M2.7 Measurement and Solid Geometry

• Use geometric shapes to describe objects and use measures of the shapes.
• Use coordinates to compute perimeters of polygons and areas of triangles and rectangles.
• Give arguments that combine dissection and informal limits to yield the circumference and area formulas for a circle.
• Give dissection arguments that yield the volume formula for prisms.
• Use the volume formula for prisms and an informal limit argument to obtain the volume formula for cylinders.
• Identify the shapes of two-dimensional cross-sections of three-dimensional objects.
• Identify three-dimensional objects generated from rotations of two-dimensional shapes.
• Obtain the formula for volume of a pyramid with square base via dissection.
• Use Cavalieri's Principle to obtain the formula for the volume of a pyramid from the formula for the volume of a pyramid with square base.
• Use volume formulas to solve problems.
• Solve volume problems involving the calculation of density.

In this unit students give more sophisticated, although still informal, arguments for the circumference, area, and volume formulas that they learned in earlier grades. These arguments rely on dissections, informal limits, and Cavalieri's Principle. After giving arguments for the volume formulas, students use these formulas in solving a variety of modeling problems, including problems that involve density.

Students have been reasoning with shapes and their attributes since first grade. In grade 5, they packed unit cubes into right rectangular prisms with whole-number length sides and showed that the product of the edge lengths gives the

same result as counting the unit cubes. (5.MD.5a) In grade 7, students described the two-dimensional figures that result from slicing three-dimensional figures. (7.G.A.3) They gave an informal derivation of the relationship between the circumference and area of a circle, and used the resulting formula together with formulas for volumes of cubes and right prisms from earlier grades to solve problems. (7.G.B.4, 7.G.B.6) In grade 8, students learned the formulas for the volumes of cones, cylinders, and spheres, and used them to solve real-world and mathematical problems. (8.G.C.9)

M2.7.0 Pre-unit diagnostic assessment

Assess students' ability to

• find the circumference of a circle from its area;
• find the volumes of various shapes including cylinders, cones,prisms;
• describe two-dimensional figures that result from slicing a right triangular prism.

In this unit students give more sophisticated, although still informal, arguments for the circumference, area, and volume formulas that they learned in earlier grades. These arguments rely on dissections, informal limits, and Cavalieri's Principle. After giving arguments for the volume formulas, students use these formulas in solving a variety of modeling problems, including problems that involve density.

M2.7.1 Dimensions, surface area, and volume

Use volume formulas to solve real-life modeling problems.

In this unit students give more sophisticated, although still informal, arguments for the circumference, area, and volume formulas that they learned in earlier grades. These arguments rely on dissections, informal limits, and Cavalieri's Principle. After giving arguments for the volume formulas, students use these formulas in solving a variety of modeling problems, including problems that involve density.

M2.7.2 Area and perimeter on the coordinate plane

Use coordinates to compute perimeters of polygons and areas of triangles and rectangles

In this unit students give more sophisticated, although still informal, arguments for the circumference, area, and volume formulas that they learned in earlier grades. These arguments rely on dissections, informal limits, and Cavalieri's Principle. After giving arguments for the volume formulas, students use these formulas in solving a variety of modeling problems, including problems that involve density.

M2.7.3 Informal arguments for circle circumference

Give arguments that combine dissection and informal limits to yield the circumference and area formulas for a circle.

In this unit students give more sophisticated, although still informal, arguments for the circumference, area, and volume formulas that they learned in earlier grades. These arguments rely on dissections, informal limits, and Cavalieri's Principle. After giving arguments for the volume formulas, students use these formulas in solving a variety of modeling problems, including problems that involve density.

M2.7.4 Informal arguments for volume formulas

• Give dissection arguments that yield the volume formula for prisms.
• Use the volume formula for prisms and an informal limit argument to obtain the volume formula for cylinders.
• Obtain the formula for volume of a pyramid with square base via dissection.

In this unit students give more sophisticated, although still informal, arguments for the circumference, area, and volume formulas that they learned in earlier grades. These arguments rely on dissections, informal limits, and Cavalieri's Principle. After giving arguments for the volume

formulas, students use these formulas in solving a variety of modeling problems, including problems that involve density.

M2.7.5 Cross-sections, solids of revolution, and Cavalieri's Principle

• Identify two-dimensional cross-sections of three-dimensional objects.
• Identify three-dimensional objects generated from rotating two-dimensional shapes.
• Use Cavalieri's Principle to obtain the formula for the volume of a pyramid from the formula for the volume of a pyramid with square base.
• Use Cavalieri's Principle to obtain the formula for the volume of a cone.

In this unit students give more sophisticated, although still informal, arguments for the circumference, area, and volume formulas that they learned in earlier grades. These arguments rely on dissections, informal limits, and Cavalieri's Principle. After giving arguments for the volume formulas, students use these formulas in solving a variety of modeling problems, including problems that involve density.

M2.7.6 Use volume formulas to solve problems

• Solve real-world and mathematical situations involving volume and surface area.
• Solve volume problems involving the calculation of density.

In this unit students give more sophisticated, although still informal, arguments for the circumference, area, and volume formulas that they learned in earlier grades. These arguments rely on dissections, informal limits, and Cavalieri's Principle. After giving arguments for the volume formulas, students use these formulas in solving a variety of modeling problems, including problems that involve density.

M2.7.7 Summative Assessment

Students demonstrate their ability to

• explain where formulas for the volume of various shapes come from;
• use volume to solve a real-world problem;
• sketch two-dimensional cross-sections of a rectangular prism;
• describe a three-dimensional shape generated by rotating a shape around a line.

In this unit students give more sophisticated, although still informal, arguments for the circumference, area, and volume formulas that they learned in earlier grades. These arguments rely on dissections, informal limits, and Cavalieri's Principle. After giving arguments for the volume formulas, students use these formulas in solving a variety of modeling problems, including problems that involve density.