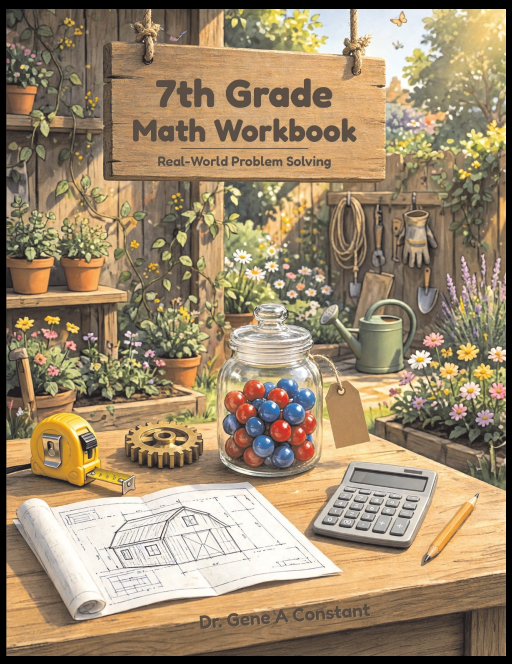
GLOBAL SOVEREIGN UNIVERSITY · HOMESCHOOL — MENTOR'S EDITION

Grade 7 Math

Ten Free Lesson Plans

One 45-minute lesson for each chapter of the 7th Grade Math Workbook: Real-World Problem Solving, written word for word for the parent or teacher.



Also inside: the GSU campus poster and the free Grade Level Check.

How to Use This Pack

Each plan runs one 45-minute lesson in five steps: The Hook, Work It Together, The Talk, Solo Climb and The Takeaway, with a next-day review. The gold boxes are the lesson, word for word. You do not need to be a math expert: the book and the method do the teaching, and you ask “how do you know?”

What you need: the *7th Grade Math Workbook* (paperback ISBN 979-8-1830-8099-5, or the ebook from the GSU Bookstore), this pack, a pencil and paper. Every answer in these plans comes from the book’s own Answer Key.

Free online: the Grade 7 Mathematics class at globalsovereignuniversity.org/grade-7-math-class teaches the same ten lessons, with Listen and quick self-checks. GENO, GSU’s free tutor, can explain any step another way at globalsovereignuniversity.org/free-tutor.

Contents

	The GSU campus poster	3
Lesson 1	**The Year-End Ledger** · The Bookkeeper · Adding and Subtracting Integers	4
Lesson 2	**The Shed Estimate** · The Carpenter · Multiplying and Dividing Rational Numbers	8
Lesson 3	**Can We Fill the Order?** · The Farm Manager · Ratios, Unit Rates and Proportions	12
Lesson 4	**Opening Day** · The Shop Owner · Percents, Markups, Taxes and Scale Drawings	16
Lesson 5	**The Quote Formula** · The Event Planner · Writing and Simplifying Expressions	20
Lesson 6	**Load Plan for Saturday** · The Logistics Coordinator · Equations and Inequalities	24
Lesson 7	**The Community Center Plan** · The Architect · Area, Perimeter, Circles and Angles	28
Lesson 8	**The New Storage Tank** · The Water Engineer · Volume and Surface Area	32
Lesson 9	**The Valley Report** · The Wildlife Biologist · Samples, Inferences and Measures of Center	36
Lesson 10	**The Ride Safety Report** · The Safety Engineer · Probability and Compound Events	40
	The Grade Level Check · a free, private screener for reading and math, grades 4 to 8	44

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The Education of the Future is HERE

Grade 7 Math · Lesson 1 — The Year-End Ledger

Adding and Subtracting Integers · ages 11 to 14 · 45 minutes · the workbook, one screen, this page, a pencil and paper

At a Glance

- **The book:** 7th Grade Math Workbook: Real-World Problem Solving, Chapter 1 (The Bookkeeper), by Dr. Gene A Constant.
- **Free tool:** Budget Builder (money coming in and going out of a real budget), free, no login, plays in the browser: globalsovereignuniversity.org/budget-builder.
- **Free class:** Lesson 1 of the free Grade 7 Mathematics class: globalsovereignuniversity.org/grade-7-math-class#lesson-1.
- **Ages and time:** Grade 7 · ages 11 to 14 · 45 minutes.
- **Prep (5 min):** read the Teaching Creed and have the workbook open to Chapter 1. Draw a number line from −10 to 10 on a strip of paper and set out a coin or button.

Why this lesson

Every ledger, bank account and thermometer runs on signed numbers. A child who can walk a coin below zero on a number line can keep honest books for life, and every later chapter that uses negatives stands on this one.

What the learner will be able to do

- Use positive and negative numbers to stand for gains and losses
- Find the absolute value of a number
- Add and subtract integers
- Work multi-step problems with three or more gains and losses
- Find a net result and explain what it means

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)

"Draw a number line on a strip of paper from −10 to 10. Put a coin on 4. Walk it back 9 steps. Where does it land, and what does that number mean if the coin is your money?"

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 Temperature Drops Below Zero (Section 1.1) together: Start at the noon temperature: 8°F. A storm drops it 23°F, so subtract: 8 − 23. 23 is bigger than 8, so the answer crosses below zero: 8 − 23 = −15. The temperature is now −15°F. Then read Paying Down a Debt (Section 1.2) together: A member owes the storehouse $60, so the balance is −60. She earns $45 doing guard duty on the harvest. Add: −60 + 45. The signs are different: 60 − 45 = 15. The negative number had the larger absolute value, so the answer is negative: −15. She still owes $15.

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

3 · The Talk (8 min)

1. Why does subtracting a negative number make the answer bigger? 2. When you add a positive and a negative number, how do you know the sign of the answer? 3. What does a net result of −$100 tell the board?

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

- Q1: Subtracting means taking away. Taking away a debt or a loss leaves you better off, so 3 − (−5) is the same as 3 + 5.
- Q2: Look at which number is farther from zero. The answer takes the sign of the number with the larger absolute value.
- Q3: That after every gain and loss is counted, the accounts together owe $100.

4 · Solo Climb (12 min)

Five problems on your own, with your work shown.
1. A survey crew starts at the co-op office, 250 feet above sea level, and walks down 315 feet into a canyon to check a spring. What is their elevation now?
2. The co-op needs 500 fence posts and has 320, a shortfall of −180. A delivery brings 95 posts. What is the new shortfall?
3. A member owes −$80 for winter supplies. He works extra shifts and earns $55. The co-op board then forgives $15 of what he still owes. What is his final balance?
4. The co-op has 84 cows. It sells 6, a neighbor gives it 12, and 4 are sold at auction. How many cows does it have now?
5. The town has 300 people. In one year 14 move away, 8 babies are born and 22 new people move in. What is the population now?

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. A solar battery is at 100%. A cloudy week drains 45%, a sunny day adds 18% and a night of heavy use drains 30%. What is the charge now?
2. A diver is at −28 feet and rises 11 feet. Where is she now?

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 negative number is a loss, a debt or a drop. To subtract, add the opposite." · Homework: Keep a one-week ledger of your own: allowance or chores paid in as positive numbers, anything spent as negative. Add the column at the end of the week and say what the net result means.

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

- Losing the sign: writing 8 when the answer is −8.
- Subtracting a negative as if it were positive: 3 − (−5) is 8, not −2.
- Adding the size of the numbers when the signs are different, instead of subtracting.

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: "My child keeps getting 3 − (−5) wrong. Help them see why subtracting a negative is the same as adding, without giving the answer."

Adapt It and Measure It

Differentiation

- Struggling: walk the coin on the number line for every problem before writing anything.
- Ahead: keep a week-long ledger of family money in and out and find the net result.
- Large co-op: give each team a different month of the co-op's books to balance.
- Reluctant: let the child track the temperature outside each morning and evening for a week.

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 1 BADGE — The Honest Ledger · 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. −65 feet, which is 65 feet below sea level (250 − 315)
2. −85 posts (−180 + 95)
3. −$10, he still owes $10 (−80 + 55 = −25; −25 + 15 = −10)
4. 86 cows (84 − 6 + 12 − 4)
5. 316 people (300 − 14 + 8 + 22)

Keep It Fresh: 1. 43% (100 − 45 + 18 − 30) · 2. −17 feet

Every answer above comes from the workbook's own Answer Key. The book behind this lesson: 7th Grade Math Workbook: Real-World Problem Solving, Chapter 1 (The Bookkeeper).

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Grade 7 Math · Lesson 2 — The Shed Estimate

Multiplying and Dividing Rational Numbers · ages 11 to 14 · 45 minutes · the workbook, one screen, this page, a pencil and paper

At a Glance

- **The book:** 7th Grade Math Workbook: Real-World Problem Solving, Chapter 2 (The Carpenter), by Dr. Gene A Constant.
- **Free tool:** Fraction Action (visual fractions, including dividing fractions), free, no login, plays in the browser: globalsovereignuniversity.org/fraction-action.
- **Free class:** Lesson 2 of the free Grade 7 Mathematics class: globalsovereignuniversity.org/grade-7-math-class#lesson-2.
- **Ages and time:** Grade 7 · ages 11 to 14 · 45 minutes.
- **Prep (5 min):** read the Teaching Creed and have the workbook open to Chapter 2. Cut a strip of paper 15¾ inches long and have a ruler and pencil ready.

Why this lesson

Carpenters, cooks and builders multiply and divide fractions and decimals all day. The sign rules and the flip-and-multiply rule are short, but children who only memorize them mix them up. Doing it with a real strip of paper makes the rule stick.

What the learner will be able to do

- Use the sign rules to multiply and divide integers
- Multiply and divide fractions and mixed numbers
- Multiply and divide decimals
- Decide when to round down to whole pieces
- Read a negative rate as a loss over time

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)

"Take a strip of paper 15¾ inches long and mark off pieces 1½ inches long. How many whole pieces do you get, and what is left over?"

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 Rate Over Time (Section 2.1) together: The shop heater breaks. The temperature changes at −2.5°F every hour. After 6 hours, multiply the rate by the time: −2.5 × 6. 2.5 × 6 = 15, and a negative times a positive is negative. The temperature has changed by −15°F. Then read Sharing a Loss (Section 2.2) together: A storm ruins a delivery, and the crew loses $450. Write the loss as −450. Three partners split it equally: −450 ÷ 3. 450 ÷ 3 = 150, and a negative divided by a positive is negative. Each partner's share is −$150.

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

3 · The Talk (8 min)

1. Why is a negative times a negative a positive? 2. Why do we flip the second fraction when we divide? 3. When should you round down instead of rounding to the nearest whole number?

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

- Q1: Each negative flips the direction. Flipping twice brings you back to positive, the way losing a debt is a gain.
- Q2: Dividing asks how many of one amount fit into another. Multiplying by the reciprocal answers the same question in one step.
- Q3: When the answer counts whole things you need, like braces, frames or posts. Half a brace cannot be used.

4 · Solo Climb (12 min)

Five problems on your own, with your work shown.
1. A carpenter on a heavy framing job drinks 3.5 liters of water a day. How much water should the crew pack for one carpenter on a 14-day job?
2. Fifteen crew members pay equally into a $105.75 tool fund. How much does each person pay?
3. A jar holds 5¼ ounces of wood glue. Each joint uses ⅜ ounce. How many joints can be glued?
4. A solar panel on the shop roof makes 2.25 kilowatt-hours each hour of full sun. How much does it make in 6.5 hours?
5. A water tank holds 1,200 gallons. The client wants ⅔ of it pumped to the garden. How many gallons is that?

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: −14 + 9 − (−6)
2. Which is greater, |−12| or |9|? By how much?

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)

"Same signs make a positive; different signs make a negative. To divide by a fraction, flip it and multiply." · Homework: Measure a real board, shelf or table with a tape measure to the nearest quarter inch. Work out how many 1½-inch blocks could be cut from it, and how much would be left over.

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

- Forgetting the sign rule: a negative times a positive is negative.
- Dividing by a fraction without flipping it to its reciprocal.
- Rounding up when you need whole pieces. Half a brace is not a brace, so round down.

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: "My child does not understand why dividing by ¾ gives a bigger answer. Show them with a picture instead of giving the answer."

Adapt It and Measure It

Differentiation

- Struggling: cut real strips of paper for each fraction problem before computing.
- Ahead: estimate how many boards a real shelf or fence at home would take.
- Large co-op: each team prices one part of a shed and the group adds the totals.
- Reluctant: let the child measure and cut something real, such as craft sticks or paper strips.

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 2 BADGE — The Steady Hand · 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. 49 liters (3.5 × 14)
2. $7.05 (105.75 ÷ 15)
3. 14 joints (5¼ ÷ ⅜ = 21/4 × 8/3 = 14)
4. 14.625 kilowatt-hours (2.25 × 6.5)
5. 800 gallons (1,200 × ⅔)

Keep It Fresh: 1. 1 · 2. |−12| = 12 is greater by 3

Every answer above comes from the workbook's own Answer Key. The book behind this lesson: 7th Grade Math Workbook: Real-World Problem Solving, Chapter 2 (The Carpenter).

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Grade 7 Math · Lesson 3 — Can We Fill the Order?

Ratios, Unit Rates and Proportions · ages 11 to 14 · 45 minutes · the workbook, one screen, this page, a pencil and paper

At a Glance

- **The book:** 7th Grade Math Workbook: Real-World Problem Solving, Chapter 3 (The Farm Manager), by Dr. Gene A Constant.
- **Free tool:** Math Jeopardy (a quiz game show with a Grade 7 board), free, no login, plays in the browser: globalsovereignuniversity.org/math-jeopardy.
- **Free class:** Lesson 3 of the free Grade 7 Mathematics class: globalsovereignuniversity.org/grade-7-math-class#lesson-3.
- **Ages and time:** Grade 7 · ages 11 to 14 · 45 minutes.
- **Prep (5 min):** read the Teaching Creed and have the workbook open to Chapter 3. Have a clock or phone timer and a sheet of paper for writing a name over and over.

Why this lesson

A rate is how the world measures work: gallons per hour, miles per gallon, dollars per pound. Once a child can find the rate for one and scale it, they can plan a farm, a road trip or a grocery list.

What the learner will be able to do

- Write a ratio three ways
- Find a unit rate
- Solve a proportion by unit rate or by cross-multiplication
- Convert units inside a rate problem
- Use rates to predict output and plan supplies

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)

"Time yourself writing your name 10 times. Now use that rate to predict how long 50 times would take, then check."

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 How Fast Does the Filter Work? (Section 3.1) together: The farm's water filter cleans 180 gallons in 4 hours. Divide gallons by hours: 180 ÷ 4. 180 ÷ 4 = 45. The filter cleans 45 gallons per hour. Then read How Long to Pick 14 Pounds? (Section 3.2) together: A picker gathers 3.5 pounds of mushrooms in 2 hours. Find the unit rate: 3.5 ÷ 2 = 1.75 pounds per hour. Divide the goal by the rate: 14 ÷ 1.75 = 8. Check with a proportion: 3.5/2 = 14/h, so 3.5h = 28 and h = 8. It takes 8 hours.

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

3 · The Talk (8 min)

1. What does the word per tell you? 2. Why must the units match before you multiply a rate? 3. How can you check a proportion answer?

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

- Q1: That it is a rate: how much for one of something, such as gallons per hour or miles per gallon.
- Q2: A per-minute rate times hours gives a wrong answer. Change hours to minutes first, or change the rate to per hour.
- Q3: Find the unit rate both ways. If 3.5 pounds take 2 hours and 14 pounds take 8 hours, both give 1.75 pounds per hour.

4 · Solo Climb (12 min)

Five problems on your own, with your work shown.
1. A farmhand lays 120 bricks for a new oven in 1.5 hours. At that rate, how many bricks can he lay in an 8-hour day?
2. A greenhouse with 8 beds grows 320 pounds of tomatoes. The farm builds 5 more identical beds. How many pounds will all 13 beds grow?
3. A runner carries a message 6 miles in 45 minutes. At the same pace, how many minutes will the next 8 miles take?
4. The sawmill gets 45 board feet of lumber from every 2 logs. A new barn needs 315 board feet. How many logs are needed?
5. It takes 12 pounds of fresh fruit to make 8 jars of jam. A tree gives 54 pounds of fruit. How many jars can be made?

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: -3.6×2.5
2. Find: $2\frac{2}{3} \div \frac{1}{3}$

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)

"Find the rate for one, then scale it. Make the units match before you multiply." · Homework: At the store, read the unit price on two sizes of the same food. Check one of them yourself by dividing the price by the amount.

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

- Dividing the wrong way: 180 gallons in 4 hours is 180 ÷ 4, not 4 ÷ 180.
- Mixing units, such as multiplying a per-minute rate by hours.
- Setting up a proportion with the amounts in different places on each side.

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: "My child keeps setting up proportions upside down. Help them check which number goes on top, without giving the answer."

Adapt It and Measure It

Differentiation

- Struggling: build a two-column table (amount and time) and fill in the rate for one first.
- Ahead: compare the unit prices of three sizes of the same product at a store.
- Large co-op: each team times a task and predicts how long the whole group would take.
- Reluctant: let the child time something they enjoy, such as free throws or laps, and predict a bigger number.

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 3 BADGE — The Order Filler · 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. 640 bricks (120 ÷ 1.5 = 80 per hour; 80 × 8)
2. 520 pounds (320 ÷ 8 = 40 per bed; 40 × 13)
3. 60 minutes (7.5 minutes per mile × 8)
4. 14 logs (22.5 board feet per log; 315 ÷ 22.5)
5. 36 jars (1.5 pounds per jar; 54 ÷ 1.5)

Keep It Fresh: 1. −9 · 2. 8

Every answer above comes from the workbook's own Answer Key. The book behind this lesson: 7th Grade Math Workbook: Real-World Problem Solving, Chapter 3 (The Farm Manager).

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Grade 7 Math · Lesson 4 — Opening Day

Percents, Markups, Taxes and Scale Drawings · ages 11 to 14 · 45 minutes · the workbook, one screen, this page, a pencil and paper

At a Glance

- **The book:** 7th Grade Math Workbook: Real-World Problem Solving, Chapter 4 (The Shop Owner), by Dr. Gene A Constant.
- **Free tool:** Percent Power (tips, tax and discounts), free, no login, plays in the browser: globalsovereignuniversity.org/percent-power.
- **Free class:** Lesson 4 of the free Grade 7 Mathematics class: globalsovereignuniversity.org/grade-7-math-class#lesson-4.
- **Ages and time:** Grade 7 · ages 11 to 14 · 45 minutes.
- **Prep (5 min):** read the Teaching Creed and have the workbook open to Chapter 4. Lay out 100 pennies, beans or squares of paper in a 10-by-10 grid.

Why this lesson

Prices, tax, discounts and interest are percents, and percents are where adults lose the most money by not checking. Seeing 15 out of 100 on a real grid turns a word into something a child can count.

What the learner will be able to do

- Find a percent of a number
- Figure a markup, a discount, sales tax and simple interest
- Find a percent increase or decrease
- Apply two percent changes one after the other
- Use a scale drawing to find real lengths and areas

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 out 100 pennies or beans in a 10-by-10 square. Push 15 of them aside. That is 15%. Now what is 15% of $40?"

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 Sales Tax on a Sale (Section 4.1) together: A customer buys $450 of tools. The town's sales tax is 6%. Change 6% to a decimal: 0.06. Multiply: 450 × 0.06 = 27. The tax is $27, so the customer pays $477. Then read Pricing a New Item (Section 4.2) together: The store pays $40 for a garden kit and marks it up 15%. Find the markup: 40 × 0.15 = 6. Add it to the cost: 40 + 6 = 46. The selling price is $46. (Shortcut: 40 × 1.15 = 46.).

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

3 · The Talk (8 min)

1. Why can you not just add a 10% loss and a 20% loss? 2. What is the difference between a markup and a discount? 3. On a scale drawing, why do you change each length to real feet before finding area?

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

- Q1: The second percent works on a smaller amount, so the total loss is less than 30%.
- Q2: A markup adds a percent to what the store paid. A discount takes a percent off the price.
- Q3: Area does not grow by the same scale as length. Change the lengths first, then multiply.

4 · Solo Climb (12 min)

Five problems on your own, with your work shown.
1. A bin holds 800 pounds of birdseed. Damp gets in and spoils 5%. How many pounds are spoiled and how many are left?
2. Bags of winter bird food cost $25. To clear them by spring, the owner takes 20% off. What is the new price?
3. Customers last year: 320 a week. This year the store grew by 15%. How many customers a week now?
4. A customer fixes up a used mower for $120 and sells it for $180. What is the profit as a percent of the cost?
5. A display model of a water tower uses 1 inch = 5 feet. The real tower is 45 feet tall. How tall is the model?

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. Which is the better buy: 3 pounds of seed for $7.50, or 5 pounds for $11.75?
2. Solve the proportion 4/9 = x/36.

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)

"To find a percent of a number, change it to a decimal and multiply. Each new percent works on the new amount." · Homework: Find a sale sign in a store or flyer. Work out the sale price yourself, then add your state's sales tax to see what you would really pay.

The badge moment: finishing all five steps earns the Bronze ring of this lesson's badge, The Fair Price. 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 two percent changes together. A 10% loss then a 20% loss is not a 30% loss.
- Forgetting to add the markup or tax back onto the starting amount.
- Finding the paper area of a scale drawing first and then multiplying by the scale.

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: "My child thinks a 10% loss followed by a 20% loss is a 30% loss. Help them see why it is not, without giving the answer."

Adapt It and Measure It

Differentiation

- Struggling: shade squares on a 10-by-10 grid for every percent before multiplying.
- Ahead: find a real receipt and check the tax rate the store used.
- Large co-op: run a pretend store with price tags, a sale and a tax table.
- Reluctant: let the child plan a sale on something they own and price it three ways.

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 4 BADGE — The Fair Price · 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. 40 pounds spoiled; 760 pounds left
2. $20 (25 − 5)
3. 368 customers (320 + 48)
4. 50% (60 ÷ 120)
5. 9 inches (45 ÷ 5)

Keep It Fresh: 1. 5 pounds for $11.75 ($2.35 a pound vs. $2.50) · 2. x = 16

Every answer above comes from the workbook's own Answer Key. The book behind this lesson: 7th Grade Math Workbook: Real-World Problem Solving, Chapter 4 (The Shop Owner).

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Grade 7 Math · Lesson 5 — The Quote Formula

Writing and Simplifying Expressions · ages 11 to 14 · 45 minutes · the workbook, one screen, this page, a pencil and paper

At a Glance

- **The book:** 7th Grade Math Workbook: Real-World Problem Solving, Chapter 5 (The Event Planner), by Dr. Gene A Constant.
- **Free tool:** Math Jeopardy (a quiz game show with a Grade 7 board), free, no login, plays in the browser: globalsovereignuniversity.org/math-jeopardy.
- **Free class:** Lesson 5 of the free Grade 7 Mathematics class: globalsovereignuniversity.org/grade-7-math-class#lesson-5.
- **Ages and time:** Grade 7 · ages 11 to 14 · 45 minutes.
- **Prep (5 min):** read the Teaching Creed and have the workbook open to Chapter 5. Set out a few cups and spoons, or any two kinds of small objects, in two piles.

Why this lesson

Expressions are how a planner writes one rule that works for any number of guests. The distributive property and combining like terms are the two moves that keep those rules short and correct.

What the learner will be able to do

- Write an expression from a word rule
- Use the distributive property to expand an expression
- Combine like terms
- Factor out the greatest common factor
- Tell whether two expressions are equivalent

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)

"Make two piles: 3 cups and 5 spoons, then 2 cups and 4 spoons. Push them together. How do you write the total without counting each one again?"

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 Rule Becomes an Expression (Section 5.1) together: Rule: the sound system costs $5 to set up plus $2 for every hour it runs. The part that never changes is the constant: 5. The part that changes is 2 for each hour h: 2h. The expression is 5 + 2h (or 2h + 5). Then read Packing Party Bags (Section 5.2) together: Each party bag has 3 balloons (b) and 2 stickers (s): 3b + 2s. For 4 bags, multiply the whole bag by 4: 4(3b + 2s). Distribute: 4 × 3b + 4 × 2s. The total is 12b + 8s.

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

3 · The Talk (8 min)

1. What makes two terms “like terms”? 2. Why does 4(x + 3) equal 4x + 12 and not 4x + 3? 3. How can you check that a factored expression is right?

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

- Q1: The same variable to the same power, such as 3x and 5x. Numbers alone are like terms with each other.
- Q2: The 4 multiplies everything inside the parentheses, so both x and 3 are multiplied by 4.
- Q3: Distribute it back out. 6(3r + 4p) gives 18r + 24p, the expression you started with.

4 · Solo Climb (12 min)

Five problems on your own, with your work shown.
1. Write an expression: five less than three times the number of tables (t).
2. A dance floor is 5 yards wide and x + 4 yards long. Distribute to write its area: 5(x + 4).
3. The north tent has 5x chairs and 3y lanterns. The south tent has 2x chairs and 4y lanterns. Write one simplified expression for the total.
4. The planner starts with (12x + 20) napkins and uses (4x + 5). Write a simplified expression for what is left.
5. Two rooms use 3(2x + 1) and 2(4x + 3) gallons of punch. Distribute and combine to find the total.

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. An old pump turned 60% of its fuel into useful power. A new one turns 75%. What is the increase in percentage points? In percent?
2. A $64 jacket is on sale for $48. What is the percent off?

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)

“Multiply the outside number by every term inside. Only like terms can be combined.” · Homework: Write a price rule for something you do, such as “$3 to start plus $2 for every dog walked.” Test it for 1, 4 and 10 dogs.

The badge moment: finishing all five steps earns the Bronze ring of this lesson’s badge, The Formula Maker. 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

- Multiplying only the first term: 4(x + 3) is 4x + 12, not 4x + 3.
- Combining unlike terms, such as 3x + 5y into 8xy.
- Dropping the minus sign when you distribute a negative: −4(m − 2) is −4m + 8.

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: “My child writes 4(x + 3) as 4x + 3. Help them see why the 4 multiplies both terms, without giving the answer.”

Adapt It and Measure It

Differentiation

- Struggling: use real objects for each variable, such as cups for x and spoons for y.
- Ahead: write a price rule for a family business idea and test it for several cases.
- Large co-op: each team writes a rule for one part of an event and the group combines them.
- Reluctant: let the child write a rule for their allowance or chores.

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 5 BADGE — The Formula Maker · 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. 3t − 5
2. 5x + 20
3. 7x + 7y
4. 8x + 15
5. 14x + 9

Keep It Fresh: 1. 15 percentage points; a 25% increase (15 ÷ 60) · 2. 25%

Every answer above comes from the workbook's own Answer Key. The book behind this lesson: 7th Grade Math Workbook: Real-World Problem Solving, Chapter 5 (The Event Planner).

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Grade 7 Math · Lesson 6 — Load Plan for Saturday

Equations and Inequalities · ages 11 to 14 · 45 minutes · the workbook, one screen, this page, a pencil and paper

At a Glance

- **The book:** 7th Grade Math Workbook: Real-World Problem Solving, Chapter 6 (The Logistics Coordinator), by Dr. Gene A Constant.
- **Free tool:** Equation Explorer (solve for x, starting with one-step equations), free, no login, plays in the browser: globalsovereignuniversity.org/equation-explorer.
- **Free class:** Lesson 6 of the free Grade 7 Mathematics class: globalsovereignuniversity.org/grade-7-math-class#lesson-6.
- **Ages and time:** Grade 7 · ages 11 to 14 · 45 minutes.
- **Prep (5 min):** read the Teaching Creed and have the workbook open to Chapter 6. Set out 5 small boxes or envelopes and a pile of 72 coins, beans or buttons.

Why this lesson

Equations and inequalities answer the two real questions of logistics: exactly how many, and how many at most. Undoing steps in reverse order is a habit that carries into all of algebra.

What the learner will be able to do

- Solve one-step and two-step equations
- Solve equations with parentheses and with fractions
- Write an inequality from a real limit
- Solve inequalities and graph the answers
- Flip the inequality sign when multiplying or dividing by a negative

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)

"Put 5 closed boxes and 12 loose coins on a scale or in a pile. If the total is 72 coins, how many coins are in each box? Undo the loose coins first."

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 How Many Items in a Box? (Section 6.1) together: A crew brings back 5 sealed boxes and 12 loose cans, 72 items in all. Each box holds x items. Write the equation: 5x + 12 = 72. Subtract 12 from both sides: 5x = 60. Divide both sides by 5: x = 12. Check: 5 × 12 + 12 = 72. Each box holds 12 items. Then read Four Identical Bins (Section 6.2) together: Four storage bins each hold c crates of food plus 5 crates of water. All four hold 68 crates. Write the equation: 4(c + 5) = 68. Divide both sides by 4: c + 5 = 17. (Or distribute first: 4c + 20 = 68.) Subtract 5: c = 12. Each bin holds 12 crates of food.

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

3 · The Talk (8 min)

1. Why do you undo the adding or subtracting before the multiplying or dividing? 2. What is the difference between an equation and an inequality answer? 3. When must you flip the inequality sign?

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

- Q1: You undo the steps in the reverse order they were done, like taking off shoes before socks.
- Q2: An equation has one answer. An inequality has a range of answers, such as 20 boxes or fewer.
- Q3: When you multiply or divide both sides by a negative number. Test it: $2 < 5$, but $-2 > -5$.

4 · Solo Climb (12 min)

Five problems on your own, with your work shown.
1. A loading dock must be 1,000 feet of shelving. 250 feet are done, and the crew adds 50 feet a day (d). Solve 50d + 250 = 1,000.
2. Half of the volunteers (v/2) sign up for the night shift, but 3 cancel, leaving 14. Solve v/2 − 3 = 14.
3. The tech budget is $500. A battery costs $200 and the rest buys 6 identical lights. Solve 6p + 200 = 500.
4. You can spend at most $150. A tool kit costs $45 and tarp costs $15 a yard. Solve 15y + 45 ≤ 150.
5. A first-aid station is stocked with 120 bandages and must keep at least 40. Each training class uses 8. Solve 120 − 8s ≥ 40.

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. Simplify: 7a − 3 + 2a + 9
2. Expand: −2(5x − 4)

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)

"Undo in reverse order, and do the same to both sides. Divide by a negative and the sign flips." · Homework: Find a real limit at home: a shelf that holds so many books, a bag that holds so many pounds. Write it as an inequality and solve it.

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

- Doing the steps in the wrong order: undo adding or subtracting before you divide.
- Forgetting to flip the inequality sign when you divide by a negative number.
- Giving a fraction of a box or a driver when the answer must be a whole number.

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: "My child does not know when to flip the inequality sign. Help them test it with real numbers, without giving the answer."

Adapt It and Measure It

Differentiation

- Struggling: use real boxes and coins to act out every two-step equation.
- Ahead: write an inequality for a real limit at home, such as a shelf or a bag, and solve it.
- Large co-op: each team plans one truck load under a weight limit.
- Reluctant: let the child plan how many of something they can buy with a set amount of money.

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 6 BADGE — The Load Master · 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. d = 15 days
2. v = 34 volunteers
3. p = $50 per light
4. y ≤ 7 yards
5. s ≤ 10 classes (−8s ≥ −80; flip the sign)

Keep It Fresh: 1. 9a + 6 · 2. −10x + 8

Every answer above comes from the workbook's own Answer Key. The book behind this lesson: 7th Grade Math Workbook: Real-World Problem Solving, Chapter 6 (The Logistics Coordinator).

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Grade 7 Math · Lesson 7 — The Community Center Plan

Area, Perimeter, Circles and Angles · ages 11 to 14 · 45 minutes · the workbook, one screen, this page, a pencil and paper

At a Glance

- **The book:** 7th Grade Math Workbook: Real-World Problem Solving, Chapter 7 (The Architect), by Dr. Gene A Constant.
- **Free tool:** Geometry Quest (perimeter, area and angles), free, no login, plays in the browser: globalsovereignuniversity.org/geometry-quest.
- **Free class:** Lesson 7 of the free Grade 7 Mathematics class: globalsovereignuniversity.org/grade-7-math-class#lesson-7.
- **Ages and time:** Grade 7 · ages 11 to 14 · 45 minutes.
- **Prep (5 min):** read the Teaching Creed and have the workbook open to Chapter 7. Find a round plate and a piece of string at least as long as the plate is around.

Why this lesson

Architects need three numbers they can trust: the distance around, the space inside and the angles. Measuring a real plate shows a child where π comes from instead of asking them to take it on faith.

What the learner will be able to do

- Find the perimeter of a polygon
- Find the circumference of a circle
- Find the area of rectangles, triangles and circles
- Use angle relationships to find missing angles
- Find the area of composite shapes

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)

"Wrap a string around a round plate, then lay it straight next to the plate's width. About how many widths long is the string?"

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 Fencing a Round Pond (Section 7.1) together: The garden pond is a circle with a radius of 15 feet. Use $C = 2\pi r$: $C = 2 \times 3.14 \times 15$. $2 \times 3.14 = 6.28$, and $6.28 \times 15 = 94.2$. The pond's edge is 94.2 feet around. Then read A Round Reading Room (Section 7.2) together: The reading room is a circle 40 feet across, so its radius is 20 feet. Use $A = \pi r^2$: $A = 3.14 \times 20^2$. $20^2 = 400$, and $3.14 \times 400 = 1{,}256$. The floor is 1,256 square feet.

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 does every circle use the same π? 2. What is the difference between perimeter and area? 3. How do you find the area of an odd shape?

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

- Q1: Every circle is the same shape at a different size, so the distance around is always a little more than three diameters.
- Q2: Perimeter is the distance around and is measured in feet. Area is the space inside and is measured in square feet.
- Q3: Break it into rectangles, triangles and circles, find each area, and add or subtract them.

4 · Solo Climb (12 min)

Five problems on your own, with your work shown.
1. The main hall is a rectangle 125 feet long and 85 feet wide. How much fencing goes around it?
2. A garden bed is a right triangle with a base of 60 feet and a height of 40 feet. What is its area?
3. A straight wall makes a 180° angle. A light on the wall lights 115° to the left. What angle is left on the right?
4. A rotating sprinkler covers a full circle in 4 equal parts. What angle does each part cover?
5. A square tool shed has an area of 400 square feet. Railing costs $12 a foot. What does railing all the way around cost?

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. Solve: 7 − 2x = 19
2. Solve and describe the answer: −5x > 35

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)

"Perimeter goes around; area covers. For a circle, the radius is half the distance across." · Homework: Measure one room at home. Find its perimeter and its floor area, then work out how many 1-foot square tiles would cover the floor.

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

- Using the diameter where the formula needs the radius.
- Writing area in feet instead of square feet.
- Adding the angles of a triangle to 360° instead of 180°.

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: "My child mixes up radius and diameter. Help them see the difference with a real circle, without giving the answer."

Adapt It and Measure It

Differentiation

- Struggling: measure real circles with string for every circumference problem.
- Ahead: draw a floor plan of one room with a round rug and find all three numbers.
- Large co-op: each team designs one room of the community center and the group adds the areas.
- Reluctant: let the child measure a bike wheel or a ball and find how far it rolls in one turn.

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 Planner's Eye · 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. 420 feet (125 + 125 + 85 + 85)
2. 1,200 square feet (½ × 60 × 40)
3. 65° (180 − 115)
4. 90° (360 ÷ 4)
5. $960 (side 20 ft; perimeter 80 ft; 80 × 12)

Keep It Fresh: 1. x = −6 · 2. x < −7

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

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Grade 7 Math · Lesson 8 — The New Storage Tank

Volume and Surface Area · ages 11 to 14 · 45 minutes · the workbook, one screen, this page, a pencil and paper

At a Glance

- **The book:** 7th Grade Math Workbook: Real-World Problem Solving, Chapter 8 (The Water Engineer), by Dr. Gene A Constant.
- **Free tool:** Measurement Master (reading a tape measure and ruler accurately), free, no login, plays in the browser: globalsovereignuniversity.org/measurement-master.
- **Free class:** Lesson 8 of the free Grade 7 Mathematics class: globalsovereignuniversity.org/grade-7-math-class#lesson-8.
- **Ages and time:** Grade 7 · ages 11 to 14 · 45 minutes.
- **Prep (5 min):** read the Teaching Creed and have the workbook open to Chapter 8. Find a small box and a handful of sugar cubes, dice or blocks.

Why this lesson

Volume tells how much a tank holds; surface area tells how much steel or paint it takes. Mixing the two up wastes real money, and filling a real box is the fastest way to keep them apart.

What the learner will be able to do

- Find the volume of rectangular and triangular prisms
- Find the volume of a cylinder
- Find the surface area of a prism
- Find the lateral and total surface area of a cylinder
- Use volume and surface area to compare designs and costs

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)

"Fill a small box with sugar cubes or dice. Count how many fit along each edge. Can you find the total without counting every one?"

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 An Underground Tank (Section 8.1) together: The tank is a rectangular prism 20 feet long, 15 feet wide and 10 feet deep. Multiply: 20 × 15 × 10. 20 × 15 = 300, and 300 × 10 = 3,000. The tank holds 3,000 cubic feet. Then read A Grain Silo (Section 8.2) together: A silo has a radius of 8 feet and a height of 25 feet. Use $V = \pi r^2 h$: 3.14 × 8² × 25. 8² = 64, and 64 × 25 = 1,600. 3.14 × 1,600 = 5,024. The silo holds 5,024 cubic feet.

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

3 · The Talk (8 min)

1. Why do you multiply, not add, to find volume? 2. When should a face be left out of surface area? 3. Two boxes hold the same amount. Why might one cost less to build?

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

- Q1: Each layer of cubes is length times width, and there are as many layers as the height.
- Q2: When it is not covered, such as the floor of a shed that is not painted.
- Q3: It can have less surface area, so it needs less wood or steel to make.

4 · Solo Climb (12 min)

Five problems on your own, with your work shown.
1. A raised bed is 12 feet long, 4 feet wide and 1.5 feet deep. Soil costs $4 a cubic foot. What does it cost to fill?
2. A fuel drum is 4 feet across and 6 feet tall. What is its volume?
3. A storeroom is 15 by 15 by 10 feet. A fan moves 250 cubic feet of air a minute. How long to change all the air once?
4. A tent has a triangular front and back (base 6 ft, height 4 ft) and two sloped sides 5 ft by 10 ft. No floor. How much canvas is needed?
5. A steam pipe is 2 feet across and 50 feet long. How much wrap covers its outside?

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. A circle has a diameter of 18 inches. Find its circumference and area.
2. A triangle has a base of 14 cm and an area of 63 square cm. What is its height?

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)

“Volume fills; surface area covers. Volume of a prism or cylinder is the base area times the height.” · Homework: Find a box at home. Measure it, work out its volume and its surface area, and decide how much wrapping paper it would take.

The badge moment: finishing all five steps earns the Bronze ring of this lesson’s badge, The Tank Builder. 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 length, width and height instead of multiplying them.
- Counting a face that is not covered, such as a floor that is not painted.
- Leaving out the two round ends when a cylinder is closed.

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: “My child confuses volume and surface area. Help them see the difference with a cereal box, without giving the answer.”

Adapt It and Measure It

Differentiation

- Struggling: build each prism with blocks or sugar cubes before using the formula.
- Ahead: measure a real can and find how much it holds and how much label covers it.
- Large co-op: each team designs a tank and the group compares cost and size.
- Reluctant: let the child plan the wrapping paper for a real gift box.

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 8 BADGE — The Tank Builder · 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. $288 (72 cubic feet × 4)
2. 75.36 cubic feet (3.14 × 2² × 6)
3. 9 minutes (2,250 ÷ 250)
4. 124 square feet (24 + 100)
5. 314 square feet (2 × 3.14 × 1 × 50)

Keep It Fresh: 1. C = 56.52 inches; A = 254.34 square inches · 2. 9 cm

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

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Grade 7 Math · Lesson 9 — The Valley Report

Samples, Inferences and Measures of Center · ages 11 to 14 · 45 minutes · the workbook, one screen, this page, a pencil and paper

At a Glance

- **The book:** 7th Grade Math Workbook: Real-World Problem Solving, Chapter 9 (The Wildlife Biologist), by Dr. Gene A Constant.
- **Free tool:** Statistics Skeptic (how numbers can mislead, as a game), free, no login, plays in the browser: globalsovereignuniversity.org/statistics-skeptic.
- **Free class:** Lesson 9 of the free Grade 7 Mathematics class: globalsovereignuniversity.org/grade-7-math-class#lesson-9.
- **Ages and time:** Grade 7 · ages 11 to 14 · 45 minutes.
- **Prep (5 min):** read the Teaching Creed and have the workbook open to Chapter 9. Write down the ages of everyone at the table on a sheet of paper.

Why this lesson

Every news story, poll and report is built on a sample and an average. A child who can spot a biased sample and choose the right measure of center is hard to fool.

What the learner will be able to do

- Tell a random sample from a biased one
- Use a sample to make an inference about a population
- Find the mean, median, mode and range
- Spot an outlier and explain its effect
- Choose the measure of center that tells the truest story

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)

"Write down the ages of everyone at your table. Now add one 90-year-old. What happens to the mean? What happens to the middle number?"

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 Estimating Sick Trees (Section 9.2) together: A biologist checks 40 trees chosen at random from a forest of 2,000. Six have a fungus. Find the sample rate: 6 ÷ 40 = 0.15, or 15%. Apply it to the whole forest: 0.15 × 2,000 = 300. About 300 trees probably have the fungus. Then read Which Average Tells the Truth? (Section 9.3) together: Fish counted at a dam over 7 days: 45, 42, 48, 12, 46, 50, 44. The 12 was a day the counter jammed. Mean: 287 ÷ 7 = 41. In order: 12, 42, 44, 45, 46, 48, 50. Median: 45. The jam pulls the mean down. The median, 45, better describes a typical day.

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

3 · The Talk (8 min)

1. What makes a sample fair? 2. Why does one very large or small number change the mean so much? 3. How can a small sample tell you about a whole forest or lake?

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

- Q1: Every member of the whole group has an equal chance of being picked.
- Q2: The mean adds every value, so one far-off number pulls the total and the average toward it. The median only looks at the middle.
- Q3: If the sample is random, its rate is a good guess for the whole group, so you scale it up with a proportion.

4 · Solo Climb (12 min)

Five problems on your own, with your work shown.
1. To choose the next project, the office draws 40 names from a box holding all 400 volunteers' names. Biased or unbiased?
2. Of 60 trail cameras tested, 15 have weak batteries. The office owns 1,200 cameras. About how many have weak batteries?
3. Hourly bird counts at a feeder: 14, 28, 8, 35, 12. What is the range? Is the count steady?
4. Boot sizes for new volunteers: 9, 10, 10, 11, 9, 10, 12, 10, 8. What is the mode? Why is it more useful than the mean here?
5. Of 15 beetles caught in a trap, 6 are an invasive species. The valley has about 80 trapped beetles a night. About how many are invasive?

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. A box is 5 by 5 by 5 inches. Find its volume and surface area.
2. A can has a radius of 3 cm and a height of 10 cm. Find its volume.

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 fair sample is a random one. When one value is far off, the median tells the truer story." · Homework: Run a fair survey of your own: ask a random sample of family or friends one question, then decide what your result says about everyone you did not ask.

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

- Trusting a sample that was not chosen at random.
- Using the mean when one outlier pulls it far away from the typical value.
- Forgetting to put the numbers in order before finding the median.

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: "My child does not see why one strange number changes the mean so much. Help them try it with real numbers, without giving the answer."

Adapt It and Measure It

Differentiation

- Struggling: put every data set in order on paper before finding the median.
- Ahead: run a small fair survey of family or friends and report the result.
- Large co-op: each team collects a different sample of the same question and the group compares results.
- Reluctant: let the child collect data on something they care about, such as game scores.

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 Fair Counter · 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. Unbiased. Every volunteer had an equal chance
2. About 300 (15/60 = ¼; ¼ × 1,200)
3. Range 27 (35 − 8); no, it swings widely
4. Mode 10. The office needs to know which size to order most of; a mean like 9.9 is not a real boot size
5. About 32 (6/15 = x/80)

Keep It Fresh: 1. 125 cubic inches; 150 square inches · 2. 282.6 cubic cm

Every answer above comes from the workbook's own Answer Key. The book behind this lesson: 7th Grade Math Workbook: Real-World Problem Solving, Chapter 9 (The Wildlife Biologist).

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Grade 7 Math · Lesson 10 — The Ride Safety Report

Probability and Compound Events · ages 11 to 14 · 45 minutes · the workbook, one screen, this page, a pencil and paper

At a Glance

- **The book:** 7th Grade Math Workbook: Real-World Problem Solving, Chapter 10 (The Safety Engineer), by Dr. Gene A Constant.
- **Free tool:** Math Jeopardy (a quiz game show with a Grade 7 board), free, no login, plays in the browser: globalsovereignuniversity.org/math-jeopardy.
- **Free class:** Lesson 10 of the free Grade 7 Mathematics class: globalsovereignuniversity.org/grade-7-math-class#lesson-10.
- **Ages and time:** Grade 7 · ages 11 to 14 · 45 minutes.
- **Prep (5 min):** read the Teaching Creed and have the workbook open to Chapter 10. Have two coins ready to flip and a sheet of paper for tallies.

Why this lesson

Engineers keep people safe by measuring chance and building backups. Flipping real coins shows why we multiply for "both" and why three backups make total failure so rare.

What the learner will be able to do

- Find theoretical and experimental probability
- Find the probability of a complement
- List or count outcomes in a sample space
- Find the probability of independent and dependent compound events
- Use expected value to decide whether a risk is worth taking

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)

"Flip a coin 20 times and count the heads. Does your count match what you expected? Now flip two coins at once 20 times. How often are both heads?"

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 Two Backup Generators (Section 10.2) together: Generator A fails on 10% of nights. Generator B fails on 20%. They are independent. Both fail: 0.10 × 0.20 = 0.02. That is a 2% chance that both fail on the same night. With one generator the risk was 10% or 20%. Two together cut it to 2%. Then read Is the Search Worth It? (Section 10.3) together: A search for a lost part costs $50. There is a 20% chance of finding it, and the part is worth $400. Expected payoff: 0.20 × 400 = $80. Subtract the cost: 80 − 50 = $30. On average the search earns $30, so it is worth doing over time.

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

3 · The Talk (8 min)

1. Why do we multiply chances when two things must both happen? 2. How is drawing without putting back different? 3. Why do engineers build backups?

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

- Q1: The second event happens only on a part of the times the first one did, so you take a part of a part.
- Q2: The first draw changes what is left, so the second chance is figured from a smaller group.
- Q3: Every backup must fail before the whole system fails, so each one multiplies the chance of total failure by a small number.

4 · Solo Climb (12 min)

Five problems on your own, with your work shown.
1. A park records weather for 60 days and has hail on 15. Based on this, what is the probability of hail tomorrow?
2. There is a 12% chance of a hard freeze tonight. What is the probability there will not be a hard freeze?
3. A supply truck can take 3 roads (River, Ridge, Valley) and leave at 2 times (dawn, dusk). How many plans are possible?
4. A first-aid kit has 5 bandages, 3 wipes and 2 ice packs. You pull one item at random. What is the probability it is a wipe or an ice pack?
5. The park garden has a 50% chance of a big harvest (800 lb), 30% of an average one (500 lb) and 20% of a small one (200 lb). What is the expected harvest?

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 the mean, median, mode and range: 7, 3, 9, 7, 4.
2. A random sample of 80 trees finds 12 with beetles. About what percent of trees have beetles?

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)

"For two independent things to both happen, multiply their chances. Backups make total failure very unlikely." · Homework: Find a real backup at home: a spare key, a second flashlight, a spare tire. Talk about how the backup makes total failure much less likely.

The badge moment: finishing all five steps earns the Bronze ring of this lesson's badge, The Safety Seal. 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 probabilities for "both happen" when you should multiply them.
- Forgetting that the second pick changes when you do not put the first one back.
- Writing a probability bigger than 1, or a percent bigger than 100%.

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: "My child adds probabilities when two things must both happen. Help them see why we multiply, without giving the answer."

Adapt It and Measure It

Differentiation

- Struggling: list every outcome on paper before writing any probability.
- Ahead: work out the chance a three-part backup system fails and explain it in one sentence.
- Large co-op: each team runs 20 coin trials and the group pools the results.
- Reluctant: let the child design a fair game with dice and explain its odds.

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 10 BADGE — The Safety Seal · 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. 15/60 = 1/4 = 25%
2. 88% (100% − 12%)
3. 6 plans (3 × 2)
4. 5/10 = 1/2 = 50%
5. 590 pounds (400 + 150 + 40)

Keep It Fresh: 1. Mean 6; median 7; mode 7; range 6 · 2. 15%

Every answer above comes from the workbook's own Answer Key. The book behind this lesson: 7th Grade Math Workbook: Real-World Problem Solving, Chapter 10 (The Safety Engineer).

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THE GRADE LEVEL CHECK

Ninety percent of parents believe their child is on grade level. About thirty percent are.



THE DATA GAP

~9 in 10
parents believe
their child is on grade level

~3 in 10
proficient
in reading & math — NAEP

3/10

Something in the middle is translating one into the other.
Researchers have a name for it: B-flation.

Sources: national parent survey research · NAEP, the Nation's Report Card

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HOW A REPORT CARD CAN BE HONEST AND STILL BE WRONG

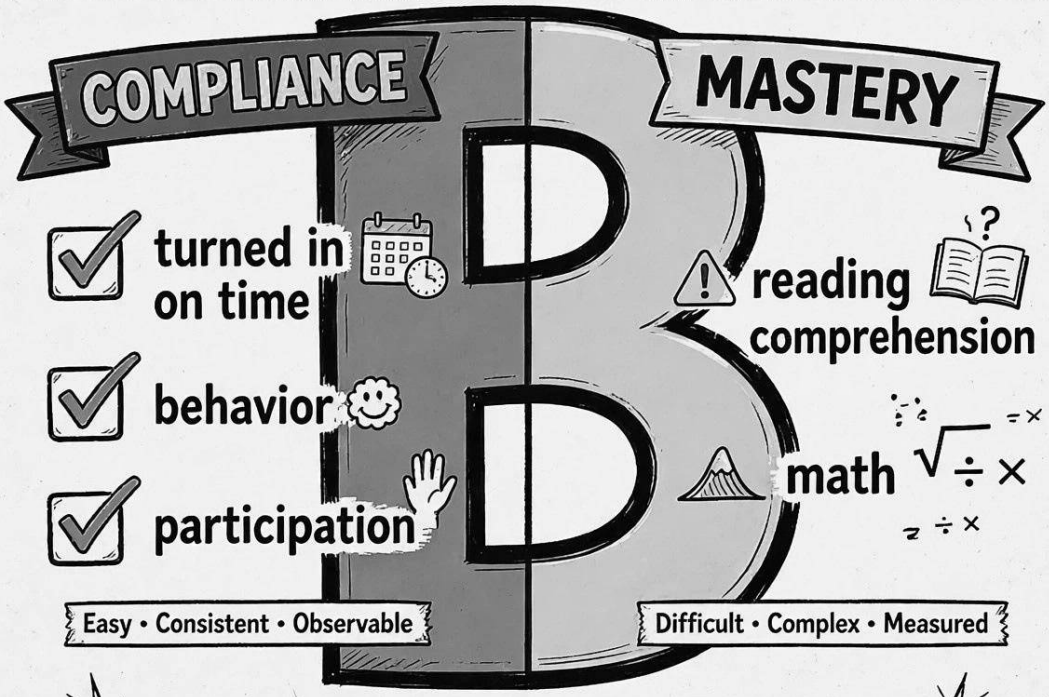
PAGE 02

Middle school grades blend two different things.

One is understanding, the other is compliance.
Both matter but the second is easier.

Understanding

Compliance



In Oregon, the bar moved.

Since 2020, students have not had to prove reading and writing proficiency to graduate.

A student who is organized, polite, punctual and cannot read a chapter will earn B's for years.

Every B is true about compliance • and false about mastery.

The report card is not lying. It is answering a different question.

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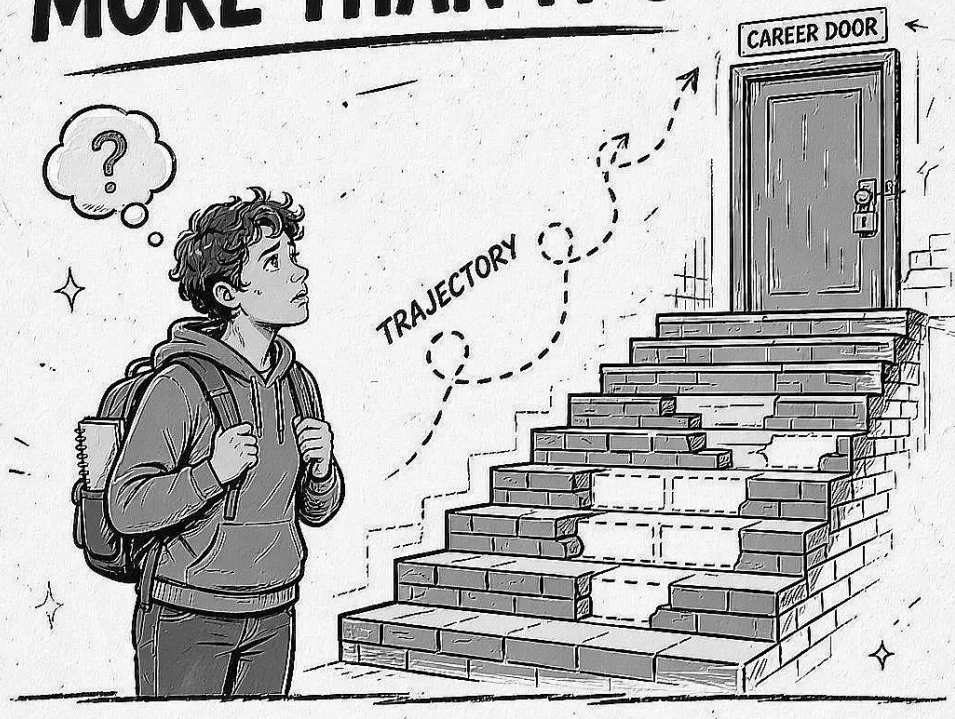
PAGE 3

WHY THIS MATTERS MORE THAN IT SOUNDS



WHAT HAPPENS

- A gap you know about is a problem.
- A gap you don't know about is a trajectory.
- The student moves to the next grade on material they never secured.
- By the time it surfaces, it is a failed placement exam, a repeated course, a career door that quietly does not open.
- And the person concludes they are not smart, because nobody ever showed them the actual measurement.

Scan the code on page 4 to check, privately.

Page 3 • Understanding the Hidden Gap •

PAGE 4

SO HERE IS THE MEASUREMENT.

FREE, AND NOBODY IS WATCHING.



This check gives you a straight answer about reading and math — the highest grade level where answers hold up.

READING
15 questions
grade 4–8 passages → harder

MATHEMATICS
15 questions
grade 4–8 ladder

WRITING
one prompt
scoring guide you apply

Global Sovereign University

SCAN TO CHECK PRIVATELY

Free • Private • In Your Browser

Disclaimer: It is a screener, not a standardized test, not norm-referenced, not psychometrically validated. Does not satisfy state homeschool assessment. This is a signal, not a diagnosis.