TEKS Cluster: Geometry and Measurement – Pythagorean Theorem

8.7 **Expressions, equations, and relationships.** The student applies mathematical process standards to use geometry to solve problems.

Connected Knowledge and Skills 8.6

Pythagorean Theorem

Readiness Standards

8.7(C) use the Pythagorean theorem and its converse to solve problems

Supporting Standards

8.6(C) use models and diagrams to explain the Pythagorean theorem

8.7(D) determine the distance between two points on a coordinate plane using the Pythagorean theorem

8.7(C) Readiness

TEKS Scaffold

TEKS	Student Expectation
G.9(B)	apply the relationships in special right triangles 30°-60°-90° and 45°-45°-90° and the Pythagorean theorem, including Pythagorean triples, to solve problems (S)
G.6(D)	verify theorems about the relationships in triangles, including proof of the Pythagorean Theorem, the sum of interior angles, base angles of isosceles triangles, midsegments, and medians, and apply these relationships to solve problems (S)
8.7(D)	determine the distance between two points on a coordinate plane using the Pythagorean theorem (S)
8.7(C)	**8.7 Expressions, equations, and relationships.** The student applies mathematical process standards to use geometry to solve problems. The student is expected to: **(C) use the Pythagorean theorem and its converse to solve problems**

Stimulus

Word Problem*	Verbal Description	Chart/Table	Graph
Equation/ Expression	Ordered Pairs	Diagram/Image*	Number Line
Base Ten Blocks	Measurement Tool	Formula	Geometric Figures*

Item Types

Multiselect (2 pts)	Match Table Grid (2 pts)	Drag and Drop* (1-2 pts)	Fraction Model (1-2 pts)
Hot Spot (1-2 pts)	Inline Choice (1-2 pts)	Number Line (1-2 pts)	Graphing (1-2 pts)
Text Entry (1-2 pts)	Equation Editor (1-2 pts)	Multiple Choice* (1 pt)	

Content Builder (see Appendix for Tree Diagram)

- Use the Pythagorean theorem and its converse to solve problems

Instructional Implications

In conjunction with 8.6(C), students use the Pythagorean theorem ($a^2 + b^2 = c^2$) and its converse (if $a^2 + b^2 = c^2$, then the triangle with legs a and b and hypotenuse c is a right triangle) to solve problems. Instruction should vary the context of the problems (e.g., given the hypotenuse and one of the legs, determine the missing leg; given the lengths of two sides, determine the hypotenuse).

Students should be able to apply the converse to determine if a shape yields a right triangle (e.g., given the length of three sides of a triangle, determine if the triangle is a right triangle). Instruction should also include a variety of problems where the length of the legs or hypotenuse of the right triangle represent irrational numbers (e.g., $a = \sqrt{10}$, $b = \sqrt{17}$, $c = \sqrt{27}$).

It is important for instruction to include a variety of real-world problems.

Learning from Mistakes

Students may make the following mistakes:

- Having difficulty identifying the hypotenuse vs. the legs of rotated right triangles
- Confusing the hypotenuse as the length of one of the legs*
- Not understanding $\sqrt{27}$ and 27 are two different numerical values
- Thinking the square root of a number equals the number divided by 2
- Adding the length of the two shortest sides of a right triangle to determine the length of the longest side*

Academic Vocabulary

converse of the Pythagorean theorem
hypotenuse
leg
Pythagorean theorem
right triangle*
square root

Interesting Items

8.7(C) 2018 #33
8.7(C) 2016 #15
8.7(C) 2015 #16

8.6(C) **8.6 Expressions, equations, and relationships.** The student applies mathematical process standards to develop mathematical relationships and make connections to geometric formulas. The student is expected to:

(C) use models and diagrams to explain the Pythagorean theorem

Stimulus

Word Problem	Verbal Description*	Chart/Table	Graph
Equation/ Expression	Ordered Pairs	Diagram/Image	Number Line
Base Ten Blocks	Measurement Tool	Formula	Geometric Figures*

Item Types

Multiselect (2 pts)	Match Table Grid (2 pts)	Drag and Drop (1-2 pts)	Fraction Model (1-2 pts)
Hot Spot (1-2 pts)	Inline Choice (1-2 pts)	Number Line (1-2 pts)	Graphing (1-2 pts)
Text Entry (1-2 pts)	Equation Editor (1-2 pts)	Multiple Choice* (1 pt)	

Academic Vocabulary

hypotenuse
leg
Pythagorean theorem
right triangle*

Interesting Items

8.6(C) 2017 #26

Role in Concept Development

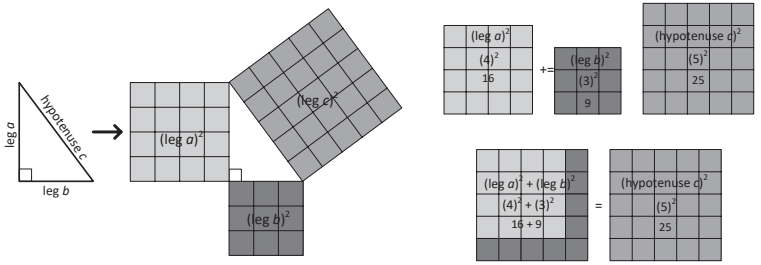
Supports
8.7(C) use the Pythagorean theorem and its converse to solve problems

Connection/ Relevance
Being able to use models and diagrams to explain the Pythagorean theorem provides the foundation students need to solve problems using the Pythagorean theorem and its converse.

When to Teach
Before/Prerequisite to 8.7(C)

Instructional Implications
Students use models and diagrams to explain the Pythagorean theorem ($a^2 + b^2 = c^2$, where a and b represent the legs of a right triangle and c represents the hypotenuse). Instruction should include the use of concrete models (e.g., tangrams, centimeter cubes, snap cubes, inch tiles, etc.) or square grid paper where students build or cut out squares with side lengths equal to the legs and hypotenuse of a right triangle.

Students rearrange or assemble the squares to outline the right triangle, and then compare the area of the two squares for the legs to the area of the square for the hypotenuse. Students use diagrams to match the models in order to explain the Pythagorean theorem. Students should be aware that the sum of the areas of the squares formed by the two legs of a right triangle equal the area of the square formed by the hypotenuse of the right triangle.



Instruction should include the use of a variety of models and diagrams.

Learning from Mistakes
Students may make the following mistakes:
- Confusing the hypotenuse as the leg of a right triangle*
- Creating a rectangle instead of a square on the legs or hypotenuse

8.7(D) **8.7 Expressions, equations, and relationships.** The student applies mathematical process standards to use geometry to solve problems. The student is expected to:

(D) determine the distance between two points on a coordinate plane using the Pythagorean theorem

Stimulus

Word Problem	Verbal Description	Chart/Table	Graph*
Equation/ Expression	Ordered Pairs*	Diagram/Image	Number Line
Base Ten Blocks	Measurement Tool	Formula	Geometric Figures*

Item Types

Multiselect (2 pts)	Match Table Grid (2 pts)	Drag and Drop (1-2 pts)	Fraction Model (1-2 pts)
Hot Spot (1-2 pts)	Inline Choice (1-2 pts)	Number Line (1-2 pts)	Graphing (1-2 pts)
Text Entry (1-2 pts)	Equation Editor (1-2 pts)	Multiple Choice* (1 pt)	

Academic Vocabulary

endpoint*
hypotenuse
leg
Pythagorean theorem
right triangle

Interesting Items

8.7(D) 2018 #27
8.7(D) 2017 #22
8.7(D) 2016 #3

Role in Concept Development

Supports

8.7(C) use the Pythagorean theorem and its converse to solve problems

Connection/ Relevance

Being able to determine the distance between two points on a coordinate plane reinforces an understanding of the Pythagorean theorem so it can be used efficiently to solve problems.

When to Teach

After 8.7(C)

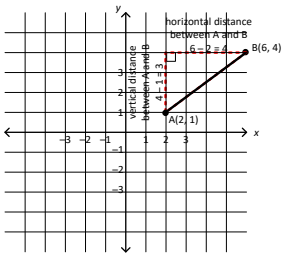
Instructional Implications

In conjunction with 8.6(C)/8.7(C), students determine the distance between two points on a coordinate plane using the Pythagorean theorem. Instruction should include the use of different rational numbers as the coordinates for the points.

On a coordinate plane:

- One leg of the right triangle represents the vertical distance between the two points
- The other leg of the right triangle represents the horizontal distance between the two points
- The length of the hypotenuse of the right triangle represents the distance between the two points

The distance between point A and point B can be calculated using the Pythagorean theorem, as shown below.



Let a = vertical distance between A and B: 4 – 1 = 3
Let b = horizontal distance between A and B: 6 – 2 = 4

Use $a^2 + b^2 = c^2$, where a = 3 and b = 4, to calculate c:

$(3)^2 + (4)^2 = c^2$
$9 + 16 = c^2$
$25 = c^2$
$\sqrt{25} = \sqrt{c^2} = 5 = c$, which represents the distance between A and B on the coordinate plane.

Learning from Mistakes

Students may make the following mistakes:

- Having difficulty identifying the hypotenuse vs. the legs of rotated right triangles
- Confusing the hypotenuse as the length of one of the legs*
- Not understanding √27and 27 are two different numerical values
- Thinking the square root of a number equals the number divided by 2
- When given a graph, estimating the number units between each vertex as a means of determining the side length of a right triangle*