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., $\sqrt{7}$ is between $\sqrt{4}$ and $\sqrt{9}$
- 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

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 $\sqrt{2}$ 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)

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

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.