Grade 8 Math · Lesson 9 — The Roof Truss Check

Angle Relationships · 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 9 (The Architect), 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 9 of the free Grade 8 Mathematics class: globalsovereignuniversity.org/grade-8-math-class#lesson-9.
- **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 9. Have a paper triangle cut from scrap paper and a ruler; on a sunny day, a tape measure for shadows.

Why this lesson

Architects and carpenters check angles every day: parallel beams, roof trusses, braces. Angle rules and similar triangles let a child find a measurement they cannot reach, such as the height of a tree.

What the learner will be able to do

- Identify and calculate angles formed by parallel lines and transversals.
- Apply the triangle angle sum theorem.
- Work with exterior angles of triangles.
- Understand and apply angle-angle similarity.

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)

"Tear the three corners off a paper triangle and lay them side by side. What do they make together?"

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 A brace crosses two parallel beams and makes a 110° angle (Section 9.1) together: Its alternate interior angle is equal: 110° Its co-interior angle adds to 180°: 180 - 110 = 70° So every angle at the brace is either 110° or 70°. Then read Find x in a triangle with angles 45°, 60°, and x° (Section 9.2) together: Use angle sum: 45 + 60 + x = 180 Simplify: 105 + x = 180 Solve: x = 75°.

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. Why do the angles of every triangle add to 180°? 2. How is an exterior angle related to the two far inside angles? 3. How can a shadow tell you a tree's height?

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

- Q1: Torn off and placed side by side they make a straight line, and a straight line is 180°.
- Q2: It equals their sum.
- Q3: The sun makes similar triangles, so height over shadow is the same for you and the tree.

4 · Solo Climb (12 min)

Five problems on your own, with your work shown.
1. Co-interior angles measure 2x and 3x + 30. Find x and the angle measures.
2. Isosceles triangle: base angles both 55°. Find the vertex angle.
3. Exterior angle is 130°. One remote interior is 55°. Find the other.
4. A 6-ft person casts a 4-ft shadow. A tree casts a 20-ft shadow. Tree height?
5. Triangle sides 5, 12, 13. Similar triangle has shortest side 15. Find other sides.

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. Parallel lines cut by transversal. One angle = 72°. Find its alternate interior angle.
2. Triangle angles: 2x, 3x, 4x. Find all angles.

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)

A triangle's angles add to 180°. Parallel lines make equal angle pairs, and similar triangles let you measure what you cannot reach. · Homework: On a sunny day, measure your shadow and a tree's shadow, then work out the tree's height with similar triangles.

The badge moment: finishing all five steps earns the Bronze ring of this lesson's badge, The Angle Checker. 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

- Mixing up corresponding and co-interior angles: co-interior angles add to 180°.
- Forgetting that an exterior angle equals the two remote interior angles added together.
- Setting up a shadow proportion with heights and shadows in different places.

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: "Give me two parallel lines cut by a transversal at 65°, and let me name all eight angles."

Adapt It and Measure It

Differentiation

- Struggling: color matching angles with the same pencil color.
- Ahead: find the height of a building or tree with shadows.
- Large co-op: each team checks the angles of one part of a paper roof truss.
- Reluctant: tear the corners off a paper triangle and let the 180° speak for itself.

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 9 BADGE — The Angle Checker · 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. x = 30; the angles are 60° and 120°
2. 70°
3. 75°
4. 30 ft
5. Scale factor 3: sides 36 and 39

Keep It Fresh: 1. 72° · 2. x = 20: 40°, 60°, 80°

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 9 (The Architect).

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