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

G.C

A. Understand and apply theorems about circles

B. Find arc lengths and areas of sectors of circles

G.CO

A. Experiment with transformations in the plane

B. Understand Congruence in terms of rigid motions

C. Prove geometric theorems

D. Make geometric constructions

G.GMD

A. Explain volume formulas and use them to solve problems

B. Visualize relationships between two-dimensional and three-dimensional objects

G.GPE

A. Translate between the geometric description and the equation for a conic section

B. Use coordinates to prove simple geometric theorems algebraically

G.MG

A. Apply geometric concepts in modeling situations

G.SRT

A. Understand similarity in terms of similarity transformations

B. Prove theorems involving similarity

C. Define trigonometric ratios and solve problems involving right triangles

D. Apply trigonometry to general triangles

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.
WRK.K-12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.

STUDENT LEARNING TARGETS

Declarative Knowledge

Students will understand that:

- 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:

- Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures. Analysis
- 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

Benchmark Assessments

Benchmark Assessments conducted three times per year, using Pear Assessment (Standards Based Assessments)

Alternate Assessments

- Portfolios
- Verbal Assessment (instead of written)
- Multiple choice
- Modified Rubrics
- Performance Based Assessments

Formative Assessments

- Student feedback/questioning/observation
- Exit Ticket
- Error analysis
- Specific skill assessment/questions
- Survey/polling
- Reflection questions
- Scored/evaluated class work or homework
- Task completion

Summative Assessments

Lesson Quizzes
Unit Test
Performance Tasks

RESOURCES (Instructional, Supplemental, Intervention Materials)

Core Instructional Materials

Envisions Geometry

Kuta Software

Supplemental Materials

NJ DOE Model Curriculum unit: Extending to Three Dimensions

Illustrative Mathematics unit: Solid Geometry

Khan Academy unit: Solid Geometry

NJCTL unit: 3D Geometry

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.