Richmond Public Schools

Curriculum Framework

Grade 8

Strand: Measurement and Geometry	
8.6 The student will a) solve problems, including practical problems, involving volume and surface area of cones and square-based pyramids; and b) describe how changing one measured attribute of a rectangular prism affects the volume and surface area.	
Suggested Pacing	
Third Nine Weeks – 10 Instructional Days (including common assessment)	
Related Standards	
Spiral Down **7.4** The student will a) describe and determine the volume and surface area of rectangular prisms; and b) solve problems, including practical problems, involving the volume and surface area of rectangular prisms and cylinders.	**Spiral Up** **G.13** The student will use surface area and volume of three-dimensional objects to solve practical problems. **G.14** The student will apply the concepts of similarity to two- or three-dimensional geometric figures. This will include b) determining how changes in one or more dimensions of a figure affect area and/or volume of the figure; c) determining how changes in area and/or volume of a figure affect one or more dimensions of the figure
Essential Questions	**Common Misconceptions**
How does the volume of a three-dimensional figure differ from its surface area? *Volume is the amount a container holds. Surface area of a figure is the sum of the area on surfaces of the figure.*	• Students need additional practice determining the surface area of a square-based pyramid. • Provide students with practice on both multiple choice and open response formats and to include measurements that are decimals.

How are the formulas for the volume of prisms and cylinders similar? *For both formulas you are finding the area of the base and multiplying that by the height.* **What effect does changing one attribute of a prism by a scale factor have on the volume of the prism?** *When you increase or decrease the length, width, or height of a prism by a factor greater than 1, the volume of the prism is also increased by that factor.*	• Students need examples of how finding the surface area with a net relates to using the provided formula.
Understanding the Standard	**Essential Knowledge and Skills**
• A polyhedron is a solid figure whose faces are all polygons. • Nets are two-dimensional representations of a three-dimensional figure that can be folded into a model of the three-dimensional figure. • Surface area of a solid figure is the sum of the areas of the surfaces of the figure. • Volume is the amount a container holds. • A rectangular prism is a polyhedron that has a congruent pair of parallel rectangular bases and four faces that are rectangles. A rectangular prism has eight vertices and twelve edges. In this course, prisms are limited to right prisms with bases that are rectangles. • The surface area of a rectangular prism is the sum of the areas of the faces and bases, found by using the formula $S.A. = 2lw + 2lh + 2wh$. All six faces are rectangles.	**The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to** • Distinguish between situations that are applications of surface area and those that are applications of volume. (a) • Determine the surface area of cones and square-based pyramids by using concrete objects, nets, diagrams and formulas. (a) • Determine the volume of cones and square-based pyramids, using concrete objects, diagrams, and formulas. (a) • Solve practical problems involving volume and surface area of cones and square-based pyramids. (a) • Describe how the volume of a rectangular prism is affected when one measured attribute is multiplied by a factor of $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{2}$, 2, 3, or 4. (b)

• The volume of a rectangular prism is calculated by multiplying the length, width and height of the prism or by using the formula $V = lwh$. • A cube is a rectangular prism with six congruent, square faces. All edges are the same length. A cube has eight vertices and twelve edges. • A cone is a solid figure formed by a face called a base that is joined to a vertex (apex) by a curved surface. In this grade level, cones are limited to right circular cones. • The surface area of a right circular cone is found by using the formula, $S.A. = \pi r^2 + \pi rl$, where l represents the slant height of the cone. The area of the base of a circular cone is πr^2. • The volume of a cone is found by using $V = \frac{1}{3}\pi r^2 h$, where h is the height and πr^2 is the area of the base. • A square-based pyramid is a polyhedron with a square base and four faces that are triangles with a common vertex (apex) above the base. In this grade level, pyramids are limited to right regular pyramids with a square base.	• Describe how the surface area of a rectangular prism is affected when one measured attribute is multiplied by a factor of $\frac{1}{2}$ or 2. (b)

• The volume of a pyramid is $\frac{1}{3}Bh$, where B is the area of the base and h is the height. • The surface area of a pyramid is the sum of the areas of the triangular faces and the area of the base, found by using the formula $S.A. = \frac{1}{2}lp + B$ where l is the slant height, p is the perimeter of the base and B is the area of the base. • The volume of a pyramid is found by using the formula $V = \frac{1}{3}Bh$, where B is the area of the base and h is the height. • The volume of prisms can be found by determining the area of the base and multiplying that by the height. • The formula for determining the volume of cones and cylinders are similar. For cones, you are determining $\frac{1}{3}$ of the volume of the cylinder with the same size base and height. The volume of a cone is found by using $V = \frac{1}{3}\pi r^2 h$. The volume of a cylinder is the area of the base of the cylinder multiplied by the height, found by using the formula, $V = \pi r^2 h$, where h is the height and πr^2 is the area of the base. • The calculation of determining surface area and volume may vary depending upon the approximation for pi. Common approximations for π include 3.14, $\frac{22}{7}$, or the pi button on the calculator.	

• When the measurement of one attribute of a rectangular prism is changed through multiplication or division the volume increases by the same factor by which the attribute increased. For example, if a prism has a volume of 2· 3· 4, the volume is 24 cubic units. However, if one of the attributes is doubled, the volume doubles. That is, 2· 3· 8, the volume is 48 cubic units or 24 doubled. • When one attribute of a rectangular prism is changed through multiplication or division, the surface area is affected differently than the volume. The formula for surface area of a rectangular prism is $2(lw) + 2(lh) + 2(wh)$ when the width is doubled then four faces are affected. For example, a rectangular prism with length = 7 in., width = 4 in., and height = 3 in. would have a surface area of $2(7\cdot4) + 2(7\cdot3) + 2(4\cdot3)$ or 122 square inches. If the height is doubled to 6 inches then the surface area would be found by $2(7\cdot4) + 2(7\cdot6) + 2(4\cdot6)$ or 188 square inches.	
Vocabulary	**Instructional Activities Organized by Learning Objective**
3-Dimensional Polyhedron Face Vertex Side Attributes Base Area Surface Area Volume Cube Pyramid Prism	**Virginia Department of Education** Changing Attributes – Lesson Plan **Textbook** *Virginia Pre-Algebra, ©2012, Glencoe/McGraw-Hill* • Volume of Pyramid, Cones, and Spheres, page(s) 725 – 730 **(in part)** • Surface Area of Pyramids and Cones, page(s) 744 - 749 **(in part)** **Notes** • Surface Area and Volume of Solid Figures

Cone
Cylinder
Circumference
Net
Lateral Height
Perimeter

Assessment

RPS PowerSchool Unit Test – RPS 8.6 Common Assessment
Test ID#:

Formative Assessments
White Board Checks
Kahoot.it
Plickers
Exit Tickets
Graphic Organizers
Venn Diagrams

Resources

- **Print**
  Virginia Coach, NEW SOL Edition, Grade 8, Mathematics
  Lesson 8 – page 57 (Solve Surface Area Problems)
  Lesson 9 – page 64 (Solve Volume Problems)
  Lesson 10 – page 71 (Effects of Changing Dimensions)

- **Technology-based**
  - *ExploreLearning.com (Gizmos)* – Pyramids and Cones**(in part)** – Interactive Instructional Resource
  - *LearnAlberta.com* – Exploring Surface Area, Volume, and Nets**(in part)** – Interactive Lesson
  - *VertualNerd.com* – What is a Cone? – Instructional Video

Station Activities

- Task cards - (solving SA and V for pyramids and cones)
- 3 D's to 2 D's (provide a paper 3D model of a pyramid and a cone, students cut the 3D figure to make a 2D figure, illustrate the net, measure the dimensions, and solve SA and V)
- Foldable - Have students create a foldable, describing characteristics, providing examples, and relationships.

Cross-Curricular Connections

English
Have students journal how increasing the length of a solid will affect the volume and surface area of a similar solid

Business/Manufacturing
Have students explore the difference in volume and surface area in two cereal boxes that have the same net weight. Further exploration

Differentiations

- Give students net template, have students measure the dimensions and compute the surface area and volume.
- Have students highlight key words that will help determine if the problem is for surface area or volume.
- Have students highlight dimensions on formula sheet, then highlight the dimensions from a given problem.
- Remind students about how to simplify expressions with replacement variables.

could include determining the best dimensions to result in a specific volume to have the lowest cost to produce a box.	