

MATHEMATICS TEACHING AND ASSESSMENT

Pythagorean problem solving



Grade 8 • NC.8.G.7

Teacher models • Seven instructional sections
30 multiple-choice tasks • 30 open/performance tasks
Worked keys • Student workspaces • Observation tools

Reusable across several lessons. Select evidence purposefully; this is not a 60-item single-session assessment.

Free sample | Contents

NC.8.G.7 | Eighth Grade mathematics

This sample contains 18 complete selected pages from the 91-page resource, plus this sample contents page. Original printed page numbers are retained. Gaps are intentional.

Included original pages: 1-14, 29-30, 59, 74

Representative activities

M01: sample PDF page(s) 15; original page(s) 14

M02: sample PDF page(s) 15; original page(s) 14

O01: sample PDF page(s) 16; original page(s) 29

O02: sample PDF page(s) 17; original page(s) 30

Selected teacher prompts and keys: original page(s) 59, 74

Using this sample

Read the preparation and access guidance before using a selected activity.

Keep teacher keys and private preparation pages separate from student copies.

Use the original resource contents to see the scope of the complete packet.

Complete paid download

The complete resource includes the full PDF task bank and teaching materials.

ALIGNMENT

Standard and scope

Apply the Pythagorean Theorem and its converse to solve real-world and mathematical problems.

Current North Carolina Standard Course of Study, adopted June 2017. Source-verified for the 2026-2027 and 2027-2028 school years. Newly adopted standards begin in 2028-2029.

- Model real-world and mathematical situations with right triangles.
- Find unknown legs and hypotenuses, preserving exact roots when appropriate.
- Use the converse to test right angles and solve two-stage geometric problems.

Physical objects are idealized as straight, vertical, horizontal, or rectangular as explicitly stated. Schematic sketches need not be drawn to scale; calculations use stated dimensions.

PLANNING

Use the bank across sessions

Warm-up: M01-M04 and O01-O04.

I Do: M05-M08 and O05-O08.

We Do: M09-M13 and O09-O13.

Collaborative practice: M14-M18 and O14-O18.

Independent practice: M19-M23 and O19-O23.

Small-group reteach: M24-M27 and O24-O27.

Exit ticket: M28-M30 and O28-O30.

Suggested sequence: launch and model; shared reasoning; collaborative application; independent evidence and responsive reteach. A section may span several meetings. Choose 2-4 tasks for a session, then revisit remaining tasks as needed.

Materials: pencil, eraser, ruler, squared paper, calculator for checking approximations, scissors and plain paper for teacher-supervised models. For volume investigations, use waterproof solids with matching dimensions or the supplied numerical data. No purchased software is required.

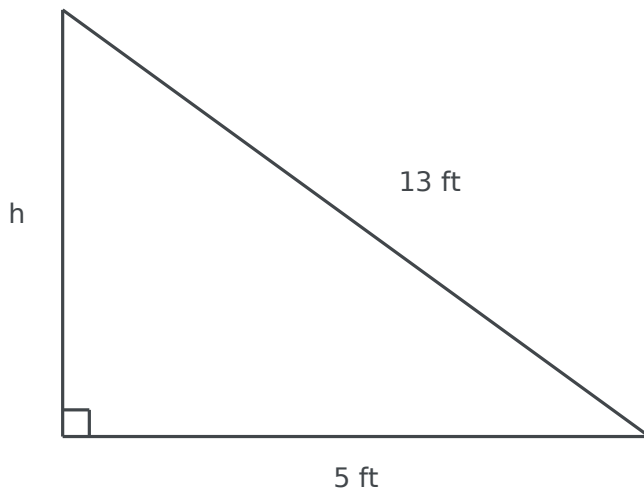
Prerequisites: squares and square roots, positive lengths, area of a square/circle, coordinate differences, and consistent units. Check these orally before scored tasks. Read prompts aloud, enlarge diagrams, and offer tactile or high-contrast grids without supplying the relation being assessed.

TEACHER MODEL

Which side is unknown?

A ladder is 13 ft long. Its foot is 5 ft from a vertical wall on level ground. The ladder lies opposite the right angle and is therefore the hypotenuse.

Schematic; use labels, not measured lengths.



Say: “ $h^2 + 5^2 = 13^2$. The hypotenuse is already known, so subtract 25 from 169: $h^2 = 144$. The positive length is $h = 12$ ft.” Check $144 + 25 = 169$. Do not add 5^2 and 13^2 : that would treat the known hypotenuse as a leg.

TEACHER MODEL

Test before assuming a right angle

A triangular frame has sides 8 cm, 15 cm, and 17 cm. Begin with an unmarked sketch; a drawing's appearance cannot certify a right angle.

Longest side: 17. Compare $8^2 + 15^2 = 64 + 225 = 289$ with $17^2 = 289$. Equality establishes a right angle opposite 17 by the converse. For sides 8, 15, and 18, the comparison is 289 versus 324, so the frame is not right. Anchor: identify a right angle or test for it → name the hypotenuse → write the squared-length equation → solve for a positive length → interpret and check.

REPRODUCIBLE ORGANIZER

Make reasoning visible

Name: _____ Date: _____

Givens and what I need to find**Representation and calculations****Justification or independent check****Conclusion with units and meaning**

TEACHING SEQUENCE

Warm-up

Optional bank: M01-M04; O01-O04. Core: O01. Suggested time: 15-25 minutes; extend construction and discussion as needed.

Launch

Ask learners to read the givens and sketch the situation without calculating. Invite two explanations of what the unknown measures.

Teacher language

“Which two directions in this situation are perpendicular?”

Elicit and examine

Ask: “Why does your equation match this diagram?” Look for labels linked to quantities, a justified operation, and a conclusion that addresses the original question.

Respond to a gap

If the response uses an unconnected formula, ask the learner to identify each quantity on the model. Record any formula or numerical hint you supply as a cue, then reassess with a new task.

Closure

Have a learner summarize the key relationship in words and identify one condition needed for it to apply.

Core solution and look-fors

Place a right-angle marker between the given lengths. The opposite side is c . $c^2 = 6^2 + 8^2 = 100$; $c = 10$ m (approximately 10.0 m). It exceeds either leg and is less than 14 m, the sum of the legs. If a route comparison is requested, the route is 14 m; saving = $14 - 10$ m.

TEACHING SEQUENCE**I Do**

Optional bank: M05-M08; O05-O08. Core: O05. Suggested time: 15-25 minutes; extend construction and discussion as needed.

Model aloud

Work through the core task, pausing before each equation. Say why the relation applies, what each symbol means, and how the conclusion answers the question.

Teacher language

“The longest sloping side lies opposite the right angle.”

Elicit and examine

Ask: “Why does your equation match this diagram?” Look for labels linked to quantities, a justified operation, and a conclusion that addresses the original question.

Respond to a gap

If the response uses an unconnected formula, ask the learner to identify each quantity on the model. Record any formula or numerical hint you supply as a cue, then reassess with a new task.

Closure

Have a learner summarize the key relationship in words and identify one condition needed for it to apply.

Core solution and look-fors

Place a right-angle marker between the given lengths. The opposite side is c . $c^2 = 7^2 + 24^2 = 625$; $c = 25$ ft (approximately 25.0 ft). It exceeds either leg and is less than 31 ft, the sum of the legs. If a route comparison is requested, the route is 31 ft; saving = $31 - 25$ ft.

TEACHING SEQUENCE

We Do

Optional bank: M09-M13; O09-O13. Core: O09. Suggested time: 15-25 minutes; extend construction and discussion as needed.

Share the work

Ask partners to propose the first representation, then compare equations. Record both a valid approach and a plausible error; have learners explain the difference.

Teacher language

“Does the unknown represent a leg or the hypotenuse?”

Elicit and examine

Ask: “Why does your equation match this diagram?” Look for labels linked to quantities, a justified operation, and a conclusion that addresses the original question.

Respond to a gap

If the response uses an unconnected formula, ask the learner to identify each quantity on the model. Record any formula or numerical hint you supply as a cue, then reassess with a new task.

Closure

Have a learner summarize the key relationship in words and identify one condition needed for it to apply.

Core solution and look-fors

Place a right-angle marker between the given lengths. The opposite side is c . $c^2 = 6^2 + 9^2 = 117$; $c = \sqrt{117}$ m (approximately 10.8 m). It exceeds either leg and is less than 15 m, the sum of the legs. If a route comparison is requested, the route is 15 m; saving = $15 - \sqrt{117}$ m.

TEACHING SEQUENCE

Collaborative practice

Optional bank: M14-M18; O14-O18. Core: O14. Suggested time: 15-25 minutes; extend construction and discussion as needed.

Partner roles

One learner constructs or labels the model; the other checks the equation and units. Switch roles on the next task. Both write an individual explanation.

Teacher language

“Why do we subtract squared lengths here?”

Elicit and examine

Ask: “Why does your equation match this diagram?” Look for labels linked to quantities, a justified operation, and a conclusion that addresses the original question.

Respond to a gap

If the response uses an unconnected formula, ask the learner to identify each quantity on the model. Record any formula or numerical hint you supply as a cue, then reassess with a new task.

Closure

Have a learner summarize the key relationship in words and identify one condition needed for it to apply.

Core solution and look-fors

The side of length 25 is the hypotenuse. $x^2 + 24^2 = 25^2$; $x^2 = 49$; $x = 7 \text{ ft} \approx 7.0 \text{ ft}$. Check: $49 + 576 = 625$. The positive root is used because x is a length.

TEACHING SEQUENCE

Independent practice

Optional bank: M19-M23; O19-O23. Core: O19. Suggested time: 15-25 minutes; extend construction and discussion as needed.

Collect independent evidence

Give the core prompt without an example visible. Preserve the first response. Ask only neutral clarifications such as “What does this label represent?”

Teacher language

“A sketch cannot supply the right-angle conclusion.”

Elicit and examine

Ask: “Why does your equation match this diagram?” Look for labels linked to quantities, a justified operation, and a conclusion that addresses the original question.

Respond to a gap

If the response uses an unconnected formula, ask the learner to identify each quantity on the model. Record any formula or numerical hint you supply as a cue, then reassess with a new task.

Closure

Have a learner summarize the key relationship in words and identify one condition needed for it to apply.

Core solution and look-fors

Use 41 as the candidate hypotenuse because it is longest. $9^2 + 40^2 = 1681$; $41^2 = 1681$. They are equal, so the converse gives a right angle opposite the side of length 41. Do not mark a right angle on the initial diagram unless justified.

TEACHING SEQUENCE

Small-group reteach

Optional bank: M24-M27; O24-O27. Core: O24. Suggested time: 15-25 minutes; extend construction and discussion as needed.

Diagnose and reteach

Use one previously observed error to select a model. Reconnect the diagram to each term, then remove the model and offer a different item in this range.

Teacher language

“Where is the second right triangle inside this box?”

Elicit and examine

Ask: “Why does your equation match this diagram?” Look for labels linked to quantities, a justified operation, and a conclusion that addresses the original question.

Respond to a gap

If the response uses an unconnected formula, ask the learner to identify each quantity on the model. Record any formula or numerical hint you supply as a cue, then reassess with a new task.

Closure

Have a learner summarize the key relationship in words and identify one condition needed for it to apply.

Core solution and look-fors

Use 9 as the candidate hypotenuse because it is longest. $5^2 + 7^2 = 74$; $9^2 = 81$. They are unequal, so the triangle is not right. A right triangle would have to satisfy the theorem with its longest side as hypotenuse. Do not mark a right angle on the initial diagram unless justified.

TEACHING SEQUENCE

Exit ticket

Optional bank: M28-M30; O28-O30. Core: O28. Suggested time: 15-25 minutes; extend construction and discussion as needed.

Close and decide

Ask learners to complete the core task independently and explain one check. Use the remaining exit tasks later to distinguish a one-time slip from a persistent gap.

Teacher language

“What bounds make this estimate defensible?”

Elicit and examine

Ask: “Why does your equation match this diagram?” Look for labels linked to quantities, a justified operation, and a conclusion that addresses the original question.

Respond to a gap

If the response uses an unconnected formula, ask the learner to identify each quantity on the model. Record any formula or numerical hint you supply as a cue, then reassess with a new task.

Closure

Have a learner summarize the key relationship in words and identify one condition needed for it to apply.

Core solution and look-fors

The ladder is the hypotenuse, so the height must be below 10 ft. $h^2 + 6^2 = 10^2$ gives $h^2 = 64$ and $h = 8$ ft. Adding $10 + 6$ does not model a right triangle.

MULTIPLE-CHOICE BANK

M01 - M02**M01 | Warm-up**

Target: Find a hypotenuse in a right-triangle model.

A rectangular garden is 3 m by 4 m. What is its diagonal length?

- A. 4 m
 - B. 25 m
 - C. 5 m
 - D. 1 m
-

M02 | Warm-up

Target: Find a hypotenuse in a right-triangle model.

A ramp rises 5 ft over a horizontal run of 12 ft. What is its sloping length?

- A. 13 ft
 - B. 7 ft
 - C. 17 ft
 - D. $\sqrt{119}$ ft
-

WARM-UP

001 | Show your reasoning

Target: Build and solve a right-triangle application.

A rectangular patio is 6 m by 8 m. Sketch the patio and its diagonal; find the diagonal and compare it with walking along two adjoining edges. Show an equation and a reasonableness check.

Model, construction, or calculations

Explanation, check, and conclusion

WARM-UP

002 | Show your reasoning

Target: Build and solve a right-triangle application.

A ramp rises 9 ft across a horizontal run of 12 ft. Draw its cross-section, mark the right angle, and find the ramp length. Show an equation and a reasonableness check.

Model, construction, or calculations

Explanation, check, and conclusion

WORKED KEYS

M01 - M02

M01 | Warm-up

Target: Find a hypotenuse in a right-triangle model.

Answer: C • 5 m

The stated legs are perpendicular. $c^2 = 3^2 + 4^2 = 25$, so $c = 5$ m; use the positive root.

A: This reports one leg, although the hypotenuse is longer.

B: This is the squared length rather than a length.

D: This subtracts the legs without using the right-triangle relationship.

A selection alone does not establish a misconception; ask for the reasoning.

M02 | Warm-up

Target: Find a hypotenuse in a right-triangle model.

Answer: A • 13 ft

The stated legs are perpendicular. $c^2 = 5^2 + 12^2 = 169$, so $c = 13$ ft; use the positive root.

B: This subtracts the legs without using the right-triangle relationship.

C: This adds the two legs, measuring a bent route.

D: This subtracts squared legs instead of adding them.

A selection alone does not establish a misconception; ask for the reasoning.

WORKED KEYS

001 - 002**001 | Warm-up**

Target: Build and solve a right-triangle application.

Result: 10 m

Place a right-angle marker between the given lengths. The opposite side is c . $c^2 = 6^2 + 8^2 = 100$; $c = 10$ m (approximately 10.0 m). It exceeds either leg and is less than 14 m, the sum of the legs. If a route comparison is requested, the route is 14 m; saving = $14 - 10$ m.

Assess the requested representation, reasoning, accuracy, and interpretation separately. Equivalent exact forms and valid alternative constructions are acceptable.

002 | Warm-up

Target: Build and solve a right-triangle application.

Result: 15 ft

Place a right-angle marker between the given lengths. The opposite side is c . $c^2 = 9^2 + 12^2 = 225$; $c = 15$ ft (approximately 15.0 ft). It exceeds either leg and is less than 21 ft, the sum of the legs. If a route comparison is requested, the route is 21 ft; saving = $21 - 15$ ft.

Assess the requested representation, reasoning, accuracy, and interpretation separately. Equivalent exact forms and valid alternative constructions are acceptable.