

Rational and Irrational Numbers



Grade 8 | NC.8.NS.1

Teacher scripts, original models and student organizers
30 multiple-choice + 30 open/performance tasks
Worked keys and individual evidence records

Current NC standards for 2026-27 and 2027-28. Select tasks across several sessions. This resource bank is not one test.

Free sample | Contents

NC.8.NS.1 | Eighth Grade mathematics

This sample contains 20 complete selected pages from the 93-page resource, plus this sample contents page. Original printed page numbers are retained. Gaps are intentional.

Included original pages: 1-16, 31-32, 61, 76

Representative activities

M01: sample PDF page(s) 17; original page(s) 16

M02: sample PDF page(s) 17; original page(s) 16

O01: sample PDF page(s) 18; original page(s) 31

O02: sample PDF page(s) 19; original page(s) 32

Selected teacher prompts and keys: original page(s) 61, 76

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

Exact standard and scope

Understand that every number has a decimal expansion. Building upon the definition of a rational number, know that an irrational number is defined as a non-repeating, non-terminating decimal.

Domain: THE NUMBER SYSTEM

Cluster: Know that there are numbers that are not rational, and approximate them by rational numbers.

Current NC wording and numerical limits are retained. Adopted 2026 revisions beginning in 2028-29 are not substituted.

TEACHER GUIDE

Targets and evidence

Fraction: Classify a rational number and determine its decimal behavior.

Evidence: M14, M18, M23, M25, M26, O01, O02, O06, O17, O18

Pattern: Determine rationality from a fully defined infinite digit pattern.

Evidence: M02, M10, M12, M16, M24, O03, O04, O14, O26, O27

Prefix: Evaluate what a finite decimal display can establish.

Evidence: M04, M11, M13, M21, M29, O10, O24, O25, O29, O30

Root: Classify an exact square root and describe its decimal expansion.

Evidence: M01, M06, M08, M27, M30, O05, O07, O19, O21, O22

Repeat: Convert a repeating decimal to a fraction and justify rationality.

Evidence: M03, M07, M15, M22, M28, O09, O16, O20, O23, O28

Compare: Justify the rationality of two exact representations.

Evidence: M05, M09, M17, M19, M20, O08, O11, O12, O13, O15

MP2: connect quantities and symbols. MP3: justify claims. MP6: attend to signs, notation and precision. Open tasks collect actual reasoning, calculations and representations.

TEACHER GUIDE

Plan and navigation

Use four sessions of about 25-35 minutes: warm-up/model; shared/partner work; independent work; reteach/exit. Select one M and one O item per section first, using targets to match prior learning. The remaining bank supports later practice and conferences, not a single 60-item test.

Warm-up: M01-M04 and O01-O04

I Do: M05-M08 and O05-O08

We Do: M09-M13 and O09-O13

Collaborative practice: M14-M18 and O14-O18

Independent practice: M19-M23 and O19-O23

Small-group reteach: M24-M27 and O24-O27

Exit ticket: M28-M30 and O28-O30

Contents: standard/targets; planning/access; worked model; anchor/organizer; seven scripts; 15 choice pages; 30 open pages; worked keys; rubric; evidence record; sources. Print only selected student pages. Keep teacher examples and keys separate.

TEACHER GUIDE

Preparation and access

Prerequisites: fraction definitions, long division, place value and perfect squares. Check these separately before teaching the selected target.

Materials: pencil, ruler and supplied blank organizers. For approximation, a calculator may check a bound after the learner records the reasoning; it is not a substitute for explaining the bound. No special manipulatives are needed.

Access: neutral read-aloud, enlargement, high contrast, AAC/signing and dictated explanations. A scribe records student-directed steps exactly. Do not score handwriting, decoding or accent. Record calculator use and other access supports separately.

Answer-supplying cues include classifying the decimal for a learner, supplying a property, giving the rounding direction, or naming the missing equation solution. Preserve the first response and record later supported responses separately.

Differentiate by first using small perfect powers, simple fractions and explicit factors. Then change the representation or ask for a counterexample. Do not replace a required construction, calculation or justification with recognition.

N/O means unobserved, inaccessible or insufficient evidence. Zero is for observed interpretable incorrect work. These instructional ratings are not official mastery cutoffs. All instructional contexts and numerical data are invented.

WORKED TEACHER MODEL

Think aloud and connect

Say: "A rational number can be written a/b for integers a and b with b nonzero. For $3/8$, division gives $30 = 8 \times 3 + 6$, $60 = 8 \times 7 + 4$, and $40 = 8 \times 5 + 0$: the decimal 0.375 terminates. For $1/3$, the remainder 1 keeps returning, giving $0.[3]$. Both are rational. The number $0.101001000100001\dots$ defined by one more zero in each successive gap never terminates and has no eventual repeating block. A fixed block with a 1 would bound the gaps between 1 s, but these gaps grow forever. This number is irrational. A finite calculator display by itself cannot establish either infinite behavior."

Teacher prompt: Which definition or inverse operation verifies each step?

TEACHER GUIDE

Anchor: definitions and checks

Rational: a/b , where a and b are integers and $b \neq 0$. Decimal expansion terminates or eventually repeats.

Irrational: a real number whose decimal expansion neither terminates nor eventually repeats. No integer quotient represents it.

A terminating expansion can also be written with trailing zeros. Brackets in this packet indicate a repeating block: $0.[12] = 0.121212\dots$

Never classify from only a finite digit prefix. Use a fraction, exact root property, or a fully specified infinite rule.

Ask the learner to supply the mathematical decision. Read symbols neutrally and distinguish exact values from estimates.

REPRODUCIBLE STUDENT TOOL

Reasoning organizer

Name: _____ Date: _____ Item: _____

Given information / requested decision or value**Representation / definitions / equivalent steps****Answer / precision / all solutions when requested****Check / why the conclusion follows**

TEACHER GUIDE

Warm-up teaching script

Start with M01 and O01; save the rest through 04 for later. Target: Classify a rational number and determine its decimal behavior.

Launch | 2 minutes

Say: "What is known exactly, and what are you asked to determine? Restate the question before calculating." Read symbols neutrally. Do not identify the correct classification, property or sign.

Teach or elicit | 5-7 minutes

Say: "Show a definition, equivalent expression or power check that supports your answer." During shared practice invite individual steps; during independent and exit work collect first responses without supplying a method.

Probe the selected task | 3-5 minutes

Use O01. Teacher solution: $\frac{4}{9}$ is a quotient of integers with nonzero denominator, so it is rational. In lowest terms the denominator is 9. It has a prime factor other than 2 or 5, so its decimal repeats without terminating. In division only finitely many nonzero remainders are possible; a remainder must recur. Long division of the magnitude: $40 = 9 \times 4 + 4$. Thus $\frac{4}{9} = 0.[4]$. Restore the negative sign when needed.

Respond | 3-5 minutes

If a learner relies only on a display or remembered rule, return to the relevant anchor. Use a different small example, then retry a fresh bank item. Record any supplied classification, property, sign or bound as a cue, not neutral access.

Close | 2 minutes

Each partner first records a solution independently, then compares the reasoning. Early finishers change one value or condition and test whether the method still works. Record the first response, access supports, cues, and a next step. Exit evidence guides later teaching; no speed threshold applies.

TEACHER GUIDE

I Do teaching script

Start with M05 and O05; save the rest through 08 for later. Target: Classify an exact square root and describe its decimal expansion.

Launch | 2 minutes

Say: "What is known exactly, and what are you asked to determine? Restate the question before calculating." Read symbols neutrally. Do not identify the correct classification, property or sign.

Teach or elicit | 5-7 minutes

Read the worked teacher model aloud, pausing after each equality or bound. Ask the learner to name what makes the next step valid. Keep this example separate from the student response.

Probe the selected task | 3-5 minutes

Use O05. Teacher solution: $13^2 = 169 = 169$; $\sqrt{169} = 13 = 13/1$, rational.

Respond | 3-5 minutes

If a learner relies only on a display or remembered rule, return to the relevant anchor. Use a different small example, then retry a fresh bank item. Record any supplied classification, property, sign or bound as a cue, not neutral access.

Close | 2 minutes

Each partner first records a solution independently, then compares the reasoning. Early finishers change one value or condition and test whether the method still works. Record the first response, access supports, cues, and a next step. Exit evidence guides later teaching; no speed threshold applies.

TEACHER GUIDE

We Do teaching script

Start with M09 and O09; save the rest through 13 for later. Target: Convert a repeating decimal to a fraction and justify rationality.

Launch | 2 minutes

Say: "What is known exactly, and what are you asked to determine? Restate the question before calculating." Read symbols neutrally. Do not identify the correct classification, property or sign.

Teach or elicit | 5-7 minutes

Say: "Show a definition, equivalent expression or power check that supports your answer." During shared practice invite individual steps; during independent and exit work collect first responses without supplying a method.

Probe the selected task | 3-5 minutes

Use O09. Teacher solution: $x = 0.\overline{18}$. Then $100x = 18.\overline{18}$. Subtract x : $99x = 18$, so $x = 18/99 = 2/11$. This proves the infinite repeating decimal is rational.

Respond | 3-5 minutes

If a learner relies only on a display or remembered rule, return to the relevant anchor. Use a different small example, then retry a fresh bank item. Record any supplied classification, property, sign or bound as a cue, not neutral access.

Close | 2 minutes

Each partner first records a solution independently, then compares the reasoning. Early finishers change one value or condition and test whether the method still works. Record the first response, access supports, cues, and a next step. Exit evidence guides later teaching; no speed threshold applies.

TEACHER GUIDE

Collaborative practice teaching script

Start with M14 and O14; save the rest through 18 for later. Target: Determine rationality from a fully defined infinite digit pattern.

Launch | 2 minutes

Say: "What is known exactly, and what are you asked to determine? Restate the question before calculating." Read symbols neutrally. Do not identify the correct classification, property or sign.

Teach or elicit | 5-7 minutes

Say: "Show a definition, equivalent expression or power check that supports your answer." During shared practice invite individual steps; during independent and exit work collect first responses without supplying a method.

Probe the selected task | 3-5 minutes

Use O14. Teacher solution: There are infinitely many nonzero digits, so the decimal does not terminate. The zero gaps grow without bound. An eventually repeating finite block with a nonzero digit would have bounded zero gaps. Thus no eventual block can repeat; the number is irrational.

Respond | 3-5 minutes

If a learner relies only on a display or remembered rule, return to the relevant anchor. Use a different small example, then retry a fresh bank item. Record any supplied classification, property, sign or bound as a cue, not neutral access.

Close | 2 minutes

Each partner first records a solution independently, then compares the reasoning. Early finishers change one value or condition and test whether the method still works. Record the first response, access supports, cues, and a next step. Exit evidence guides later teaching; no speed threshold applies.

TEACHER GUIDE

Independent practice teaching script

Start with M19 and O19; save the rest through 23 for later. Target: Classify an exact square root and describe its decimal expansion.

Launch | 2 minutes

Say: "What is known exactly, and what are you asked to determine? Restate the question before calculating." Read symbols neutrally. Do not identify the correct classification, property or sign.

Teach or elicit | 5-7 minutes

Say: "Show a definition, equivalent expression or power check that supports your answer." During shared practice invite individual steps; during independent and exit work collect first responses without supplying a method.

Probe the selected task | 3-5 minutes

Use O19. Teacher solution: $8^2 = 64 < 75 < 81 = 9^2$. The square root of a positive integer that is not a perfect square is irrational. Its decimal is nonterminating and not eventually repeating.

Respond | 3-5 minutes

If a learner relies only on a display or remembered rule, return to the relevant anchor. Use a different small example, then retry a fresh bank item. Record any supplied classification, property, sign or bound as a cue, not neutral access.

Close | 2 minutes

Each partner first records a solution independently, then compares the reasoning. Early finishers change one value or condition and test whether the method still works. Record the first response, access supports, cues, and a next step. Exit evidence guides later teaching; no speed threshold applies.

TEACHER GUIDE

Small-group reteach teaching script

Start with M24 and O24; save the rest through 27 for later. Target: Evaluate what a finite decimal display can establish.

Launch | 2 minutes

Say: "What is known exactly, and what are you asked to determine? Restate the question before calculating." Read symbols neutrally. Do not identify the correct classification, property or sign.

Teach or elicit | 5-7 minutes

Say: "Show a definition, equivalent expression or power check that supports your answer." During shared practice invite individual steps; during independent and exit work collect first responses without supplying a method.

Probe the selected task | 3-5 minutes

Use O24. Teacher solution: The terminating number 0.41421 is rational and fits the display. A number starting with the same digits followed by a nonterminating tail with nonzero digits separated by successively longer zero gaps is irrational and can fit the same finite display. A finite display does not establish infinite decimal behavior.

Respond | 3-5 minutes

If a learner relies only on a display or remembered rule, return to the relevant anchor. Use a different small example, then retry a fresh bank item. Record any supplied classification, property, sign or bound as a cue, not neutral access.

Close | 2 minutes

Each partner first records a solution independently, then compares the reasoning. Early finishers change one value or condition and test whether the method still works. Record the first response, access supports, cues, and a next step. Exit evidence guides later teaching; no speed threshold applies.

TEACHER GUIDE

Exit ticket teaching script

Start with M28 and O28; save the rest through 30 for later. Target: Convert a repeating decimal to a fraction and justify rationality.

Launch | 2 minutes

Say: "What is known exactly, and what are you asked to determine? Restate the question before calculating." Read symbols neutrally. Do not identify the correct classification, property or sign.

Teach or elicit | 5-7 minutes

Say: "Show a definition, equivalent expression or power check that supports your answer." During shared practice invite individual steps; during independent and exit work collect first responses without supplying a method.

Probe the selected task | 3-5 minutes

Use O28. Teacher solution: $x = 0.[72]$. Then $100x = 72.[72]$. Subtract x : $99x = 72$, so $x = 72/99 = 8/11$. This proves the infinite repeating decimal is rational.

Respond | 3-5 minutes

If a learner relies only on a display or remembered rule, return to the relevant anchor. Use a different small example, then retry a fresh bank item. Record any supplied classification, property, sign or bound as a cue, not neutral access.

Close | 2 minutes

Each partner first records a solution independently, then compares the reasoning. Early finishers change one value or condition and test whether the method still works. Record the first response, access supports, cues, and a next step. Exit evidence guides later teaching; no speed threshold applies.

STUDENT CHOICE

Choice practice 1-2

M01 | How should $\sqrt{18}$ be classified?

- A. Rational; terminating decimal
- B. Rational; repeating non-terminating decimal
- C. Not a real number
- D. Irrational; non-repeating non-terminating decimal

Reasoning notes: _____

M02 | A number between 0 and 1 is defined by this rule: Write 1, then one 0, then 1, then two 0s, then 1, then three 0s, continuing with one more 0 in each gap forever. Which description follows?

- A. Irrational; a terminating expansion
- B. Rational; an eventual repeating block
- C. Irrational; no eventual repeating block
- D. Rational; finitely many nonzero digits

Reasoning notes: _____

STUDENT PERFORMANCE

001 | Warm-up

Target: Classify a rational number and determine its decimal behavior.

Classify $\frac{4}{9}$ and its decimal expansion. Use long division to find the decimal. Show remainders until you reach 0 or a repeated remainder, then justify your classification.

Definitions / equations / calculations / requested diagram

Answer / justification / check

STUDENT PERFORMANCE

002 | Warm-up

Target: Classify a rational number and determine its decimal behavior.

Classify $7/40$ and its decimal expansion. Use long division to find the decimal. Show remainders until you reach 0 or a repeated remainder, then justify your classification.

Definitions / equations / calculations / requested diagram

Answer / justification / check

TEACHER ONLY

M worked keys 1-2

M01: D. Irrational; non-repeating non-terminating decimal

Target: Classify an exact square root and describe its decimal expansion.

$4^2 = 16 < 18 < 25 = 5^2$. The square root of a positive integer that is not a perfect square is irrational. Its decimal is nonterminating and not eventually repeating.

Option checks: Rational; terminating decimal: This does not match the classification, sign set or contextual restriction justified above. Test its stated claim against the exact definition or substitute its proposed value. Rational; repeating non-terminating decimal: This does not match the classification, sign set or contextual restriction justified above. Test its stated claim against the exact definition or substitute its proposed value. Not a real number: This does not match the classification, sign set or contextual restriction justified above. Test its stated claim against the exact definition or substitute its proposed value.

M02: C. Irrational; no eventual repeating block

Target: Determine rationality from a fully defined infinite digit pattern.

There are infinitely many nonzero digits, so the decimal does not terminate. The zero gaps grow without bound. An eventually repeating finite block with a nonzero digit would have bounded zero gaps. Thus no eventual block can repeat; the number is irrational.

Option checks: Irrational; a terminating expansion: This does not match the classification, sign set or contextual restriction justified above. Test its stated claim against the exact definition or substitute its proposed value. Rational; an eventual repeating block: This does not match the classification, sign set or contextual restriction justified above. Test its stated claim against the exact definition or substitute its proposed value. Rational; finitely many nonzero digits: This does not match the classification, sign set or contextual restriction justified above. Test its stated claim against the exact definition or substitute its proposed value.

TEACHER ONLY

O worked keys 1-2

001: Rational; repeating non-terminating

Target: Classify a rational number and determine its decimal behavior.

$\frac{4}{9}$ is a quotient of integers with nonzero denominator, so it is rational. In lowest terms the denominator is 9. It has a prime factor other than 2 or 5, so its decimal repeats without terminating. In division only finitely many nonzero remainders are possible; a remainder must recur. Long division of the magnitude: $40 = 9 \times 4 + 4$. Thus $\frac{4}{9} = 0.[4]$. Restore the negative sign when needed.

Accept equivalent exact forms and valid explanations. Assess the requested process as well as the final result. A final number or label alone is incomplete when justification is requested.

002: Rational; terminating

Target: Classify a rational number and determine its decimal behavior.

$\frac{7}{40}$ is a quotient of integers with nonzero denominator, so it is rational. In lowest terms the denominator is 40. Its only prime factors are 2 and/or 5, so long division terminates. Long division of the magnitude: $70 = 40 \times 1 + 30$; $300 = 40 \times 7 + 20$; $200 = 40 \times 5 + 0$. Thus $\frac{7}{40} = 0.175$. Restore the negative sign when needed.

Accept equivalent exact forms and valid explanations. Assess the requested process as well as the final result. A final number or label alone is incomplete when justification is requested.