cube</td>
<td>____________</td>
</tr>
<tr>
<td>Rectangular Solid</td>
<td>____________</td>
</tr>
<tr>
<td>Cylinder</td>
<td>____________</td>
</tr>
</tbody>
</table>

II. Problem Solving

1. What is the surface area of the figure shown below? _______________

![Figure](image)

2. What is the surface area of the cylinder? _______________

![Cylinder](image)

3. A new company is making canned green beans. How many cans of green beans can be made out of a piece of sheet metal that is 1 square meter? Each can is shaped as shown with the given measurements. On the back of this sheet, show how you got your answer.

![Can](image)
3-D Templates for Part I.

Cube

Rectangular Solid
Cylinder
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Student Worksheet #1

I. 3-D Figures Surface Area—All answers are approximations

<table>
<thead>
<tr>
<th>Figure</th>
<th>Surface Area (sq in)</th>
<th>Surface Area (sq cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cube</td>
<td>13.5 sq in</td>
<td>96 sq cm</td>
</tr>
<tr>
<td>Rectangular Solid</td>
<td>20 sq in</td>
<td>126 sq cm</td>
</tr>
<tr>
<td>Cylinder</td>
<td>31 sq in</td>
<td>200 sq cm</td>
</tr>
</tbody>
</table>

II. Problem Solving
1. 585.2 sq cm
2. About 16 sq in
3. One square meter of material actually has 10,000 sq cm of material to make cans. Each can has a surface area of about 641 sq cm. Therefore, if we just look at the amount of material we have and assume all material can be utilized (without regard to the layout on the sheet) it would indicate that approximately 15 cans could be made from each sheet of metal. In reality, the number of cans that can be produced will probably be less because you may not be able to lay out the cans in such a way as to get full use of the sheet. Therefore 15 cans is the ABSOLUTE MAXIMUM number of cans that could be produced from each sheet.