Unit #5: Geometry: Pythagorean Theorem and Volume

Content Area: **Mathematics**
Course(s):
Time Period: **April**
Length: **1**
Status: **Published**

Unit Overview

Students will apply their prior knowledge of triangles to the specific qualities of right triangles and find the missing side lengths of right triangles in various situations. They willa lso apply concepts of squares and square roots.

Through application in real-world contexts, students learn the volume formulas for cylinders, cones and spheres. They then apply these formulas to not only find the volume of objects, but also missing dimensions such as the radius or height.

Enduring Understandings

- Everyday objects have a variety of attributes, each of which can be measured in many ways.
- Pi is necessary when calculating volume of rounded objects.
- Right triangles have a special relationship among the side lengths which can be represented by a model and a formula.
- Rounded object volume can be calculated with specific formulas.
- The Pythagorean Theorem and its converse can be proven.
- The Pythagorean Theorem can be used to find the missing side lengths in a coordinate plane and real-world situations.

Essential Questions

- How can the Pythagorean Theorem be used for indirect measurement?
- How do indirect measurement strategies allow for the measurement of items in the real world such as playground structures, flagpoles, and buildings?
- How do we determine the volume of rounded objects?
- How does the knowledge of how to use right triangles and the Pythagorean Theorem enable the design and construction of such structures as a properly pitched roof, handicap ramps to meet code, structurally stable bridges, and roads?
- Why does the Pythagorean Theorem apply only to right triangles?

Student Learning Objectives (SLOs)

- Evaluate square roots and cubic roots of small perfect squares and cubes respectively and use square and cube root symbols to represent solutions to equations of the form x2 = p and x3 = p where p is a positive rational number.
- Explain a proof of the Pythagorean Theorem and its converse.
- Identify √2 as irrational.
- Know and apply the appropriate formula for the volume of a cone, a cylinder, or a sphere to solve real-world and mathematical problems.
- Use the Pythagorean Theorem to determine the distance between two points in the coordinate plane.
- Utilize the Pythagorean Theorem to determine unknown side lengths of right triangles in two and three dimensions to solve real-world and mathematical problems.

Standards/Indicators

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.8.EE.A.2	Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that √2 is irrational.
MA.K-12.6	Attend to precision.
MA.K-12.7	Look for and make use of structure.
MA.8.G.B	Understand and apply the Pythagorean Theorem.
MA.8.G.B.6	Explain a proof of the Pythagorean Theorem and its converse.
MA.8.G.B.7	Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.
MA.8.G.B.8	Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.
MA.8.G.C	Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.
MA.8.G.C.9	Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.

Lesson Titles

- Analyzing Right Triangles
- Analyzing Right Triangles
- Baseball Diamond
- Comparing Spheres and Cylinders
- Cones and Cylinders, Pyramids and Cubes
- Filling Cylinders

- Filling Fancy Boxes
- Filling Rectangular Boxes
- Finding Areas CM Lesson
- Finding Distances
- Finding perimeter using Pythagorean Theorem
- Looking for Squares CM
- Making a New Container
- Making Cylinders and Prisms from Nets
- Measuring the Egyptian Way: converse of the Pythagorean Theorem
- Melting Ice Cream
- Packaging Blocks
- Planning Parks in Euclid CM Lesson
- Proof of the Pythagorean Theorem
- The Pythagorean Theorem
- Using Squares to Find Lengths
- Wheel of Theodorus

Career Readiness, Life Literacies & Key Skills

WRK.K-12.P.1	Act as a responsible and contributing community members and employee.
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.
WRK.K-12.P.9	Work productively in teams while using cultural/global competence.

Inter-Disciplinary Connections

- Architecture - Design a Rocket
- Art - Wheel of Theodorus
- LAL - Vocabulary

LA.RL.8.4	Determine the meaning of words and phrases as they are used in a text, including figurative and connotative meanings; analyze the impact of specific word choices on meaning and tone, including analogies or allusions to other texts.
LA.L.8.4	Determine or clarify the meaning of unknown and multiple-meaning words or phrases based on grade 8 reading and content, choosing flexibly from a range of strategies.
SCI.MS-ETS1-2	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
VPA.1.1.8	All students will demonstrate an understanding of the elements and principles that govern the creation of works of art in dance, music, theatre, and visual art.
VPA.1.3.8.D.CS1	The creation of art is driven by the principles of balance, harmony, unity, emphasis,

proportion, and rhythm/movement.

Anticipatory Set

- Current Events
- Mathematics History
- Relate to prior knowledge
- Video clips

Instructional Strategies, Learning Activities, and Levels of Blooms/DOK

- Find a missing dimension given the volume of rounded object.
- Find the volume of rounded objects in real-world contexts.
- Give volume in terms of pi and using pi ≈ 3.14.
- Students will know and be able to apply the Pythagorean Theorem.
- SWBAT apply the Pythagorean Theorem to find the distance between two points in the coordinate system.
- SWBAT apply the Pythagorean Theorem to solve problems in real-world contexts.
- SWBAT evaluate square roots of small perfect squares and cube roots of small perfect cubes.
- SWBAT explain a proof of the Pythagorean Theorem and its converse.
- SWBAT use square root and cube root symbols to solve and represent solutions of equations
- SWBAT use the Pythagorean Theorem to solve for a missing side of a right triangle given the other 2 sides in both 2-D and 3-D problems.

Modifications

ELL Modifications

Content specific:

vocabulary important for ELL students to understand include: angle, right angle, right triangle, hypotenuse, prism, pyramid, cylinder, cone, sphere, volume, area, base

- Collaboration with ELL Teacher
- Frontload information in native language
- Graphic organizers
- Modification plan

- Strategy groups
- Teacher conferences
- Using videos, illustrations, pictures, and drawings to explain or clarification

IEP & 504 Modifications

- Anticipate where needs will be
- Assign a peer to help keep student on task
- Break tests down in smaller increments
- Increase one-to-one time
- Modifications & accommodations as listed in the student's IEP
- Modified or reduced assignments
- Position student near helping peer or have quick access to teacher
- Prioritize tasks
- Provide a list of perfect squares.
- Provide completed problems for practice work and homework.
- Provide personal handout with names and examples of each solid figure to assist in identifying a solid
- Provide students with a formula sheet with one type of problem for each formula worked out for them already.
- Reduce length of assignment for different mode of delivery
- Think in concrete terms and provide hands-on-tasks
- Working contract between you and student at risk

G&T Modifications

- For Pythagorean Theorem, integrate speed into the problems to find how long it would take something to move along the path of the hypotenuse or legs.
- For volume, find the volume of complex figures (i.e. find the volume of a castle made completely of solid figures).

Formative Assessment

- Exit Tickets - Pythagorean Theorem
- Exit Tickets - Volume
- Graphic Organizer
- Group Work
- Guided Practice
- Hand Signals
- Independent Practice
- Observation

- Oral Questioning
- PARCC Questions - Pythagorean Theorem
- PARCC Questions - Volume
- Pythagorean Theorem Game
- Pythagorean Theorem Puzzle
- Senteo
- Think-Pair-Share
- Written Work

Summative Assessment

- Marking Period Assessment
- Project - Volume of student created rocket
- Project Based Assessment - Wheel of Theodorus
- Quiz - Pythagorean Theorem
- Self-Assessment
- Stations - Measure and calculate volume of 3-D figures
- Test - 3-D Geometry
- Test - Pythagorean Theorem

Alternative Assessments

Performance tasks
Project-based assignments
Problem-based assignments
Presentations

Benchmark Assessments

Skills-based assessment- math practice

Resources & Materials

- Connected Math: Filling and Wrapping
- Connected Math: Looking for Pythagorus
- Glencoe Pre-Algebra - Chapter 9
- PMI - Pythagorean Theorem

- PMI - Three Dimensional Geometry

Technology

- Calculator
- Chromebook
- PMI - 3-D Geometry
- PMI - Pythagorean Theorem Unit
- SmartBoard
- Volume of Cones, Spheres, Cylinders https://www.youtube.com/watch?v=RZkhnIzBC_k
- Water Demo of Pythagorean Theorem http://twentytwowords.com/using-liquid-to-demonstrate-the-pythagorean-theorem/

TECH.8.1.8	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
TECH.8.2.8	Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.