

MATHEMATICS INSTRUCTIONAL PACKET

Estimating quantities and comparing scale



Grade 8 • NC.8.EE.3

Teacher guide • 30 multiple-choice tasks • 30 open and performance tasks • worked keys • observation tools

A reusable bank for instruction across multiple sessions. Select a purposeful subset each day; this is not a single-sitting test.

Free sample | Contents

NC.8.EE.3 | Eighth Grade mathematics

This sample contains 18 complete selected pages from the 91-page resource, plus this sample contents page. Original printed page numbers are retained. Gaps are intentional.

Included original pages: 1-14, 29-30, 59, 74

Representative activities

M01: sample PDF page(s) 15; original page(s) 14

M02: sample PDF page(s) 15; original page(s) 14

O01: sample PDF page(s) 16; original page(s) 29

O02: sample PDF page(s) 17; original page(s) 30

Selected teacher prompts and keys: original page(s) 59, 74

Using this sample

Read the preparation and access guidance before using a selected activity.

Keep teacher keys and private preparation pages separate from student copies.

Use the original resource contents to see the scope of the complete packet.

Complete paid download

The complete resource includes the full PDF task bank and teaching materials.

TEACHER GUIDE

Standard and learning targets

Use numbers expressed in scientific notation to estimate very large or very small quantities and to express how many times as much one is than the other.

Learning targets

Estimate large and small quantities with scientific notation.

Compare quantities using multiplicative ratios.

Explain the precision and limits of a rounded estimate.

The seven sections move from activation to independent evidence. Each task states its own target. Recognition tasks complement, but do not replace, the open performances.

TEACHER GUIDE

Plan the learning

Prerequisites

Place value, positive and negative powers of ten, division and rounding.

Materials and pacing

Pencil, paper, optional calculator for checking; no specialized software required.

Use 3–5 sessions as needed: launch and model; guided and collaborative reasoning; independent transfer; targeted reteaching and exit evidence. Each section offers a bank, not a requirement to complete every item at once.

Access and differentiation

Read directions aloud, enlarge print, allow a scribe for dictated reasoning, or provide an accessible graphing surface. Keep the mathematical demand unchanged. Permit a calculator when computation is not the intended evidence; record its use. Preserve an independent first response before giving a worked example.

For extension, ask students to create a related case with a changed outcome and prove why it changes. For reteaching, return to the specific representation or operation that broke down, then use a fresh item.

Allocation in EACH bank: warm-up 01–04; I Do 05–08; We Do 09–13; collaborative 14–18; independent 19–23; small-group 24–27; exit 28–30.

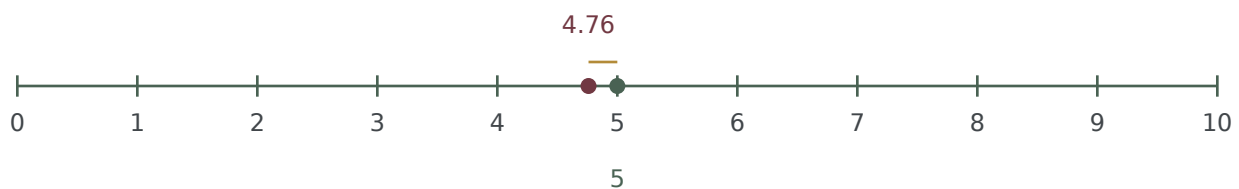
TEACHER GUIDE

Worked teacher model

A hypothetical archive has 4.76×10^8 bytes; another has 2.31×10^6 bytes. Round each coefficient to the nearest whole number: 5×10^8 and 2×10^6 . The estimated ratio is $(5 \div 2) \times 10^2 = 250$. The exact ratio is about 206.1, so the estimate is approximate, not an equality. Rounding one quantity up and the other down enlarged this ratio.

Round the coefficients; keep each power of ten

First quantity: coefficient $4.76 \rightarrow 5$



Second quantity: coefficient $2.31 \rightarrow 2$



Burgundy marks the original coefficient; green marks its rounded value. One rounds up and the other rounds down. Compare the rounded quantities with their original powers: $(5 \div 2) \times 10^{8-6} = 250$.

TEACHER GUIDE

Reasoning anchor

Scientific notation uses a coefficient at least 1 and less than 10, multiplied by a power of ten. For estimation, state the rounding rule first. Round to the nearest place, rather than deleting digits automatically.

For “how many times as much,” divide the named first quantity by the second. A ratio below 1 is meaningful: it says the first is a fraction of the second. Compare quantities in matching units.

Ask before accepting an answer

Is the number normalized? Did the stated rounding rule move up or down correctly? Is the ratio oriented as requested? Are you claiming an estimate or an exact result?

Instructional decision

Ask the learner to explain one decisive step. A selected option alone does not establish a unique misconception. Use the worked option checks to choose a follow-up question, not to label a learner.

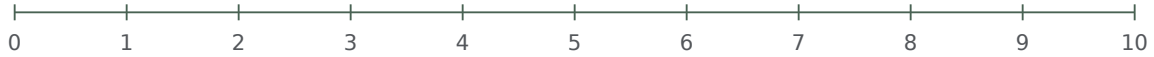
STUDENT REPRODUCIBLE

Reusable reasoning organizer

Name: _____ Date: _____

Givens, quantities and units

Plot original and rounded coefficients. Record each power of ten beside its line.

**Representation or calculation****Justification and check****Conclusion in the problem context**

TEACHER GUIDE

Warm-up teaching script

Bank: M01–M04 and O01–O04. Core task: O01. Suggested focus: 10–20 minutes; adjust for evidence.

Target: Round a quantity in scientific notation.

Say: “Show what each symbol and quantity represents before calculating.” Allow a private attempt, then compare two explanations. Ask which prior idea makes the first step legal. Keep the first attempt as baseline evidence.

Core task to use

A hypothetical sample contains 6.44×10^4 grams. Estimate its mass to one significant digit. Write the rounding step and say whether the estimate is above or below the original.

Teacher solution and discussion

6.44 rounds to 6, giving 6×10^4 grams. This estimate is below the original because the coefficient decreased.

Evidence and response

Look for the representation, justified steps and contextual conclusion requested here. If an error appears, ask “Which statement can we check directly?” Have the student test it using the original givens. After discussion, use another item from this section and record independent versus supported evidence separately.

Closure: “What made your conclusion reasonable, and what would you check on a new problem?”

TEACHER GUIDE

I Do teaching script

Bank: M05–M08 and O05–O08. Core task: O05. Suggested focus: 10–20 minutes; adjust for evidence.

Target: Evaluate an estimate using the original quantity.

Say: “Watch me represent the givens and explain each change.” Work the core problem below aloud, including its check. Pause before the final conclusion and ask students to predict its size or form. Have students annotate why each step preserves the situation.

Core task to use

Two students estimate 3.72×10^7 : one uses 4×10^7 , the other uses 5×10^7 . Determine which is closer by comparing absolute differences. Explain the limitation of any one-digit estimate.

Teacher solution and discussion

Differences are 2.8×10^6 and 1.28×10^7 . The first is smaller, so 4×10^7 is closer. A one-digit estimate omits precision and should not be used as an exact count or measurement.

Evidence and response

Look for the representation, justified steps and contextual conclusion requested here. If an error appears, ask “Which statement can we check directly?” Have the student test it using the original givens. After discussion, use another item from this section and record independent versus supported evidence separately.

Closure: “What made your conclusion reasonable, and what would you check on a new problem?”

TEACHER GUIDE

We Do teaching script

Bank: M09–M13 and O09–O13. Core task: O09. Suggested focus: 10–20 minutes; adjust for evidence.

Target: Use bounds to judge scale.

Say: “You choose the next step; I will record and question it.” Invite two approaches to the core task. Ask the class to test a disputed step with the original quantities, then complete another task without copying the model.

Core task to use

A hypothetical mass in grams is between 8×10^{-6} and 9×10^{-6} . Another mass in grams is exactly 2×10^{-8} . Give a lower and upper bound for how many times the first is the second. Show how the bounds support an estimate.

Teacher solution and discussion

Divide both bounds by the positive second quantity: $8/2 \times 100 = 400$, and $9/2 \times 100 = 450$. The ratio is between 400 and 450; a midpoint estimate is 425. Do not present it as exact.

Evidence and response

Look for the representation, justified steps and contextual conclusion requested here. If an error appears, ask “Which statement can we check directly?” Have the student test it using the original givens. After discussion, use another item from this section and record independent versus supported evidence separately.

Closure: “What made your conclusion reasonable, and what would you check on a new problem?”

TEACHER GUIDE

Collaborative practice teaching script

Bank: M14–M18 and O14–O18. Core task: O14. Suggested focus: 10–20 minutes; adjust for evidence.

Target: Use bounds to judge scale.

Assign partners as solver and verifier, then switch roles. Say: “The verifier must use the original problem, not just repeat the solver’s steps.” Compare representations and require a shared explanation of any disagreement before moving on.

Core task to use

A hypothetical mass in grams is between 6×10^9 and 7×10^9 . Another mass in grams is exactly 2×10^7 . Give a lower and upper bound for how many times the first is the second. Show how the bounds support an estimate.

Teacher solution and discussion

Divide both bounds by the positive second quantity: $6/2 \times 100 = 300$, and $7/2 \times 100 = 350$. The ratio is between 300 and 350; a midpoint estimate is 325. Do not present it as exact.

Evidence and response

Look for the representation, justified steps and contextual conclusion requested here. If an error appears, ask “Which statement can we check directly?” Have the student test it using the original givens. After discussion, use another item from this section and record independent versus supported evidence separately.

Closure: “What made your conclusion reasonable, and what would you check on a new problem?”

TEACHER GUIDE

Independent practice teaching script

Bank: M19–M23 and O19–O23. Core task: O19. Suggested focus: 10–20 minutes; adjust for evidence.

Target: Use bounds to judge scale.

Give a quiet first attempt without answer-supplying hints. Say: “Choose a representation, show your reasoning and check your conclusion.” Record what students can produce independently, then discuss after collecting first responses.

Core task to use

A hypothetical mass in grams is between 1×10^{-5} and 2×10^{-5} . Another mass in grams is exactly 2×10^{-7} . Give a lower and upper bound for how many times the first is the second. Show how the bounds support an estimate.

Teacher solution and discussion

Divide both bounds by the positive second quantity: $1/2 \times 100 = 50$, and $2/2 \times 100 = 100$. The ratio is between 50 and 100; a midpoint estimate is 75. Do not present it as exact.

Evidence and response

Look for the representation, justified steps and contextual conclusion requested here. If an error appears, ask “Which statement can we check directly?” Have the student test it using the original givens. After discussion, use another item from this section and record independent versus supported evidence separately.

Closure: “What made your conclusion reasonable, and what would you check on a new problem?”

TEACHER GUIDE

Small-group reteach teaching script

Bank: M24–M27 and O24–O27. Core task: O24. Suggested focus: 10–20 minutes; adjust for evidence.

Target: Use bounds to judge scale.

Use earlier evidence to select a precise gap. Say: “Let us make the meaning visible, then reconnect it to symbols.” Contrast a valid step with one proposed by a learner; test both. Give a fresh bank item after the supported model and label that evidence separately.

Core task to use

A hypothetical mass in grams is between 7×10^8 and 8×10^8 . Another mass in grams is exactly 2×10^6 . Give a lower and upper bound for how many times the first is the second. Show how the bounds support an estimate.

Teacher solution and discussion

Divide both bounds by the positive second quantity: $7/2 \times 100 = 350$, and $8/2 \times 100 = 400$. The ratio is between 350 and 400; a midpoint estimate is 375. Do not present it as exact.

Evidence and response

Look for the representation, justified steps and contextual conclusion requested here. If an error appears, ask “Which statement can we check directly?” Have the student test it using the original givens. After discussion, use another item from this section and record independent versus supported evidence separately.

Closure: “What made your conclusion reasonable, and what would you check on a new problem?”

TEACHER GUIDE

Exit ticket teaching script

Bank: M28–M30 and O28–O30. Core task: O28. Suggested focus: 10–20 minutes; adjust for evidence.

Target: Interpret the direction of a ratio.

Ask for an individual response and a short check. Say: “Explain why your result fits the original problem.” Collect the work before discussing answers. Use the result to select the next lesson, rather than treating one item as a final mastery judgment.

Core task to use

Two hypothetical lengths are 2×10^{-9} m and 9×10^{-7} m. Express exactly how many times the FIRST is as much as the second. Explain whether a ratio below 1 makes sense.

Teacher solution and discussion

First/second = $(2/9) \times 10^{-2} = 1/450$. This is below 1, since the first length is shorter. It is that fraction of the second length.

Evidence and response

Look for the representation, justified steps and contextual conclusion requested here. If an error appears, ask “Which statement can we check directly?” Have the student test it using the original givens. After discussion, use another item from this section and record independent versus supported evidence separately.

Closure: “What made your conclusion reasonable, and what would you check on a new problem?”

STUDENT BANK

Multiple-choice tasks

M01 • Round a quantity in scientific notation.

Round 3.72×10^7 to one significant digit. Which estimate follows this rule?

- A. 3×10^7
- B. 4×10^7
- C. 5×10^7
- D. 3.72×10^7

Reasoning notes: _____

M02 • Estimate a multiplicative comparison.

Estimate how many times 3.72×10^7 is as much as 6.41×10^4 . First round BOTH coefficients to the nearest whole number.

- A. 6.66667×10^2
- B. 5×10^2
- C. 5×10^3
- D. 6.66667×10^3

Reasoning notes: _____

OPEN / PERFORMANCE TASK

001 • Warm-up

Target: Round a quantity in scientific notation.

A hypothetical sample contains 6.44×10^4 grams. Estimate its mass to one significant digit. Write the rounding step and say whether the estimate is above or below the original.

Representation / calculation

Explanation / check / conclusion

OPEN / PERFORMANCE TASK

002 • Warm-up

Target: Estimate a multiplicative comparison.

A hypothetical sensor measures 3.82×10^7 joules and another measures 6.51×10^4 joules. Round each coefficient to the nearest whole number, then estimate how many times the first energy is the second. Explain why your answer is approximate.

Representation / calculation

Explanation / check / conclusion

TEACHER GUIDE

Multiple-choice worked keys

M01 • Round a quantity in scientific notation.

B. 4×10^7 . The next digit determines rounding: 3.72 rounds to 4. The power of ten stays 7.

Option checks: A: uses coefficient 3; the next digit instead rounds 3.72 to 4. B: satisfies the required calculation. C: uses coefficient 5; the next digit instead rounds 3.72 to 4. D: keeps the unrounded coefficient; this is not one significant digit.

M02 • Estimate a multiplicative comparison.

A. 6.66667×10^2 . Use 4×10^7 and 6×10^4 . Divide: $(4/6) \times 10^3 \approx 6.66667 \times 10^2$.

Option checks: A: matches the required calculation. B: uses 3/6 instead of the required rounded ratio 4/6. Nonterminating coefficients are displayed to six significant digits. C: uses 3/6 instead of the required rounded ratio 4/6; uses exponent difference 4 instead of 3. Nonterminating coefficients are displayed to six significant digits. D: uses exponent difference 4 instead of 3. Nonterminating coefficients are displayed to six significant digits.

TEACHER GUIDE

Open-task worked keys

O01 • Round a quantity in scientific notation.

6.44 rounds to 6, giving 6×10^4 grams. This estimate is below the original because the coefficient decreased.

O02 • Estimate a multiplicative comparison.

The rounded energies are 4×10^7 and 7×10^4 . Ratio $\approx (4/7) \times 10^3 \approx 5.71429 \times 10^2$. Rounding changes the original values, so use $\approx$ rather than exact equality.