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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