

Prove or find a counterexample

Grade 6 | Expressions and Equations

NC.6.EE.4 | Identify when two expressions are equivalent and justify with mathematical reasoning.



Teacher guide • Student practice • Worked keys

An 80-minute selected core, adaptable across sessions, plus a reusable bank of 30 multiple-choice and 30 open/performance tasks. Do not assign the entire bank as one timed test.

Includes operation organizers, reasoning spaces, targeted reteaching, an evidence record, and a three-session inquiry.

Aligned to currently implemented NC standards. The standards adopted in 2026 begin implementation in 2028-29; this packet uses the current code and wording.

Free sample | Contents

NC.6.EE.4 | Sixth Grade mathematics

This sample contains 13 complete selected pages from the 90-page resource, plus this sample contents page. Original printed page numbers are retained. Gaps are intentional.

Included original pages: 1-9, 11-12, 62, 77

Representative activities

M01: sample PDF page(s) 10; original page(s) 9

M02: sample PDF page(s) 10; original page(s) 9

O01: sample PDF page(s) 11; original page(s) 11

O02: sample PDF page(s) 12; original page(s) 12

Selected teacher prompts and keys: original page(s) 62, 77

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

How to use this packet

Navigation

Pages 3-7: standard, preparation, worked teaching model, reusable organizer, and selected-core plan. Each of the seven teaching sections then contains a script page, choice practice pages, and individual open-response pages. Worked keys, assessment tools, inquiry, and sources follow. Exact section page ranges appear on the last page.

Choose, observe, respond

Teach the selected pair in each section; use other items for later practice, interviews, or additional evidence. In I Do, the teacher completes the selected model. In We Do, students explain decisions before the teacher records them. Collaborative tasks still require an individual explanation. Keep the answer-key pages teacher-only.

Student response routes

Students may write, draw, speak, sign, use AAC, or dictate mathematical explanations. A scribe records without choosing operations or correcting reasoning. Read wording neutrally; do not emphasize a clue word or break the expression into the intended operations for the learner. Record these access supports separately from mathematical prompts.

What counts as evidence

MC choices show recognition, not full performance. Collect an original expression or transformation and an explanation on an open task. A correct value without the required reasoning does not establish every target. One successful item is a teaching signal, not a certified mastery decision.

TEACHER GUIDE

Standard and learning targets

NC.6.EE.4

Identify when two expressions are equivalent and justify with mathematical reasoning.

A | I can compare expressions using properties of operations.

B | I can justify equivalence for every allowed value.

C | I can disprove equivalence with a counterexample and explain why one matching value is insufficient.

Essential question: What evidence proves two expressions agree for all allowed values?

Boundary: Student prompts explicitly use nonnegative variable inputs; the supplied identities also hold more broadly. A counterexample must use an allowed input. Do not confuse equality at one value with equivalence as expressions.

TEACHER GUIDE

Prepare and support

Prerequisites and materials

Paper, pencil, optional colored pencils, and this packet are sufficient. Students should recall multiplication, division, fractions, and the meaning of equality. For formula work review length, area, and volume units. No proprietary manipulative or external worksheet is required. Use calculators only after the written structure is clear; record calculator use.

Vocabulary in context

Identity: equality true for every allowed input. Counterexample: one allowed input where a universal claim fails. Matching examples can support a conjecture but cannot alone prove a universal equivalence.

Access without giving the mathematics away

Offer enlarged print, a straightedge for tracking lines, neutral read-aloud, and the blank organizer. A multilingual glossary may translate operation names but must not translate the item directly into its solution. Invite an initial oral explanation before transcription. Extra time is not an error.

Respond to a misconception

If a student claims that one match is proof, compare x and $2x - 1$ at $x = 1$ and $x = 2$. If the claim is false, ask for one legal input and two separately calculated values. If true, require a property chain.

TEACHER MODEL

Think aloud and connect

Model: $2(x + 3)$, $2x + 6$, and $2x + 3$

Say: “I distribute 2 to both addends. This proves the first two expressions are equal for every x . The third expression misses a factor of 2 on 3. At $x = 0$ it is 3, while the first is 6. That single mismatch disproves equivalence.”

x	$2(x + 3)$	$2x + 6$	$2x + 3$
0	6	6	3
1	8	8	5
4	14	14	11

A mismatch disproves a universal claim. Matches suggest a pattern, but the distributive identity $2(x + 3) = 2x + 6$ supplies the proof for every x .

Ask: “Would three matches prove any pair equivalent?” Listen for: no, a property argument is needed for the universal claim. A single mismatch is enough to disprove it.

REUSABLE STUDENT ORGANIZER

Keep the structure visible

Name: _____ Date: _____ Item: _____

Copy the expression or pair exactly. Keep grouping symbols, operations, and powers attached to the correct quantities.

1. Given expression(s) / context and allowed values**2. Structure map / diagram / substitution or transformation steps****3. Conclusion, units if needed, and mathematical reason**

TEACHER GUIDE

Selected core and evidence

Warm-up | 8 minutes | Bank M01-M04, O01-O04. Selected core: M01 and O01.

I Do | 12 minutes | Bank M05-M08, O05-O08. Selected core: M05 and O05.

We Do | 15 minutes | Bank M09-M13, O09-O13. Selected core: M09 and O09.

Collaborative practice | 13 minutes | Bank M14-M18, O14-O18. Selected core: M14 and O14.

Independent practice | 17 minutes | Bank M19-M23, O19-O23. Selected core: M19 and O19.

Small-group reteach | 10 minutes | Bank M24-M27, O24-O27. Selected core: M24 and O24.

Exit ticket | 5 minutes | Bank M28-M30, O28-O30. Selected core: M28 and O28.

Pacing

The seven sections total 80 minutes. Split after We Do for two shorter lessons, or extend modeling and conferences across several days. The core selects 14 items, including teacher/shared models; the other 46 are optional practice. If students need more time for a written explanation, omit a choice item rather than rush the reasoning.

Collect by target

A: O02, O03, O08, O13, O14, O23, O24, O25, O27, O30.

B: O04, O05, O06, O09, O11, O17, O26.

C: O01, O07, O10, O12, O15, O16, O18, O19, O20, O21, O22, O28, O29.

Before teaching, read the key for each selected item. Use open work to decide whether to reteach structure, the property argument, arithmetic, or interpretation. Record which parts were supplied by the adult.

TEACHER SCRIPT | WARM-UP

Warm-up • 8 minutes

Purpose: I can disprove equivalence with a counterexample and explain why one matching value is insufficient. Selected items: M01 and O01.

0-2 min | Invite students to read the expression structure before calculating. Ask: “What is being acted on as one whole quantity?”

2-4 min | Display M01. Ask students to choose privately, then justify without using the answer letter as evidence.

4-6 min | Use O01. Invite a prediction, pause for individual thinking, and record a property or operation reason.

6-8 min | Collect the response. Ask: “What mathematical reason makes this step valid?” Record target, reasoning, and the support used.

Exact teaching anchor

Say: “A property chain can prove a statement for every allowed input. A single mismatching input can disprove it.”

Teacher-only selected solution: Not equivalent. At $x = 0$, the first expression is 24 and the second is 0. These values differ, so the expressions cannot agree for every x . A correct equivalent form of the first expression is $3 \times x + 24$. Distribute 3 to both x and 8. One matching input is insufficient: x and $2x - 1$ agree at $x = 1$ but differ at $x = 2$ (2 versus 3). The counterexample concerns nonnegative inputs; the expressions may have any resulting value.

Look/listen for: a preserved grouping or variable meaning, a valid calculation or transformation, and a stated mathematical reason. If the first step is wrong, isolate that step with the organizer; do not supply the final answer. Early finisher: invent a tempting incorrect expression and explain exactly where it changes the meaning.

STUDENT CHOICE BANK | WARM-UP

Choose and explain • M01

Name: _____ Date: _____

M01 | Target C | Which expression is equivalent to $6 \times x + 3$ for every nonnegative x ?

A. $6 + x \times 3$

B. $3 + x \times 7$

C. $4 + x \times 6$

D. $3 + x \times 6$

My reason / useful calculation: _____

M02 | Target A | Which expression is equivalent to $5 \times x + 3 \times x$ for every nonnegative x ?

A. $9 \times x$

B. $8 + x$

C. $8 \times x$

D. $15 \times x + 1$

My reason / useful calculation: _____

STUDENT OPEN BANK | WARM-UP

001 • Show your reasoning

Name: _____ Date: _____

Learning target: Decide whether expressions are equivalent and justify the decision.

Are $3 \times (x+8)$ and $11 \times x$ equivalent for every nonnegative x ? Justify with properties if yes; if no, give and calculate a counterexample. Explain why testing only $x = 1$ cannot establish equivalence.

A. Expression / steps / labeled diagram**B. Explanation / check / conclusion**

STUDENT OPEN BANK | WARM-UP

002 • Show your reasoning

Name: _____ Date: _____

Learning target: Decide whether expressions are equivalent and justify the decision.

Are $5 \times (x+7)+4$ and $5 \times x+11$ equivalent for every nonnegative x ? Justify with properties if yes; if no, give and calculate a counterexample. Explain why testing only $x = 1$ cannot establish equivalence.

A. Expression / steps / labeled diagram**B. Explanation / check / conclusion**

TEACHER KEY | MULTIPLE CHOICE

M01-M02 • Worked solutions**M01 | D | $3+x \times 6$**

$6 \times x + 3 = 3 + x \times 6$ for every x . Use commutativity of multiplication and addition; the terms and their values are unchanged. A valid property proves equality for all values, whereas a few matches alone do not.

Option A: A property transformation does not yield this expression. Substitute a nonnegative value that makes the difference visible. For example, at $x = 2$, the intended expression is 15, but this option is 12.

Option B: A property transformation does not yield this expression. Substitute a nonnegative value that makes the difference visible. For example, at $x = 1$, the intended expression is 9, but this option is 10.

Option C: A property transformation does not yield this expression. Substitute a nonnegative value that makes the difference visible. For example, at $x = 1$, the intended expression is 9, but this option is 10.

M02 | C | $8 \times x$

$5 \times x + 3 \times x = 8 \times x$ for every x . Factor x : $(5 + 3)x = 8x$. A valid property proves equality for all values, whereas a few matches alone do not.

Option A: A property transformation does not yield this expression. Substitute a nonnegative value that makes the difference visible. For example, at $x = 1$, the intended expression is 8, but this option is 9.

Option B: A property transformation does not yield this expression. Substitute a nonnegative value that makes the difference visible. For example, at $x = 1$, the intended expression is 8, but this option is 9.

Option D: A property transformation does not yield this expression. Substitute a nonnegative value that makes the difference visible. For example, at $x = 1$, the intended expression is 8, but this option is 16.

TEACHER KEY | OPEN RESPONSE

001-003 • Sample responses**001 | Target C**

Not equivalent. At $x = 0$, the first expression is 24 and the second is 0. These values differ, so the expressions cannot agree for every x . A correct equivalent form of the first expression is $3 \times x + 24$. Distribute 3 to both x and 8. One matching input is insufficient: x and $2x - 1$ agree at $x = 1$ but differ at $x = 2$ (2 versus 3). The counterexample concerns nonnegative inputs; the expressions may have any resulting value.

Accept other mathematically equivalent forms or valid arguments that meet every requested part. Record omissions separately from computational errors.

002 | Target A

Not equivalent. At $x = 0$, the first expression is 39 and the second is 11. These values differ, so the expressions cannot agree for every x . A correct equivalent form of the first expression is $5 \times x + 39$. Distribute, then add the constants 35 and 4. One matching input is insufficient: x and $2x - 1$ agree at $x = 1$ but differ at $x = 2$ (2 versus 3). The counterexample concerns nonnegative inputs; the expressions may have any resulting value.

Accept other mathematically equivalent forms or valid arguments that meet every requested part. Record omissions separately from computational errors.

003 | Target A

$5 \times x + 3 \times x = 8 \times x$ for every x . Factor x : $(5 + 3)x = 8x$. A valid property proves equality for all values, whereas a few matches alone do not. One matching input is insufficient: x and $2x - 1$ agree at $x = 1$ but differ at $x = 2$ (2 versus 3). The counterexample concerns nonnegative inputs; the expressions may have any resulting value.

Accept other mathematically equivalent forms or valid arguments that meet every requested part. Record omissions separately from computational errors.