Grade 8 Math · Lesson 12 — The Reliability Report

Probability · 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 12 (The Risk Analyst), by Dr. Gene A Constant.
- **Free tool:** Math Jeopardy (a quiz game show with a Grade 8 board), free, no login, plays in the browser: globalsovereignuniversity.org/math-jeopardy.
- **Free class:** Lesson 12 of the free Grade 8 Mathematics class: globalsovereignuniversity.org/grade-8-math-class#lesson-12.
- **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 12. Have two coins and one die ready, and a sheet of paper for tallies.

Why this lesson

Insurance, medicine, games and safety engineering all run on probability. Knowing when to multiply chances, and how drawing without replacement changes them, is how a risk analyst keeps people safe.

What the learner will be able to do

- Calculate theoretical and experimental probability.
- Use sample spaces and organized lists.
- Calculate compound probability (independent and dependent events).
- Use simulations to estimate probability.

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 heads. Is it exactly 10? Flip 20 more. What happens as you keep going?"

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 standard die is rolled. What is P(a number greater than 4)? (Section 12.1) together: Favorable outcomes: 5 and 6, so 2 outcomes Total outcomes: 1, 2, 3, 4, 5, 6, so 6 outcomes P = 2/6 = 1/3, about 33%. Then read Two coins are flipped. P(both heads)? (Section 12.2) together: Events are independent P(head on first) = 1/2 P(head on second) = 1/2 P(both heads) = 1/2 × 1/2 = 1/4.

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. When do you multiply probabilities? 2. How does drawing without replacement change the second probability? 3. Why might 20 coin flips not give exactly 10 heads?

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

- Q1: When two events must both happen and they are independent, or when you adjust the second chance after the first.
- Q2: There is one fewer item, and possibly one fewer of the kind you want.
- Q3: Probability describes the long run; short runs vary.

4 · Solo Climb (12 min)

Five problems on your own, with your work shown.
1. A standard die is rolled. P(rolling even)?
2. A card is drawn from a standard 52-card deck. P(heart)?
3. Spinner A: 3 sections (1,2,3). Spinner B: 4 sections (1,2,3,4). P(both show 2)?
4. Bag: 6 red, 4 blue. Draw 2 without replacement. P(first red, then blue)?
5. A simulation runs 1000 trials of an event. 230 successes. Estimated P(success)?

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. P(rolling two dice and getting sum of 9)?
2. Bag: 7 red, 5 blue. Draw 2 without replacement. P(both blue)?

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)

Probability is favorable over possible. Multiply for independent events, and adjust the second chance when you do not replace. · Homework: Run a small simulation at home with a coin or a die, 30 trials, and compare your result with the theoretical probability.

The badge moment: finishing all five steps earns the Bronze ring of this lesson's badge, The Reliability Expert. 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 when both events must happen. For "and", multiply.
- Forgetting that the second draw changes when you do not put the first one back.
- Expecting a short run of trials to match the theoretical probability exactly.

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: "Explain the difference between drawing with and without replacement, and give me one of each to solve."

Adapt It and Measure It

Differentiation

- Struggling: list every outcome before writing a fraction.
- Ahead: run a 100-trial simulation and compare it with the theoretical probability.
- Large co-op: each team tests one game of chance and reports whether it is fair.
- Reluctant: let the child design a simple game and work out 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 12 BADGE — The Reliability Expert · 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. 3/6 = 1/2
2. 13/52 = 1/4
3. 1/3 × 1/4 = 1/12
4. 6/10 × 4/9 = 4/15
5. 230/1000 = 0.23

Keep It Fresh: 1. 4/36 = 1/9 · 2. 5/12 × 4/11 = 5/33

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 12 (The Risk Analyst).

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