Unit 02 - The Pythagorean Theorem

Content Area: **Math**
Course(s):
Time Period: **Full Year**
Length: **29 days**
Status: **Published**

General Overview, Course Description or Course Philosophy

In Grade 8, instructional time should focus on three critical areas: (1) formulating and reasoning about expressions and equations, including modeling an association in bivariate data with a linear equation, and solving linear equations and systems of linear equations; (2) grasping the concept of a function and using functions to describe quantitative relationships; (3) analyzing two- and three-dimensional space and figures using distance, angle, similarity, and congruence, and understanding and applying the Pythagorean Theorem.

In this unit, students explore two big ideas; the Pythagorean Theorem and real numbers. Students will also review and make connections among the concepts of area, distance and irrational numbers.

OBJECTIVES, ESSENTIAL QUESTIONS, ENDURING UNDERSTANDINGS

Essential Questions:

- Why does one need to distinguish between rational and irrational numbers?
- How does one locate irrational numbers on a number line?
- How can one use the Pythagorean Theorem to solve real-world and mathematical problems?
- What strategies can be used for finding the distance between two points on a coordinate grid?
- How can the Pythagorean Theorem and its converse be used to solve a variety of problems?
- How are square roots and cube roots of numbers related to their geometric representations?
- How is the area of a square related to the side length of the square?
- How can the values of square roots be estimated?
- How can the values of cube roots be estimated?
- How is the volume of a cube related to the edge length of the cube?
- How are numbers that can be represented as fractions (rational numbers) related to numbers that cannot be represented as fractions (irrational numbers)?
- How can rational numbers be written as fractions and as terminating decimals or repeating decimals?
- How do you represent irrational numbers that cannot be written as fractions?
- What is the square root of a whole number that is not a perfect square called?
- How can you find the location of irrational numbers on a number line?
- How can properties of rational and irrational numbers be used?

Enduring Understandings:

- All numbers, rational and irrational, have a location on a number line.

- Every number has a decimal expansion.
- Every rational number has a decimal expansion that terminates or eventually repeats.
- A number in the form a/b means a is divided by b.
- Every irrational square root can be estimated by its location between two rational square roots, e.g., √7 is between √4 and √9
- Applications of the Pythagorean Theorem
- Applications of the converse of the Pythagorean Theorem.
- the Pythagorean Theorem can be used to find the distance between two points.
- The relationship between a number and its square root is the same as the relationship between the area of a square and the length of its side.
- The relationship between a number and its cube root is the same as the relationship between the volume of a cube and the length of one of its edges.
- The Pythagorean Theorem relates the areas of the squares on the sides of a right triangle to the area of the square on the hypotenuse. As a result, the Pythagorean Theorem is useful for finding the length of an unknown side of a right triangle given the length of the other two sides, finding the length of a segment joining any two points on a coordinate grid, and for writing the equation of a circle centered at the origin.
- The converse of the Pythagorean Theorem can be used to determine whether a triangle is a right triangle.
- The set of real numbers is comprised of the set of rational numbers and the set of irrational numbers. Decimals that neither repeat nor terminate are called irrational numbers.
- Irrational numbers can be located on a number line, and worked with in the same way as with rational numbers.

CONTENT AREA STANDARDS

8.F

A. Define, evaluate and compare functions

B. Use functions to model relationships between quantities

8.G

A. Understand congruence and similarity using physical models, transparencies, or geometry software

B. Understand and apply the Pythagorean Theorem

C. Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres

8.SP

A. Investigate patterns of association in bivariate data

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.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.8.NS.A.1	Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number.
MA.8.NS.A.2	Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., π^2).
MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.2	Reason abstractly and quantitatively.
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-12.6	Attend to precision.
MA.K-12.7	Look for and make use of structure.
MA.K-12.8	Look for and express regularity in repeated reasoning.

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

9.1.8.PB.1: Predict future expenses or opportunities that should be included in the budget planning process. • 9.1.8.PB.2: Explain how different circumstances can affect one's personal budget.

CS.K-12.3	Recognizing and Defining Computational Problems
CS.K-12.5	Creating Computational Artifacts
CS.K-12.6	Testing and Refining Computational Artifacts
LA.K-12.NJSLSA.R1	Read closely to determine what the text says explicitly and to make logical inferences and relevant connections from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
LA.K-12.NJSLSA.SL1	Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.
LA.K-12.NJSLSA.SL4	Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

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:

- numbers that are not rational are called irrational
- every number has a decimal expansion
- know that the square root of 2 is irrational

Procedural Knowledge

Students will be able to:

- apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.
- apply the Pythagorean Theorem to find the distance between two points in a coordinate system.
- describe a sequence that exhibits the similarity between two given two-dimensional figures.
- explain a proof of the converse of the Pythagorean Theorem.
- explain a proof of the Pythagorean Theorem.
- locate irrational numbers on a number line diagram.
- use rational approximations of irrational numbers to compare the size of irrational numbers.
- evaluate square roots of small perfect squares and cube roots of small perfect cubes.
- use the 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.

EVIDENCE OF LEARNING

Alternate Assessments

- Portfolios

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

Benchmark Assessments

- BOY Diagnostic Snapshot Assessment
- MP1 Quarterly Assessment
- MP2 Quarterly Assessment
- MP3 Quarterly Assessment
- MP4 Quarterly Assessment
- EOY Diagnostic Snapshot Assessment

Formative Assessments

Mathematical Reflections

Check Up

Self Assessment Take-Home Questions

Delta Math Assignments

Summative Assessments

Partner Quiz

Teacher created assessments (both test generator and teacher generated questions)

OnCourse generated assessments

Delta Math - Teacher generated assessments

Unit Project - Fencing the yard

RESOURCES (Instructional, Supplemental, Intervention Materials)

Instructional Materials

- CMP3 Unit - Looking for Pythagoras Investigations 1, 2, 3 and 4
- https://www.savvasrealize.com/ (teacher and student recourses)
- Delta Math

Supplemental/Intervention Materials

- https://www.khanacademy.org/
  - Pythagorean Theorem
  - Rational and Irrational Numbers
- https://illuminations.nctm.org/
  - How Irrational
  - Exploring Diagonals and the Pythagorean Theorem
  - Squares, Diagonals and Square Roots
- https://www.illustrativemathematics.org/
  - 8.8 Pythagorean Theorem and Irrational Numbers - all lessons

INTERDISCIPLINARY CONNECTIONS

Environmental Engineering (determining lengths of various situations)

Architecture and construction

Computer and information systems

Agriculture

Art

ACCOMMODATIONS & MODIFICATIONS FOR SUBGROUPS

See link to Accommodations & Modifications document in course folder.