Grade 8 Math · Lesson 7 — The Site Survey

Pythagorean Theorem · ages 12 to 15 · 45 minutes · the workbook, one screen, this page, a pencil and paper

At a Glance

- **The book:** 8th Grade Math Workbook: Real-World Problem Solving, Chapter 7 (The Surveyor), by Dr. Gene A Constant.
- **Free tool:** Geometry Quest (distance, area and angles), free, no login, plays in the browser: globalsovereignuniversity.org/geometry-quest.
- **Free class:** Lesson 7 of the free Grade 8 Mathematics class: globalsovereignuniversity.org/grade-8-math-class#lesson-7.
- **Ages and time:** Grade 8 · ages 12 to 15 · 45 minutes.
- **Prep (5 min):** read the Teaching Creed and have the workbook open to Chapter 7. Cut three sticks, straws or strings 3, 4 and 5 hand-widths long, and have a tape measure.

Why this lesson

The Pythagorean theorem is how builders square a corner, how surveyors measure across a pond and how a phone finds a distance on a map. It is three thousand years old and still used on every job site.

What the learner will be able to do

- Understand the Pythagorean theorem.
- Find missing sides of right triangles.
- Determine if a triangle is a right triangle.
- Apply the theorem to real-world problems.

The 45-Minute Climb

How to read this: the gold box in each step is your lesson, word for word. Run it as written. The notes beneath are optional support. "The group" means your family; "host" means you.

1 · The Hook (5 min)

"Lay three sticks or strings 3, 4 and 5 hand-widths long into a triangle. Is the corner square? How could a builder be sure?"

Say it like this: let your child do it with real objects if you can, then ask how they know their answer is right before you check it.

2 · Work It Together (15 min)

Open the workbook to the worked example Find c when a = 6 and b = 8 (Section 7.1) together: Use Pythagorean theorem: $a^2 + b^2 = c^2$ Substitute: $6^2 + 8^2 = c^2$ Calculate: $36 + 64 = c^2$ Simplify: $100 = c^2$ Take square root: c = 10. Then read Find a when b = 9 and c = 15 (Section 7.2) together: Rearrange: $a^2 = c^2 - b^2$ Substitute: $a^2 = 15^2 - 9^2$ Calculate: $a^2 = 225 - 81 = 144$ Take square root: a = 12.

Read each step aloud and let your child say the next step before you read it. Then play one round of Geometry Quest.

3 · The Talk (8 min)

1. Which side is c in $a^2 + b^2 = c^2$? 2. How can a builder check that a corner is square? 3. How do you find a distance between two points on a grid?

You are not fishing for one right answer. You are listening for understanding:

- Q1: The hypotenuse, the longest side, across from the right angle.
- Q2: Measure 3 along one side, 4 along the other; if the diagonal is 5, the corner is square.
- Q3: Draw the right triangle: the across and up distances are the legs, and the distance is the hypotenuse.

4 · Solo Climb (12 min)

Five problems on your own, with your work shown.
1. Find c: a = 8, b = 15
2. A 17-ft ladder leans against a wall with base 8 ft away. Height reached?
3. Is a triangle with sides 9, 12, 15 a right triangle?
4. Find the missing value for a Pythagorean triple: 9, __, 15
5. A surveyor needs to measure across a pond. She marks 60m and 80m legs. Direct distance?

Why solo: a test, a job and real life ask you to work alone. Five problems rehearse exactly that. The answers are at the end of this plan.

Keep It Fresh (5 min, the next day)

Two review problems from the book's Extra Practice.
1. Find c: a = 15, b = 20
2. Is 9, 40, 41 a Pythagorean triple?

Ready to move on? Four of the five Solo Climb problems right, with work shown, means this skill is solid. If not, reread the worked examples together and try two more problems from the chapter before the next lesson. Short review of old skills keeps them from fading.

5 · The Takeaway (5 min)

In a right triangle $a^2 + b^2 = c^2$, where c is the longest side. The same rule finds distances on a grid. · Homework: Use the 3-4-5 rule with a tape measure to check whether one corner of a table, rug or room is square.

The badge moment: finishing all five steps earns the Bronze ring of this lesson's badge, The True Surveyor. Mark it on the Climber's Passport now; the homework is how Silver and Gold are earned during the week.

Common Mistakes to Watch For

- Adding the sides instead of their squares.
- Putting the hypotenuse in the wrong place: c is always the longest side.
- Forgetting the square root at the end.

The Teaching Creed

You are not the expert; the book and the method are. Your job is to ask "how do you know?" one more time than feels natural, and to celebrate wrong answers out loud. In here, a wrong answer is where the lesson lives.

GENO, GSU's free tutor, can explain any step a second way, any hour, in 83 languages, with no login: globalsovereignuniversity.org/free-tutor. A prompt for the host: Ask GENO: "Check whether 7, 24, 25 is a right triangle, and show me the arithmetic."

Adapt It and Measure It

Differentiation

- Struggling: draw and label every triangle before computing.
- Ahead: find three Pythagorean triples of your own.
- Large co-op: each team squares a corner of the room or yard with the 3-4-5 rule.
- Reluctant: measure the diagonal of a real screen or table and check it.

Evidence of learning (no exam)

Look for three things. Tried: finished all five Solo Climb problems with work shown. Noticed: can name the mistake in Common Mistakes that they almost made. Changed: the next day, solves one new problem from the same chapter without help. Those three words are the whole rubric, and they match the badge tiers below.

Gamify It — The Campus Climb

Every GSU lesson is one badge on the Climber's Passport, earned at four depths: Bronze, Silver, Gold and Platinum.

LESSON 7 BADGE — The True Surveyor · Bronze — The Climb: finished the 45-minute lesson, all five steps. · Silver — The Try: did the homework and explained it to the host. · Gold — The Proof: completed the chapter's Action Report in the workbook with every answer checked against the Answer Key. · Platinum — The Teacher: ran this lesson as host for someone else. The harvest of a teacher is teachers.

Answers for the Host

1. c = 17
2. 15 ft
3. Yes: 81 + 144 = 225
4. 12
5. 100 m

Keep It Fresh: 1. 25 · 2. Yes: 81 + 1600 = 1681 = 41^2

Every answer above comes from the workbook's own Answer Key. The book behind this lesson: 8th Grade Math Workbook: Real-World Problem Solving, Chapter 7 (The Surveyor).

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