# Geometry Unit 5: Geometric Modeling (Gr. 9 - 11)

Content Area: **Mathematics**
Course(s): **Geometry**
Time Period: **4th Marking Period**
Length: **6 Weeks**
Status: **Published**

## Unit Overview

This unit is focused on the use of geometric concepts in modeling situations. As the unit begins, students will consider and work to explain familiar formulas used to find the circumferences and areas of circles, as well as the formulas used to find the volumes of cylinders, cones, pyramids, and spheres. In addition, students will use the volume formulas to solve applied problems as they consider how real-world objects can be described using geometric shapes, their measures, and their properties. The relationship between two and three-dimensional figures will be considered, as well, and students will be asked to identify various cross-sections of three-dimensional figures. In addition, students will be asked to apply concepts of density based on area and volume, as well as apply their understanding of geometric concepts to solve design problems.

By the end of the year, administer the Link It CC Geometry Form C TEI

## Transfer

Students will be able to independently use their learning to...

- Use perimeter, area, circumference, and volume formulas to solve for quantities of interest.
- Relate real-world objects to geometric figures, and apply the properties of these figures to solving real-world problems.
- Describe relationships between two and three-dimensional figures.
- Apply concepts of density based on area and volume in modeling situations.
- Use Cavalieri's principle to explain formulas associated with circles, and with volumes of solids.

## Meaning

## Understandings

Students will understand that...

- Two and three-dimensional geometric figures can be used to model real-world situations and figures.
- Formulas can be applied to solve for any single unknown quantity that they contain.
- The areas and volumes of composite and irregular figures can be found by breaking them down into simpler figures and adding/subtracting their individual areas/volumes.
- Different cross sections of solids may yield different two-dimensional shapes.

## Essential Questions

Students will keep considering...

- How can geometric concepts and figures be used to model real-world phenomena?
- How are the formulas for area, perimeter, circumference, and volume of geometric figures applied in solving problems?
- How can I find the area, perimeter, or volume of figures composed of a combination of various geometric figures?
- How can geometric figures be used in solving real-world problems?

## Application of Knowledge and Skill

### Students will know...

- The formulas used to find areas, perimeters, circumference, and volume of geometric figures.
- That the areas and volumes of irregular figures are equal to the sum of the areas and volumes of their individual parts.

### Students will be skilled at...

- Calculating the area, perimeter/circumference or volume of a given figure.
- Using given measurements and quantities to solve for unknown dimensions of geometric figures.
- Identifying cross sections and various parts of solid figures.
- Applying geometric concepts in modeling situations.

## Academic Vocabulary

- base of a solid
- Cavalieri's principle

- composite figure
- cone
- cross-section
- cylinder
- density
- edge of a solid
- lateral face of a solid
- lateral face of a solid
- limit
- model
- pyramid
- sphere
- volume

## Learning Goal 5.1

Students will develop informal arguments for the circumference and area of a circle.

## Daily Target 5.1.1 (Level of Difficulty: Analysis, DOK: 3 - Strategic Thinking)

SWBAT construct viable dissection arguments and informal limit arguments.

| | |
|---|---|
| MA.K-12.3 | Construct viable arguments and critique the reasoning of others. |
| MA.K-12.7 | Look for and make use of structure. |
| 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. |

## Daily Target 5.1.2 (Level of Difficulty: Knowledge Utilization, DOK: 4 - Extended Thinking)

SWBAT apply Cavaleri's principle.

| | |
|---|---|
| MA.K-12.3 | Construct viable arguments and critique the reasoning of others. |
| MA.K-12.6 | Attend to precision. |
| MA.K-12.7 | Look for and make use of structure. |
| 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. |

## Daily Target 5.1.3 (Level of Difficulty: Analysis, DOK: 3 - Strategic Thinking)

SWBAT construct an informal argument for the formula for area of a circle.

**Area of a Circle:** https://www.illustrativemathematics.org/content-standards/HSG/GMD/A/1/tasks/1567

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|---|---|
| MA.K-12.3 | Construct viable arguments and critique the reasoning of others. |
| MA.K-12.7 | Look for and make use of structure. |
| 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. |

## Learning Goal 5.2

Students will apply geometric concepts in modeling situations.

## Daily Target 5.2.1 (Level of Difficulty: Analysis, DOK: 3 - Strategic Thinking)

SWBAT construct an informal argument for the formulas for the volume of a cylinder, pyramid, and cone, and will solve problems using these formulas.

**The Great Egyptian Pyramids:** https://www.illustrativemathematics.org/content-standards/HSG/GMD/A/3/tasks/1899

| | |
|---|---|
| MA.K-12.3 | Construct viable arguments and critique the reasoning of others. |
| MA.K-12.6 | Attend to precision. |
| MA.K-12.7 | Look for and make use of structure. |
| 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. |

## Daily Target 5.2.2 (Level of Difficulty: Analysis, DOK: 3 - Strategic Thinking)

SWBAT explain and solve problems using the surface area and volume formulas for spheres.

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|---|---|
| MA.K-12.5 | Use appropriate tools strategically. |
| MA.K-12.6 | Attend to precision. |
| 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. |

## Daily Target 5.2.3 (Level of Difficulty: Analysis, DOK: 3 - Strategic Thinking)

SWBAT describe the measures and properties of geometric shapes that best represent a real-world object and model real-world objects with geometric shapes.

**Toilet Roll:** https://www.illustrativemathematics.org/content-standards/HSG/MG/A/1/tasks/40

| | |
|---|---|
| MA.K-12.1 | Make sense of problems and persevere in solving them. |
| MA.K-12.2 | Reason abstractly and quantitatively. |
| MA.K-12.4 | Model with mathematics. |
| MA.K-12.5 | Use appropriate tools strategically. |
| MA.K-12.6 | Attend to precision. |
| MA.K-12.7 | Look for and make use of structure. |
| MA.G-GMD.A.3 | Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems. |
| 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). |

## Daily Target 5.2.4 (Level of Difficulty: Analysis, DOK: 3 - Strategic Thinking)

SWBAT identify cross-sections of three-dimensional objects.

**Tennis Balls in a Can:** https://www.illustrativemathematics.org/content-standards/HSG/MG/A/1/tasks/512

| | |
|---|---|
| MA.K-12.1 | Make sense of problems and persevere in solving them. |
| MA.K-12.7 | Look for and make use of structure. |
| 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. |

## Daily Target 5.2.5 (Level of Difficulty: Analysis, DOK: 3 - Strategic Thinking)

SWBAT find the areas of composite figures, and will be able to use composite figures to estimate the areas of irregular shapes.

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|---|---|
| MA.K-12.1 | Make sense of problems and persevere in solving them. |
| MA.K-12.3 | Construct viable arguments and critique the reasoning of others. |
| MA.K-12.4 | Model with mathematics. |
| MA.K-12.5 | Use appropriate tools strategically. |
| MA.K-12.7 | Look for and make use of structure. |
| 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). |

## Daily Target 5.2.6 (Level of Difficulty: Analysis, DOK: 3 - Strategic Thinking)

SWBAT apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).

**How many cells are in the human body?** https://www.illustrativemathematics.org/content-standards/HSG/MG/A/2/tasks/1146

**3-Act Lesson: Apple Mothership** (see document below)

| | |
|---|---|
| MA.K-12.1 | Make sense of problems and persevere in solving them. |
| MA.K-12.2 | Reason abstractly and quantitatively. |
| MA.K-12.4 | Model with mathematics. |
| MA.K-12.5 | Use appropriate tools strategically. |
| MA.K-12.6 | Attend to precision. |
| 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). |

## Daily Target 5.2.7 (Level of Difficulty: Knowledge Utilization, DOK: 4 - Extended Thinking)

SWBAT solve design problems using geometric methods. For example, they may design objects or structures that satisfy physical constraints and/or minimize costs.

**Ice Cream Cone:** https://www.illustrativemathematics.org/content-standards/HSG/MG/A/3/tasks/414

| | |
|---|---|
| MA.K-12.1 | Make sense of problems and persevere in solving them. |
| MA.K-12.2 | Reason abstractly and quantitatively. |
| MA.K-12.4 | Model with mathematics. |
| MA.K-12.5 | Use appropriate tools strategically. |
| MA.K-12.6 | Attend to precision. |
| 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). |

## 21st Century Life and Careers

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| CRP.K-12.CRP1 | Act as a responsible and contributing citizen and employee. |
| CRP.K-12.CRP2 | Apply appropriate academic and technical skills. |

| | |
|---|---|
| CRP.K-12.CRP4 | Communicate clearly and effectively and with reason. |
| CRP.K-12.CRP5 | Consider the environmental, social and economic impacts of decisions. |
| CRP.K-12.CRP6 | Demonstrate creativity and innovation. |
| CRP.K-12.CRP7 | Employ valid and reliable research strategies. |
| CRP.K-12.CRP8 | Utilize critical thinking to make sense of problems and persevere in solving them. |
| CRP.K-12.CRP9 | Model integrity, ethical leadership and effective management. |
| CRP.K-12.CRP11 | Use technology to enhance productivity. |
| CAEP.9.2.12.C.1 | Review career goals and determine steps necessary for attainment. |
| CAEP.9.2.12.C.3 | Identify transferable career skills and design alternate career plans. |

## Technology

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|---|---|
| TECH.8.1.12.A.CS1 | Understand and use technology systems. |
| TECH.8.1.12.A.CS2 | Select and use applications effectively and productively. |
| TECH.8.1.12.B.CS1 | Apply existing knowledge to generate new ideas, products, or processes. |
| TECH.8.1.12.B.CS2 | Create original works as a means of personal or group expression. |
| TECH.8.1.12.C.CS1 | Interact, collaborate, and publish with peers, experts, or others by employing a variety of digital environments and media. |
| TECH.8.1.12.C.CS2 | Communicate information and ideas to multiple audiences using a variety of media and formats. |
| TECH.8.1.12.D.CS2 | Demonstrate personal responsibility for lifelong learning. |
| TECH.8.1.12.E.CS1 | Plan strategies to guide inquiry. |
| TECH.8.1.12.E.CS2 | Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media. |
| TECH.8.1.12.E.CS3 | Evaluate and select information sources and digital tools based on the appropriateness for specific tasks. |
| TECH.8.2.12.D.CS2 | Use and maintain technological products and systems. |

## Summative Assessment

- Projects
- Quizzes
- Student Portfolios
- Tests
- Unit #5 Assessment (Common Assessment)

## Formative Assessment and Performance Opportunities

- "I have...Who has..." Review Activities
- Academic Games

- Carousel Activities
- Class Discussions
- Classwork
- Closure Activities
- Concept Sorting Activities
- Desmos Activities
- Do Nows
- Edulastic
- Exit Tickets
- Four Corners Activities
- Graphic Organizers
- Homework
- Kahoot! games
- Placemat Activities
- Question-All-Writes
- Quiz-Quiz-Trade Activities
- Station Activities
- Student Interviews
- Student Response Systems
- Student Self-Ratings
- Teacher Observation
- Teacher Questioning
- Think, Pair, Share Discussions
- Thumbs Up/Down
- Whip Around
- Whiteboard Use

## Accommodations and Modifications

- 504 Accomodations
- Challenge Problems
- IEP Modifications
- Learning Centers/Stations
- Leveled Practice Opportunities
- Scaffolding Questions
- Small Group Instruction
- Student Companion Website Resources
- Technology
- Use of Manipulatives (Paper Strips, Exploragons, etc.)

## Unit Resources

- Textbook: Geometry, Common Core Ed. (Holt McDougal, 2012)
- Textbook Resource Kit & Companion Website: https://my.hrw.com/
- Geometer's Sketchpad
- Kuta Software

Additional Websites:

- Dan Meyer's 3-Act Math Tasks: https://docs.google.com/spreadsheet/pub?key=0AjIqyKM9d7ZYdEhtR3BJMmdBWnM2YWxWYVM1UWowTEE&output=htmlG
- Engage NY: Geometry Lesson Notes & Handouts: https://www.engageny.org/resource/high-school-geometry
- Geometry Teacher Mike Patterson's Common Core Teaching Notes: http://www.geometrycommoncore.com/
- Khan Academy: https://www.khanacademy.org/
- NCTM Illuminations Website: Resources for Teaching Math: http://illuminations.nctm.org/Default.aspx
- PARCC Educator Resources: http://www.parcconline.org/for-educators
- The Geometer's Sketchpad Resource Center: http://www.dynamicgeometry.com/