Surface Area and Volume – Grade Five

Lesson Summary:
In this lesson, students are introduced to the concept of surface area. They identify the surface and attributes of figures that are measurable. They describe and distinguish the measures of surface area and volume of the figures. Given scenarios, students describe attributes which represent surface area and volume. Closure occurs when the class comes to consensus by creating “workable” definitions for volume and surface area. Students apply the terms by identifying and distinguishing them in real-life scenarios.

Estimated Duration: One and one-half hours

Commentary:
Students need direct experiences identifying measurable attributes of objects before formally distinguishing and measuring surface area and volume. This understanding will prevent confusion of the attributes and the appropriate measurement units used to describe the measurements (NCTM, 2000). Given various situations which require students to think about attributes of objects helps them to distinguish whether a situation requires finding the area to “cover a surface” or finding the volume to “fill a three-dimensional space.”

Pre-Assessment:
This informal assessment determines what students know about area and volume. A whole class discussion follows the small group activity.

- Have students gather in small groups of three or four. Assign roles such as recorder, taskmaster, timekeeper and reporter.
- Post the following questions on the board, chart paper or overhead projector:
  1. What do you know about area? Give examples of where or how you observe area around you.
  2. What do you know about volume? Give examples of where or how you observe volume around you.
- Provide each group with chart paper. Instruct the students to make a two-column chart, one column for area and the other for volume.
Surface Area and Volume – Grade Five

- Monitor each group’s discussion, listening for misconceptions. Ask guiding questions to determine student understanding.
- Bring groups together for a class discussion of the questions. Record each group’s responses under the appropriate question. Discuss any questions and misconceptions.

**Scoring Guidelines:**
Assess through teacher observation. Make documentation on a clipboard, note cards, etc. Students should recognize the measurable attributes of shapes and figures and identify area as covering a two-dimensional shape and volume as filling a three dimensional object.

**Post-Assessment:**
In this individual pencil-and-paper assessment, students explain the difference between surface area and volume and justify whether a scenario involves using surface area or volume.

- Distribute *Surface Area or Volume?*, Attachment A. Collect and evaluate understanding using the rubrics and solution key in *Post-Assessment Solutions*, Attachment B.

**Scoring Guidelines:**
Evaluate students’ understanding of distinguishing and describing surface area or volume. A sample rubric follows.

<table>
<thead>
<tr>
<th>Adequate Understanding</th>
<th>Describes attributes of surface area and volume appropriately. Uses these attributes to describe how surface area and volume relates to each scenario. Appropriately selects objects from each scenario to correspond with surface area and volume.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partial Understanding</td>
<td>Describes attributes of surface area and volume appropriately. Describes how surface area and/or volume relate to each scenario with minor mistakes. Selects objects from each scenario to correspond with surface area and volume with minor mistakes.</td>
</tr>
<tr>
<td>Limited Understanding</td>
<td>Shows little or no understanding of the difference between surface area and volume. Switches attributes in describing how surface area and volume relates to each scenario. Confuses objects from each scenario which corresponds to surface area and volume.</td>
</tr>
</tbody>
</table>

**Instructional Procedures:**
**Instructional Tip:**
Volume and capacity are used to describe the measure of space within a three-dimensional figure. Volume is expressed in terms using length units such as inches or centimeters. Capacity is used to express liquid measures or the space of containers that hold liquid. For example, a can of paint has a surface area and a capacity. The surface area is represented by the measure of material used to make the can and the capacity represents the space in the can or the amount of paint (Van de Walle, 1998). It is appropriate to begin to distinguish between volume and capacity at this time.
Surface Area and Volume – Grade Five

1. Collect different objects such as boxes and metal cans for students to identify and describe the surface of the object. Have enough objects so that each group has a box and a can.

2. Discuss the concept of surface.
   a. Place students in groups as in the pre-assessment. Give each group a box and a can. Ask,
      - What is the surface of each object?
      - How would you describe the shape of the surface?
      - What shapes make up the surface?
   b. Instruct students to record their responses on the reverse side of the chart paper from the pre-assessment. Observe the group discussions and make note of different ideas.
   c. Bring the class together to discuss the findings. Record the students’ responses on the board or overhead projector. Answer any questions that may arise from the discussions. Students should come to the conclusion that the surface is represented by the cardboard and metal used to make the objects.

3. Facilitate a discussion to determine how to find the measure of the object’s surface.
   a. Ask questions such as,
      - What attributes of the figures are measurable? (E.g., height, width, circumference, diameter, area of sides or material used, volume, perimeter of a face/side, weight)
      - Which measure would be used to describe the surface?
      - Is it important to know how much an object holds, to know the measure of the surface?
      - How large was the sheet of cardboard used to make this box?
      - If the can is cut from a sheet of metal, how much metal was used?
   b. Allow time for students to discuss this in their group before accepting answers from the class. Expect students to talk about measuring the area of the surface of each object.
   c. Ask questions to guide students to relate the unit of measure to the unit of measurement. Inform students that measuring the surface of an object is called surface area. Have students record this in their journals or notebooks.

4. Present the following scenario to the class:
   *Mary is wrapping a gift in a box for her cousin.*
   Have students select the object in the scenario that relates to the surface area and volume. Discuss any misconceptions. Allow students to refer to their notes from the pre-assessment. (The box represents the surface area and the space inside of the box represents volume. The skin of the body presents the surface area and things inside represent the volume of the body.)

5. Present a different scenario and have students select the attributes of the objects that relate to surface area and volume.
   *To keep cereal from becoming stale, John’s mother puts the cereal in a plastic container.* Discuss any misconceptions. (The container represents surface area and the space inside or the cereal represents volume.)

6. Present similar scenarios until students can distinguish the difference between the relationship of the object and surface area and volume, as needed. For example,
   - Making a homemade aquarium (surface area-plastic/glass used to make sides, volume or capacity-space for water)
   - Football/basketball (surface area-measure of the material used, volume-the amount of air in the ball)
Surface Area and Volume – Grade Five

7. Have students write scenarios representing both surface area and volume. Select students to present a variety of scenarios to present to the class for discussion. Correct any misconceptions.
8. Have students explain the difference between surface area and volume and how they know their scenarios are valid in their journals. Check journal writings for understanding of the concepts.

**Differentiated Instructional Support:**
Instruction is differentiated according to learner needs, to help all learners either meet the intent of the specified indicator(s) or, if the indicator is already met, to advance beyond the specified indicator(s).
- Give students objects and allow them to verbally describe the surface of the object and what part(s) of the object relates to surface area and volume.
- Use student peers or aides to assist in the writing process.
- Provide word processing technology to assist with the writing process.
- Create task cards stating examples and definitions for quick review.

**Extensions:**
- Do a school-wide gallery walk (walk around the school) to find possible scenarios for surface area and volume (restroom sinks, milk containers, measurement tools such as beakers, graduated cylinders). Record the scenarios and how the objects relate to surface area and volume.
- Write a letter to a peer explaining surface area and volume. Include examples and explain the relationship of the object and surface area and volume.

**Home Connections:**
- Conduct a scavenger hunt at home to look for examples of surface area and/or volume.
- Create a collage from magazines to show examples of surface area and/or volume in the home or community.

**Materials and Resources:**
The inclusion of a specific resource in any lesson formulated by the Ohio Department of Education should not be interpreted as an endorsement of that particular resource, or any of its contents, by the Ohio Department of Education. The Ohio Department of Education does not endorse any particular resource. The Web addresses listed are for a given site’s main page, therefore, it may be necessary to search within that site to find the specific information required for a given lesson. Please note that information published on the Internet changes over time, therefore the links provided may no longer contain the specific information related to a given lesson. Teachers are advised to preview all sites before using them with students.

*For the teacher:* Chart paper, overhead projector or board, boxes and cans (enough for each group of three or four students)

*For the student:* Pencil, journal, can and box for each group, chart paper
Surface Area and Volume – Grade Five

Vocabulary:
- area
- surface
- surface area
- volume

Technology Connections:
Browse the Internet with their favorite search engine to look for supplemental lesson plans or virtual learning sites. Students can find the surface area of their own body.

Research:


Attachments:
Attachment A, *Post-Assessment, Surface Area and Volume*
Attachment B, *Post-Assessment Solutions, Surface Area and Volume*
Part One: Short Answer
1. Explain the difference between surface area and volume using pictures and/or words.

Part Two: Scenarios
Directions: Describe attributes of surface area and volume for each scenario.

2. Allison has permission to paint her bedroom. Allison needs to purchase paint at the paint store.

3. The committee is planning construction of a new community swimming pool. They need to contact a company to fill the pool.

4. The farmers in Champaign County produced a record amount of corn this spring. The farmers need to have enough space in their silos for the corn.

5. The fish tank needs to be cleaned and refilled. The tank holds 10 gallons of water.

6. Paul is preparing a drink to put in his water bottle for his bike trip. He mixes a beverage powder with water.
Part One: Short answer
1. Explain the difference between surface area and volume using pictures and/or words.

Answers may vary.
*Surface area is a two-dimensional measure to determine how much is needed to cover a figure. Volume is a three-dimensional measure to determine how much space inside an object can be filled.*

Part Two: Scenarios
Directions: Select objects that have attributes which relate to surface area and volume for each scenario.

2. Allison has permission to paint her bedroom. Allison needs to purchase paint at the paint store. How many gallons of paint will Allison need to paint her room?

*Allison needs to know the area of each wall in the room. This is surface area. She also needs to how many gallons of paint are in the can she purchases. The number of gallons of paint in the can represents the capacity (volume) the can holds.*

3. The committee is planning construction of a new community swimming pool. They need to contact a company to tile the sides and floor of the pool and fill the pool. What does the company need to know?

*The company needs to know the volume of the pool to determine the amount of water the pool can hold. The company needs to know the area of each wall of the pool to buy tiles for the floor and walls of the pool. This is the surface area. They also need to buy concrete for the walls of the pool.*

4. The farmers in Champaign County produced a record amount of corn to store in the silos this spring. Some farmers need to build additional silos?

*The farmers need to know the capacity (volume) of each silo to determine how much corn will fit inside each silo. The farmers need to know how much material to purchase to build the additional silos.*
5. The fish tank needs to be cleaned and refilled with fresh water and colored rocks for the tank. What do you need to know about the fish tank?

_Ten gallons of water in the tank represents the capacity (volume) the tank can hold. The area of the bottom of the fish tank needs to be known to determine how many packages of colored rocks to cover the bottom of the tank (surface area)._ 

6. Paul is preparing a drink to put in his water bottle for his bike trip. He mixes a beverage powder with water. How much water does Paul need for his 64-ounce water bottle?

_Paul has the capacity of the water bottle and can determine the amount of water to mix with the beverage powder. This is volume. The material that the water bottle is made of can be used to find the surface area of the bottle._