Volume and Surface Area

| Reporting Category | Measurement | | | |
|--------------------|--|--|--|--|
| Торіс | Solving problems involving volume and surface area | | | |
| Primary SOL | 8.7 | The student will a) investigate and solve practical problems involving volume and surface area of prisms, cylinders, cones, and pyramids; and b) describe how changing one measured attribute of a figure affects the volume and surface area. | | |
| Related SOL | 8.4 | | | |

Materials

- Models of three-dimensional figures—prism, cylinder, cone, and pyramid
- Volume and Surface Area activity sheet (attached)
- 8½ x 11 inch construction paper
- Tape
- Rulers
- Mini marshmallows
- Three-Dimensional Figures graphic organizer (attached)
- Volume and Surface Area Challenge Problems (attached)

Vocabulary

prism, cylinder, cone, pyramid, surface area, volume (earlier grades)

Student/Teacher Actions (what students and teachers should be doing to facilitate learning)

- 1. Display models of the prism, cylinder, cone, and pyramid, and review their names, faces, bases. Also, discuss the difference between volume and surface area, and review how to find the volume and surface area of these figures.
- 2. Group students in pairs, and give each pair a roll of tape, a ruler, enough mini marshmallows to fill a large paper cylinder, and two sheets of 8½ x 11 inch construction paper. Also, distribute individual copies of the Volume and Surface Area activity sheet. Again, quickly review how to calculate the volume and surface area of a cylinder.
- 3. Have students work with partners to complete the activity sheet. As they work, provide assistance, as needed.
- 4. When students are finished, review the process and the answers with the class.
- 5. Distribute individual copies of the Three-Dimensional Figures graphic organizer and the Volume and Surface Area Challenge Problems. Have students work with partners to solve the problems, using the information on the organizer. Instruct them to write all formulas they use and show all their work.
- 6. When students are finished, have them present their solutions and work to the class. Lead a class discussion regarding how students approached each problem. Again, review how to

find the volume and surface area of the figures. Have them store their Three-Dimensional Figures graphic organizers for future reference.

Assessment

- Questions
 - What happens to the volume of a prism when you double the height of the figure? How do you know?
 - How is the volume of a pyramid related to the volume of a prism?
 - How is the volume of a cylinder related to the volume of a cone?
- Journal/Writing Prompts
 - Explain the difference between volume and surface area.

Extensions and Connections (for all students)

- Have the class brainstorm real-life situations that would require knowledge of volume or surface area of prisms, cylinders, cones, or pyramids.
- Have students create practical problems that involve finding volume or surface area of various three-dimensional figures.
- Make real-world connections to the volume and surface area of such things as the Egyptian pyramids, a farm silo, packaging, and a potato chip can.
- Repeat the lesson using 8½ x 11 inch sheets of paper cut in half to make two smaller cylinders.

Strategies for Differentiation

- Label nets with the dimensions needed to find volume and surface area. Have students tape the nets together so they can see what each measurement represents. Then, have students solve for the volume and surface area of the nets they created.
- Before having students solving these problems, have them identify whether the problem is asking for volume or surface area.
- Use water or rice to fill three-dimensional figures to show how three cones fit into a cylinder and three pyramids fit into a cube.
- Provide students access to the formula sheet every day in class.



Name _____ Date _____

- 1. Use your ruler to measure the length and width of two identical sheets of paper in centimeters. Length = _____; Width = _____;
- 2. Form one of the sheets of paper into a *tall* cylinder with no overlapping edges, and tape the edges together. Form the other sheet of paper into a short cylinder with no overlapping edges, and tape the edges together.
- 3. Use the length and width of each sheet of paper to identify the circumference and height of each cylinder. Circumference of tall cylinder = _____; Circumference of short cylinder = _____

Height of tall cylinder = _____; Height of short cylinder = _____

- 3. Which cylinder do you think will hold the most mini marshmallows? Why do you think this?
- 4. *Estimate* how many mini marshmallows each cylinder will hold. Estimated number of marshmallows: Tall cylinder = _____; Short cylinder = _____;
- 4. Calculate the diameter of each cylinder, using its circumference $(d = C \div \pi)$. Show your work.

| Tall cylinder | Short cylinder |
|---------------|----------------|
| | |
| | |
| | |

5. Calculate the radius of each cylinder, using its diameter ($r = d \div 2$). Show your work.

| Tall cylinder | Short cylinder |
|---------------|----------------|
| | |
| | |
| | |

6. Calculate the surface area of each cylinder, using its radius and height, but do not include the areas of the top and bottom (SA = $2\pi rh$). Show your work

| Tall cylinder | Short cylinder |
|---------------|----------------|
| | |
| | |
| | |

- 7. Fill each cylinder with mini marshmallows to determine how many it will hold. Actual number of marshmallows: Cylinder A = ; Cylinder B =
- 8. Calculate the volume of each cylinder, using its radius and height ($V = \pi r^2 h$). Show your work.

- Were your estimates correct? ______
 Why, or why not? ______
- 8. How does the length of the radius affect the volume of a cylinder?

Three-Dimensional Figures

| Figure | Dimensions | Volume | Surface Area |
|--------|------------|-----------------------|---------------------------|
| h | h, r, l | $\frac{1}{3}\pi r^2h$ | $SA = \pi r l + \pi r^2$ |
| | r, h | $V = \pi r^2 h$ | $SA = 2\pi rh + 2\pi r^2$ |
| | l, w, h | V = lwh | SA = 2lw + 2lh + 2wh |
| | B, h | $\frac{1}{3}Bh$ | $SA = \frac{1}{2}lp + B$ |

Volume and Surface Area Challenge Problems

Name

Date _____

1. Find the surface area of this 3-D figure. List all formulas you use, and show all your work.



2. Find the volume of this 3-D figure. List all formulas you use, and show all your work.

