

Substitute Guide: The Pythagorean Theorem & Distance

Course: Geometry (Grades 9–12) **Subject:** Mathematics **Time:** ~50 min standard · ~90 min block Math

Learning goal (plain language)

Students practice the **Pythagorean Theorem** — $a^2 + b^2 = c^2$ for right triangles — and use it to find a **missing leg or hypotenuse**, to measure the **distance between two points** on a grid (the distance formula), to solve a **real-world ladder problem**, and to test whether a triangle is a **right triangle** using the **converse**. **You do not need a math background to run this.** Every formula, a worked example, and a labeled graph are printed in the student packet. Students **show their work**; you do not need to teach the method — the packet does the teaching. Your job is to hand it out, read the start script, keep the room on task, and collect the packets.

Standards alignment

Framework: 19 TAC §111.41 (Geometry). Knowledge & skills for right-triangle relationships and coordinate geometry — the Pythagorean Theorem and its converse, and finding distance on the coordinate plane.

- **Provisional — G.6(D):** apply the Pythagorean Theorem and its converse to solve problems and to determine whether a triangle is a right triangle.
- **Provisional — G.2(B):** use the distance formula on the coordinate plane to find the length of a segment between two points.
- **Provisional — G.5(A):** use right-triangle relationships and length calculations to solve mathematical and real-world problems.

Provisional — pending educator verification against the current official TAC source.

(Standards are paraphrased here, not quoted. Please confirm codes and wording against your official source. This packet is **not** claimed to be "aligned to the TEKS" until reviewed.)

Setup Before class (5 min)

- Count and hand out one **student packet** per student.
- Confirm each student has a **pencil**. A **basic or scientific calculator is allowed but not required**; students who have one may use it (helpful for square roots).
- Write the date on the board and remind students to fill in the name line.
- Keep the **answer key** with you — it is a separate file and is **not** in the student packet.
- **Standard vs. block:** on a ~50-minute period, students do items 1–8, 10, and ACE (item 9 is optional). On a ~90-minute block, students also complete **item 9**, the multi-step composite-distance task.

Materials What's needed

- Printed student packet (5–7 pages) per student.
- Pencil per student; a basic four-function or scientific calculator is optional.
- This guide and the separate answer key (teacher only).

- No technology, no internet, no special supplies.

Timing Suggested pacing (standard ~50 min • block ~90 min)

Segment	Standard (~50 min)	Block (~90 min)	What students do
Start — Retrieval warm-up	6 min	8 min	Q1–Q2 (squaring & roots; horizontal/vertical distance)
Build — Study the math	8–12 min	12–15 min	Read reference box, worked example, Figure 1; Q3
Apply — Use what you know	20–26 min	28–34 min	Q4–Q8 (missing side, distance, ladder, error analysis, converse)
Block — Extra applied task	optional	12–15 min	Q9 (composite path vs. straight-line distance)
Explain — Justify (CER)	6–10 min	8–12 min	Q10 claim/evidence/reasoning (converse)
Close — ACE	5 min	5–7 min	Articulate / Connect / Extend
Continue — early finishers	optional	optional	Build Pythagorean triples; test 5-6-8

Script Read aloud to start

"Today's assignment is a paper math packet called *The Pythagorean Theorem and Distance*. You will work by yourself with a pencil. A basic or scientific calculator is allowed if you have one, but you do not need one. The most important rule: **show your work** — write down the squares you compute and the square root you take, not just a final number. When an answer is not a perfect square, give both the exact square root and a rounded decimal. Everything you need is printed in the packet, including a worked example, a labeled graph, and all the formulas. Start with the warm-up, then read the Build section before the Apply questions. If a question is tricky, skip it and come back. Put your name, class period, and date at the top now. You have about [50 / 90] minutes; raise your hand if you need help reading a question."

Support When students ask for help

- **Students show their work; you do not need to teach the method.** Point them back to the printed **reference box** and the **worked example** — the method is right there.
- **You may read any part aloud** to a student or the class.
- If a student is stuck, prompt with "What does the worked example do?" or "Which side is across from the right angle — that is the hypotenuse" rather than giving the answer.
- For a missing side, remind them: to find the hypotenuse you **add** the squares then square-root; to find a leg you **subtract** ($a^2 = c^2 - b^2$) then square-root.
- Remind students that the **distance formula is just $a^2 + b^2 = c^2$** — the horizontal change is one leg and the vertical change is the other.
- It is fine if a student cannot finish the optional early-finisher challenge.

Access Accommodations & language support

- **Read-aloud** of any question is allowed for all students.
- Point students to the **worked example**, the **formulas** in the reference box, and the **sentence stems** for Q10 and ACE.

- A **calculator is allowed** for any student who wants one — this removes the square-root arithmetic barrier so students can focus on the reasoning.
- Extended time is fine; the core can stop after Q10 if time runs short.
- Students may show work with numbers and short phrases if writing full sentences is a barrier, as long as the reasoning is clear.
- The packet is grayscale-safe — Figure 1 uses black lines, labeled vertices, a right-angle mark, and text, so it prints and reads clearly in black and white.

Tools Allowed & not allowed

Allowed: pencil, the printed packet, a basic or scientific calculator, quiet self-read-aloud. **Not needed / not allowed:** phones for messaging, internet, AI tools, or getting answers from another student.

Collect at the end: Collect every packet, whether finished or not, with names on them. Stack them for the teacher. Note on a sticky how far most students got and any questions that caused confusion.

Answer key: The **answer key is a separate file** (answerkey.html) and is for the teacher only. Please do not hand it to students.

Teacher follow-up (for the returning teacher)

The highest-value items to review next class are the **error analysis (Q7)** and the **justification (Q10)**, which reveal the "add the legs" error and whether students can use the converse instead of assuming a scalene triangle is right. Watch for **mislabeled hypotenuses** on the ladder item (Q6), **forgetting to square-root** (Q3, Q5), and dropping the **exact radical** when the answer is not a perfect square ($Q3 \rightarrow \sqrt{180}$, $Q9c \rightarrow \sqrt{116}$). The **distance** items (Q5, Q9) show who connects the distance formula back to $a^2 + b^2 = c^2$. The separate answer key lists worked steps, alternate strategies, misconceptions, and a 3-point rubric for Q10.

HS_GEOM_Pythagorean_01 — The Pythagorean Theorem & Distance on the Coordinate Plane Substitute Guide