Grade 8 Math · Lesson 3 — The Mission Briefing

Scientific Notation Applications · 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 3 (The Space Scientist), 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 3 of the free Grade 8 Mathematics class: globalsovereignuniversity.org/grade-8-math-class#lesson-3.
- **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 3. Look up the distance to the Moon (about 384,000 km) and set a grain of sand or salt on a dark sheet of paper.

Why this lesson

Science, medicine and computing all run on numbers too big or too small to write out. Scientific notation lets a child compare a planet and a virus on the same line, and it is the bridge from arithmetic to the sciences.

What the learner will be able to do

- Write numbers in scientific notation.
- Convert between standard form and scientific notation.
- Perform operations with numbers in scientific notation.
- Compare very large and very small numbers.

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)

"The Moon is about 384,000 km away. A grain of sand is about 0.0005 m wide. Write both so a scientist could compare them in one glance."

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 Write 93,000,000 in scientific notation (Section 3.1) together: Move decimal until you have a number between 1 and 10: 9.3 Count places moved: 7 places to the left Write: 9.3×10^{7}. Then read Write 0.00045 in scientific notation (Section 3.1) together: Move decimal until you have a number between 1 and 10: 4.5 Count places moved: 4 places to the right Since original number is small, exponent is negative: 4.5×10^{-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. Why must the first number in scientific notation be between 1 and 10? 2. How do you know whether the exponent is positive or negative? 3. Why must the exponents match before you add?

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

- Q1: So every number has one standard form, and so you can compare sizes by looking at the exponent first.
- Q2: Large numbers get a positive exponent; numbers smaller than 1 get a negative one.
- Q3: Adding needs like units: $6.5 \times 10^{6} + 2.3 \times 10^{6}$ is 6.5 million plus 2.3 million.

4 · Solo Climb (12 min)

Five problems on your own, with your work shown.
1. Write in scientific notation: 0.00067 = ___
2. $(4 \times 10^{5}) \times (3 \times 10^{2})$ = ___
3. A spacecraft travels 4.8×10^{12} km in 8×10^{4} hours. Speed?
4. $(8.4 \times 10^{5}) - (3.2 \times 10^{4})$ = ___
5. Which is larger: 3.5×10^{8} or 9.2×10^{7}?

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. $(2.4 \times 10^{6}) \times (5 \times 10^{-3})$ = ___
2. $(9.6 \times 10^{8}) \div (3.2 \times 10^{5})$ = ___

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)

Scientific notation is a number from 1 to 10 times a power of ten. Multiply the numbers, then add the exponents. · Homework: Look up one very large and one very small number that matters to you, such as the distance to a city or the size of a cell, and write both in scientific notation.

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

- Leaving the first number outside 1 to 10: 45×10^6 must become 4.5×10^7.
- Moving the decimal the wrong way for a small number: 0.0045 is 4.5×10^{-3}.
- Adding exponents when adding numbers. You add exponents only when you multiply.

The Teaching Creed

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

GENO, GSU's free tutor, can explain any step a second way, any hour, in 83 languages, with no login: globalsovereignuniversity.org/free-tutor. A prompt for the host: Ask GENO: "Check my scientific notation for 0.00067 and tell me which way I moved the decimal point."

Adapt It and Measure It

Differentiation

- Struggling: count the decimal moves with a pencil tap for each place.
- Ahead: compare the mass of Earth with the mass of a grain of sand.
- Large co-op: each team sorts ten real distances from smallest to largest.
- Reluctant: let the child choose a favorite planet or animal fact to write in scientific notation.

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 Mission Planner · 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. 6.7×10^{-4}
2. $12 \times 10^{7} = 1.2 \times 10^{8}$
3. 6×10^{7} km/h
4. 8.08×10^{5}
5. 3.5×10^{8}

Keep It Fresh: 1. 1.2×10^{4} · 2. 3×10^{3}

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 3 (The Space Scientist).

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