Subject: Math Grade: 8 Unit #: 8 Title: Looking for Pythagoras

UNIT OVERVIEW

STAGE ONE: Identify Desired Results

Established Goals/Standards

8.GB.6 Prob 1,2 & 3
8.GB.8 Prob 1,2 & 3

Long-Term Transfer Goal

At the end of this unit, students will use what they have learned to independently…

The unit Looking for Pythagoras will allow students to explore side lengths and areas of right triangles and squares. They will also develop skills recognizing rational and irrational numbers, locating irrational numbers on a number line, relating the area of a square to its side length amd the volume of a cibe to its side length.

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. You can locate irrational numbers on a number line, and work with them in the same way as with rational numbers.

Meaning

Enduring Understandings

Students will understand that…

- Develop strategies for finding the distance between two points on coordinate grid
- Explain a proof of the Pythagorean Theorem and use the Theorem to solve everyday problems
- Recognize rational and irrational numbers
- Relate the area of a square to its side length amd the volume of a cibe to its side length.
- Estimate square roots and cube roots

Essential Questions

Students will consider such questions as…

How do driving distance and flying distance between two coordinates relate to each other (1.1)? How do the coordinates of endpoints of a segment help draw othewr lines, which are parallel or pendicular to the segment 1.2)? How does knowing how to calculate areas of rectangles and triangles help in the calculation of irregular areas?

Acquisition

What knowledge will students learn as part of this unit?

What are the variables in a problem?
Does the problem call for using the Pythagorean Theorem?

What skills will students learn as part of this unit?

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		Do I need to find the distance between two points? How are the side lengths and the area of square related?	

STAGE TWO: Determine Acceptable Evidence	
	Assessment Evidence
Criteria for to assess understanding: *(This is used to build the scoring tool.)*	Performance Task focused on Transfer: Unit test **Do** I need to find the distance between two points? **How** are the side length and the area of a square related? **How** can I estimate the square root or cube root of a number?
	Other Assessment Evidence: • Check up (post investigation 1) • Unit test • Self-assessments of learning targets • Teacher observations • Common assessment (task be determined during CPT)

T, M, A *(Code for Transfer, Meaning Making and Acquisition)*	STAGE THREE: Plan Learning Experiences	
	Learning Events: **Investigation 1: Coordinate Grids** In this Investigation, students review the concept of a coordinate grid as they analyze a map in which streets are laid out on a grid. They make the connection between the coordinates of two points and the driving distance between them. In Problem 1.1, they compare the distances traveled by a car (which must travel along horizontal and vertical streets) and by a helicopter (which can take the shortest, straight-line route) between two points. They use a ruler to find the helicopter distance. This Investigation also sets the stage for finding the distance between two points on a grid without measuring. Students continue the use of the coordinate grid to investigate geometric figures in Problem 1.2. Given two vertices, they find other vertices that define a square, a nonsquare rectangle, a right triangle, and a nonrectangular parallelogram. In Problem 1.3, they calculate areas of several figures drawn on a dot grid.	Evidence of learning: *(formative assessment)* •Reflection questions •Ace questions •Class work •Teacher observations

Investigation 2: Squaring Off

In this Investigation, students explore the relationship between the area of a square drawn on a dot grid and the length of its sides. This provides an introduction to the concept of square root. They develop a strategy for finding the distance between two points by analyzing the line segment between them: they draw a square using the segment as one side, find the area of the square, and then find the positive square root of that area. The students expand on this method of finding side length by recalling the method for finding the volume of a cube. The connection between finding the volume and the properties of a cube helps to introduce the cube root of a number.

Investigation 3: The Pythagorean Theorem

In this Investigation, students develop the Pythagorean Theorem and explore its implications. They then investigate a geometric puzzle that verifies the theorem, and they use the theorem to find the distance between two points on a grid. In the last Problem, they explore and apply the converse of the Pythagorean Theorem: If a, b, and c are the lengths of the sides of a triangle and $a^2 + b^2 = c^2$, then the triangle is a right triangle.

Investigation 4: Using the Pythagorean Theorem: Understanding Real Numbers

In this Investigation, the construction of the Wheel of Theodorus leads to the exploration of the square roots of all the whole numbers. Although you can order these numbers on a number line, you cannot represent some of them, such as $\sqrt{2}$, by a terminating or repeating decimal. This leads to the definition of the set of rational numbers and to the conclusion that you can represent every fraction by a repeating or terminating decimal and vice versa. This, in turn, leads to a definition of the numbers that you cannot represent as terminating or repeating decimals as the set of irrational numbers. Also students become familiar with real numbers as a set of numbers consisting of rational and irrational numbers.

Investigation 5: Using the Pythagorean Theorem: Analyzing Triangles and Circles

In this Investigation, students apply the Pythagorean Theorem to solve various Problems. They find distances on a baseball diamond, investigate and apply properties of 30-60-90 triangles, and write an equation of a circle centered at the origin. The Problems are diverse so that students see the power of the Pythagorean Theorem in real-world and mathematical contexts.

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Investigation 1
Coordinate Grids

Problem 1.1
Driving Around Euclid: Locating Points and Finding Distances
Focus Question
How do driving distance and flying distance between two coordinates relate to each other?

Problem 1.2
Planning Parks: Shapes on a Coordinate Grid
Focus Question
How do the coordinates of endpoints of a segment help draw other lines, which are parallel or perpendicular to the segment?

Problem 1.3
Finding Areas
Focus Question How does knowing how to calculate areas of rectangles and triangles help in the calculation of the area of irregular shapes?

Investigation 2
Squaring Off

Problem 2.1 Looking for Squares
Focus Question
How many different square areas are possible to draw using the dots on a dot grid as vertices? Why are some square areas not possible?

Problem 2.2
Square Roots
Focus Question What does $\sqrt{x}$ mean? How does it relate to x^2?

Problem 2.3 Using Squares to Find Lengths
Focus Question How can you find the distance between any two points on a grid?

Problem 2.4 Cube Roots
Focus Question What does it mean to take the cube root of a number?

Investigation 3
The Pythagorean Theorem

Problem 3.1 Discovering the Pythagorean Theorem
Focus Question You know the sum of the two shortest side lengths of a triangle must be greater than the third side length. Is there a similar relationship among the squares on the sides of a triangle? Is the relationship the same for all triangles?

Problem 3.2 A Proof of the Pythagorean Theorem
Focus Question How can you prove that the relationship observed in Problem 3.1 will work for all right triangles?

Problem 3.3
Finding Distances
Focus Question How can you find the distance between any two points on a plane?

Problem 3.4 Measuring the Egyptian Way: Lengths That Form a Right Triangle
Focus Question If a triangle with side lengths a, b, and c satisfies the relationship $a^2 + b^2 = c^2$, is the triangle a right triangle?

Investigation 4
Using the Pythagorean Theorem: Understanding Real Numbers

Problem 4.1 Analyzing the Wheel of Theodorus: Square Roots on a Number Line
Focus Question Can you find distances that are exact square roots of all whole numbers? Can you order square roots on a number line?

Problem 4.2
Representing Fractions as Decimals
Focus Question Why can you represent every fraction as a repeating or terminating decimal? How can you predict which representations will repeat and which will terminate?

Problem 4.3
Representing Decimals as Fractions
Focus Question Can you represent every repeating or terminating decimal as a fraction? Explain.

Problem 4.4 Getting Real: Irrational Numbers
Focus Question
Can you identify every number as either rational or irrational?

Investigation 5
Using the Pythagorean Theorem: Analyzing Triangles and Circles

Problem 5.1 Stopping Sneaky Sally: Finding Unknown Side Lengths
Focus Question How can you use the Pythagorean Theorem to find distances in a geometric shape?

Problem 5.2
Analyzing Triangles
Focus Question How do the lengths of the sides of a 30-60-90 triangle relate to each other?

Problem 5.3
Analyzing Circles
Focus Question What is the relationship between the coordinates of a point (x, y) on a circle with a center at the origin?