

07 Solids

Content Area: **Math**
Course(s):
Time Period: **Full Year**
Length: **3-4 weeks**
Status: **Published**

General Overview, Course Description or Course Philosophy

[NJSLS Geometry Overview](#)

In this unit, students practice spatial visualization in three dimensions, study the effect of dilation on area and volume, derive volume formulas using dissection arguments and Cavalieri's Principle, and apply volume formulas to solve problems involving surface area to volume ratios, density, cube roots, and square roots. (IM)

OBJECTIVES, ESSENTIAL QUESTIONS, ENDURING UNDERSTANDINGS

Objectives: In this unit, students practice spatial visualization in three dimensions, study the effect of dilation on area and volume, derive volume formulas using dissection arguments and Cavalieri's Principle, and apply volume formulas to solve problems involving surface area to volume ratios, density, cube roots, and square roots. (IM)

Essential Questions:

- How is Cavalieri's Principle applied to develop volume formulas?
- What types of modeling problems can be solved using solid geometry?
- How are linear, area, and volume measurements related in similar figures?

Enduring Understandings:

- Formulas for volumes and surface area of solids are based on the properties of those of figures.
- Solids are used in many modeling applications.

CONTENT AREA STANDARDS

MA.G-MG.A.1	Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
MA.G-MG.A.2	Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).
MA.G-MG.A.3	Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.4	Model with mathematics.
MA.K-12.7	Look for and make use of structure.
MA.K-12.8	Look for and express regularity in repeated reasoning.
MA.G-GMD.A.1	Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone.
MA.G-GMD.A.2	Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.
MA.G-GMD.A.3	Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.
MA.G-GMD.B.4	Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.

RELATED STANDARDS (Technology, 21st Century Life & Careers, ELA Companion Standards are Required)

CS.K-12.1.a	Include the unique perspectives of others and reflect on one's own perspectives when designing and developing computational products.
CS.K-12.2.c	Solicit and incorporate feedback from, and provide constructive feedback to, team members and other stakeholders.
CS.K-12.3.a	Identify complex, interdisciplinary, real-world problems that can be solved computationally.
CS.K-12.3.b	Decompose complex real-world problems into manageable sub-problems that could integrate existing solutions or procedures.
CS.K-12.3.c	Evaluate whether it is appropriate and feasible to solve a problem computationally.
LA.RH.9-10.4	Determine the meaning of words and phrases as they are used in a text, including vocabulary describing political, social, or economic aspects of history and the social sciences; analyze the cumulative impact of specific word choices on meaning and tone.
LA.RH.9-10.7	Integrate quantitative or technical analysis (e.g., charts, research data) with qualitative analysis in print or digital text, to analyze information presented via different mediums.
LA.RST.9-10.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
LA.RST.9-10.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
LA.RST.9-10.5	Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
WRK.K-12.P.4	Demonstrate creativity and innovation.
WRK.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.

STUDENT LEARNING TARGETS

Declarative Knowledge

Students will understand that:

- Applying the formulas for area of circles, rectangles and triangles is necessary before finding the surface area and volume of prisms and pyramids
- Prisms and pyramids are defined by the polygon on the base of the solid
- There may be two different values used for the height of the triangular prism and pyramid. One used for the height of the base and the other used for the height of the solid.
- Formulas for volumes and surface area of solids are based on the properties of those of figures.
- Solids are used in many modeling applications.

Procedural Knowledge

Students will be able to:

- Apply concepts of density based on area and volume in modeling situations.(★) Analysis
- Apply geometric methods to solve design problems.(★) Analysis
- Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. Analysis
- Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.(★) Analysis
- Identify the shapes of two-dimensional cross-sections of three-dimensional objects and the three-dimensional objects generated by rotations of two-dimensional objects. Comprehension
- Use geometric shapes, their measures, and their properties to describe objects.(★) Comprehension

EVIDENCE OF LEARNING

Formative Assessments

- Student feedback/questioning/observation
- Error analysis
- Specific skill assessment/questions
- Survey/polling
- Task completion and review of quizzes and material presented in the Geometry class

Summative Assessments

There will be no formal assessments in this course.

RESOURCES (Instructional, Supplemental, Intervention Materials)

NJ DOE Model Curriculum unit: [Extending to Three Dimensions](#)

Illustrative Mathematics unit: [Solid Geometry](#)

Khan Academy unit: [Solid Geometry](#)

NJCTL unit: [3D Geometry](#)

Desmos Activities: [Volume of Rectangular Prisms](#), [Volume of Solids](#), [Cross Sections of 3D figures](#)

Course approved textbook

Kuta Software worksheets

INTERDISCIPLINARY CONNECTIONS

Interdisciplinary connections are frequently addressed through modeling and application problems whereby students solve and analyze situations taken from business, physics, engineering, biology, statistics, geography, and numerous other fields. Examples can be found in topic specific textbook problems and digital resources.

ACCOMMODATIONS & MODIFICATIONS FOR SUBGROUPS

See link to Accommodations & Modifications document in course folder.

