

TEACHER AND STUDENT RESOURCE

Reading the Parts of Mathematical Models



NC Math 2 • NC.M2.A-SSE.1

Seeing Structure in Expressions

Seven instructional sections with 30 multiple-choice and 30 open or performance tasks, teaching scripts, original mathematical visuals, generous workspaces, and worked keys.

Free sample | Contents

NC.M2.A-SSE.1 | NC Math 2 mathematics

This sample contains 22 complete selected pages from the 123-page resource, plus this sample contents page. Original printed page numbers are retained. Gaps are intentional.

Included original pages: 1-16, 31-32, 61-62, 91-92

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) 61-62, 91-92

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.

ALIGNMENT

Standard and learning targets

Interpret expressions that represent a quantity in terms of its context.

- a. Identify and interpret parts of a quadratic, square root, inverse variation, or right triangle trigonometric expression, including terms, factors, coefficients, radicands, and exponents.
- b. Interpret quadratic and square root expressions made of multiple parts as a combination of single entities to give meaning in terms of a context.

T1 Interpret quadratic terms, factors, coefficients, exponents, and grouped quantities in context.

T2 Interpret square-root radicands, coefficients, and grouped quantities in context.

T3 Interpret inverse-variation and right-triangle trigonometric expression parts in context.

Each item names its own target. The bank supports multiple sessions; do not assign all 60 tasks in one sitting.

NAVIGATION

Choose evidence deliberately

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

T1: M01, O01, M02, O02, M05, O05, M08, O08, M11, O11, M14, O14, M17, O17, M19, O19, M22, O22, M24, O24, M27, O27, M30, O30

T2: M03, O03, M06, O06, M09, O09, M12, O12, M15, O15, M18, O18, M21, O21, M25, O25, M28, O28

T3: M04, O04, M07, O07, M10, O10, M13, O13, M16, O16, M20, O20, M23, O23, M26, O26, M29, O29

DAILY LEARNING TARGETS

A multi-session teaching path

Session 1 Identify and represent

Learning target: Interpret quadratic terms, factors, coefficients, exponents, and grouped quantities in context.

Learning target: Interpret square-root radicands, coefficients, and grouped quantities in context.

Use Warm-up, I Do, and early We Do tasks. Ask for a first response before showing the model.

Session 2 Explain and connect

Learning target: Interpret square-root radicands, coefficients, and grouped quantities in context.

Learning target: Interpret inverse-variation and right-triangle trigonometric expression parts in context.

Use We Do and collaborative tasks. Compare approaches and justify each step with the original conditions.

Session 3 Transfer independently

Learning target: Interpret quadratic terms, factors, coefficients, exponents, and grouped quantities in context.

Learning target: Interpret square-root radicands, coefficients, and grouped quantities in context.

Learning target: Interpret inverse-variation and right-triangle trigonometric expression parts in context.

Select independent items spanning the targets, reteach an evidenced gap, and use an unrehearsed exit item.

PLANNING

Materials, access and pacing

Materials

Pencils, erasers, straightedge, student pages, and optional graph paper. A calculator may support arithmetic after a learner states the intended relationship. No device or paid software is required.

Prerequisites

Units of length and area, distributive property, square roots, fraction meanings, and sine/cosine/tangent as side ratios in a right triangle.

Pacing

Use a short diagnostic warm-up, a model and shared task in one session; collaborative and independent reasoning in later sessions; then targeted reteaching and an exit task. Select two to four tasks at a time based on evidence. Each section's full bank is reusable, not mandatory in one lesson.

Neutral access

Read directions aloud without interpreting the graph, enlarge a page, supply a writing or pointing response method, and allow a learner to dictate an explanation. Keep axes, units, data and mathematical demand unchanged.

Separate instruction from evidence

Keep the learner's first response. Record answer-supplying cues separately from access supports. A completed teacher graph or worked key is for discussion after independent work, never a student construction template.

Review convention

Contexts are invented instructional models. Interpret a quantity before calculating. Parentheses and radical scope determine which operations act on a whole entity. A coefficient's units depend on the modeled relationship. Inverse models exclude zero denominators; physical lengths and rates use appropriate nonnegative or positive domains.

TEACHER MODEL

A complete side length is one entity

A square photograph has side x cm and a 2 cm border on every side. Interpret $(x+4)^2$ and $(x+4)^2 - x^2$.

The outside side is $x+2+2=x+4$ cm. Treat that whole length as one entity and square it to get outside area. Subtract x^2 , the original photograph area, to obtain border area. Expanding gives $8x+16$ cm²: four 2-by- x strips total $8x$, and four 2-by-2 corners total 16. The model requires $x>0$ for a positive-size photograph.

VISUAL ANCHOR

Read a whole group before its parts

The same mathematical mark can play different roles depending on the model. Use the quantity and its units to decide.

Expression	Grouped entity	What the whole expression gives
$x(x+5)$	$x+5$ is a rectangle length	Area from two lengths
$\sqrt{A/\pi}$	A/π is the squared radius	Nonnegative radius
$60/r$	60 is fixed volume; r is flow	Filling time
$12 \sin \theta$	$\sin \theta$ is opposite/hypotenuse	Opposite leg for hypotenuse 12

For quadratic and square-root models, a multi-part group often has one meaningful name: a complete side, a whole area, or a squared radius. Naming that entity prevents errors with scope and units.

REUSABLE REASONING GUIDE

Represent, justify, interpret

Name: _____ Date: _____

Givens, quantities and restrictions**Representation and calculation****Justification or check****Conclusion, domain and units**

WARM-UP

Teaching script

Core: 001 • T1: Interpret quadratic terms, factors, coefficients, exponents, and grouped quantities in context.

Optional bank: M01–M04; O01–O04. Select tasks across more than one meeting if needed.

Suggested discussion/work time: 5–8 minutes. Adjust for access and evidence; this is not a speed criterion.

Display student page O01, including its visual when present. Ask learners to name the quantity before evaluating. Contrast exponent and coefficient, area and length, and an inverse constant and a changing output.

Core task

A square tile has side s centimeters. Explain the meaning of s^2 and $4s$, including the units of each. Identify a value of s for which the numerical values coincide, while the physical quantities still differ.

Teacher solution and discussion

s^2 is area in cm^2 ; $4s$ is perimeter in cm . At $s=4$, both numerical values are 16, but one measures square centimeters and the other centimeters. Equal numerical values do not make area and length the same quantity.

Evidence and response

Ask the learner to point to the exact term, factor, exponent, or radicand and name its contextual quantity and units. If they treat a grouped quantity as isolated symbols, name the whole entity first. A numerical answer without a meaning is insufficient evidence of interpretation.

Closure: Ask learners to state one feature they verified and one check they used. Use the worked key for M01 to compare all alternatives after evidence is collected.

I DO

Teaching script

Core: 005 • T1: Interpret quadratic terms, factors, coefficients, exponents, and grouped quantities in context.

Optional bank: M05–M08; O05–O08. Select tasks across more than one meeting if needed.

Suggested discussion/work time: 10–12 minutes. Adjust for access and evidence; this is not a speed criterion.

Display student page O05, including its visual when present. Point to the entire grouped quantity and say its contextual name. Identify units before and after squaring or rooting. For a trig term, identify the angle and its opposite, adjacent, and hypotenuse sides first.

Core task

A height model is $h(t) = -4t^2 + 16t + 3$ meters, with t measured in seconds. Interpret the term 3 and the grouped expression $-4t^2 + 16t$ in context. Evaluate both contributions at $t=1$ and explain how they combine.

Teacher solution and discussion

The constant 3 meters is initial height. The group $-4t^2 + 16t$ is net height change from the start at time t . At $t=1$ the group is $-4+16=12$ meters, so $h(1)=3+12=15$ meters. The group is a single net contribution, not a separate height measurement to ignore.

Evidence and response

Ask the learner to point to the exact term, factor, exponent, or radicand and name its contextual quantity and units. If they treat a grouped quantity as isolated symbols, name the whole entity first. A numerical answer without a meaning is insufficient evidence of interpretation.

Closure: Ask learners to state one feature they verified and one check they used. Use the worked key for M05 to compare all alternatives after evidence is collected.

WE DO

Teaching script

Core: 009 • T2: Interpret square-root radicands, coefficients, and grouped quantities in context.

Optional bank: M09–M13; O09–O13. Select tasks across more than one meeting if needed.

Suggested discussion/work time: 10–15 minutes. Adjust for access and evidence; this is not a speed criterion.

Display student page O09, including its visual when present. Have learners suggest an interpretation of each part, then test it with units and one value. Compare factored and expanded forms by tracing the same contextual quantity through both.

Core task

In the model $v = \sqrt{2ad}$, a is acceleration in m/s^2 and d is distance in m . Explain the grouped radicand's units and the units of v . At $a=2, d=9$, evaluate the radicand before finding v .

Teacher solution and discussion

The product $2ad$ has units $(\text{m/s}^2) \times \text{m} = \text{m}^2/\text{s}^2$, the square of speed units. At $a=2, d=9$ it is $2 \times 2 \times 9 = 36 \text{ m}^2/\text{s}^2$. Its principal square root is $v = 6 \text{ m/s}$. The coefficient 2 is dimensionless.

Evidence and response

Ask the learner to point to the exact term, factor, exponent, or radicand and name its contextual quantity and units. If they treat a grouped quantity as isolated symbols, name the whole entity first. A numerical answer without a meaning is insufficient evidence of interpretation.

Closure: Ask learners to state one feature they verified and one check they used. Use the worked key for M09 to compare all alternatives after evidence is collected.

COLLABORATIVE PRACTICE

Teaching script

Core: O14 • T1: Interpret quadratic terms, factors, coefficients, exponents, and grouped quantities in context.

Optional bank: M14–M18; O14–O18. Select tasks across more than one meeting if needed.

Suggested discussion/work time: 15–20 minutes. Adjust for access and evidence; this is not a speed criterion.

Display student page O14, including its visual when present. Assign each learner a part to interpret, then ask the group to reconstruct the whole model. Challenge interpretations that ignore a fixed fee, initial level, radical scope, or reference angle.

Core task

A landscaping charge is $C(s)=5(s+1)^2+40$ dollars, where $s+1$ is the side in meters of a square planted area. Interpret 5, $(s+1)^2$, and 40. Explain the units of the coefficient 5.

Teacher solution and discussion

The group $(s+1)^2$ is planted area in m^2 . The coefficient 5 is the planting price, \$5 per m^2 . Their product is the variable planting charge in dollars. The constant 40 is a fixed \$40 fee added once, independent of area.

Evidence and response

Ask the learner to point to the exact term, factor, exponent, or radicand and name its contextual quantity and units. If they treat a grouped quantity as isolated symbols, name the whole entity first. A numerical answer without a meaning is insufficient evidence of interpretation.

Closure: Ask learners to state one feature they verified and one check they used. Use the worked key for M14 to compare all alternatives after evidence is collected.

INDEPENDENT PRACTICE

Teaching script

Core: O19 • T1: Interpret quadratic terms, factors, coefficients, exponents, and grouped quantities in context.

Optional bank: M19–M23; O19–O23. Select tasks across more than one meeting if needed.

Suggested discussion/work time: 15–20 minutes. Adjust for access and evidence; this is not a speed criterion.

Display student page O19, including its visual when present. Collect explanations in words, diagrams, or labeled expressions without supplying the contextual meaning. Require units and the role of a complete group when the prompt asks for them.

Core task

A vendor sells x items at a modeled price of $20-2x$ dollars per item and has a fixed \$50 cost. Profit is $P(x)=x(20-2x)-50$ dollars. Interpret the product as one entity, distinguish it from profit, and evaluate both at $x=4$.

Teacher solution and discussion

The product is revenue: x items times a modeled price $20-2x$ dollars per item. Profit subtracts the fixed \$50 cost. At $x=4$, revenue is $4 \times 12 = \$48$ and profit is $48 - 50 = -\$2$. Negative profit means a \$2 loss, not negative revenue.

Evidence and response

Ask the learner to point to the exact term, factor, exponent, or radicand and name its contextual quantity and units. If they treat a grouped quantity as isolated symbols, name the whole entity first. A numerical answer without a meaning is insufficient evidence of interpretation.

Closure: Ask learners to state one feature they verified and one check they used. Use the worked key for M19 to compare all alternatives after evidence is collected.

SMALL-GROUP RETEACH

Teaching script

Core: O24 • T1: Interpret quadratic terms, factors, coefficients, exponents, and grouped quantities in context.

Optional bank: M24–M27; O24–O27. Select tasks across more than one meeting if needed.

Suggested discussion/work time: 10–15 minutes. Adjust for access and evidence; this is not a speed criterion.

Display student page O24, including its visual when present. Use an area partition, a root-operation chain, or a labeled right triangle according to the observed gap. Ask the learner to explain the whole entity before interpreting an individual symbol.

Core task

A manufacturing model gives cost $C(x)=2x^2+5x+12$ dollars for a nonnegative integer count x of items. Identify the terms, coefficients, and exponents. Interpret the fixed term 12 and the linear contribution $5x$, then explain why $2x^2$ and $5x$ cannot be combined.

Teacher solution and discussion

The terms are $2x^2$, $5x$, and 12. The variable coefficients are 2 and 5; x has powers 2 and 1. The \$12 is a fixed cost. The linear contribution $5x$ adds \$5 per item, in addition to the separate quadratic contribution $2x^2$; it is not the entire per-item cost. Unlike variable powers cannot be combined by adding coefficients alone.

Evidence and response

Ask the learner to point to the exact term, factor, exponent, or radicand and name its contextual quantity and units. If they treat a grouped quantity as isolated symbols, name the whole entity first. A numerical answer without a meaning is insufficient evidence of interpretation.

Closure: Ask learners to state one feature they verified and one check they used. Use the worked key for M24 to compare all alternatives after evidence is collected.

EXIT TICKET

Teaching script

Core: O28 • T2: Interpret square-root radicands, coefficients, and grouped quantities in context.

Optional bank: M28–M30; O28–O30. Select tasks across more than one meeting if needed.

Suggested discussion/work time: 5–8 minutes. Adjust for access and evidence; this is not a speed criterion.

Display student page O28, including its visual when present. Use a new context or learner-created model. Check whether every stated quantity, grouping, and unit is coherent, not merely whether the arithmetic is correct.

Core task

A formula claims the side of a square with area $3x^2+12x+12$ is $\sqrt{3x^2+12x+12}$, with $x \geq 0$. Factor the radicand as one entity and give a simpler side expression, explaining why it remains nonnegative.

Teacher solution and discussion

The area factors as $3(x^2+4x+4)=3(x+2)^2$. The side is $\sqrt{3} \cdot |x+2|$. Since $x \geq 0$ gives $x+2 > 0$, this simplifies to $\sqrt{3}(x+2)$. The factor $x+2$ is one length-related group, and the nonnegative principal root determines the sign.

Evidence and response

Ask the learner to point to the exact term, factor, exponent, or radicand and name its contextual quantity and units. If they treat a grouped quantity as isolated symbols, name the whole entity first. A numerical answer without a meaning is insufficient evidence of interpretation.

Closure: Ask learners to state one feature they verified and one check they used. Use the worked key for M28 to compare all alternatives after evidence is collected.

MULTIPLE-CHOICE BANK

M01 / M02 • Select and justify**M01 | Warm-up | T1**

A square garden has side x meters. In its area expression x^2 , what does the exponent 2 represent?

- A. Doubling the side length.
- B. Multiplying the side length by itself to form area.
- C. Adding two square meters.
- D. A fixed area of 2 m^2 .

Reasoning: _____

M02 | Warm-up | T1

A rectangle has width x and length $x+5$ meters. What do the factors in $x(x+5)$ represent?

- A. Two separate areas that must be added.
- B. The two side lengths whose product is the area.
- C. The number of rectangles and the price of each.
- D. The perimeter and the width.

Reasoning: _____

WARM-UP

001 • Show your reasoning

T1: Interpret quadratic terms, factors, coefficients, exponents, and grouped quantities in context.

A square tile has side s centimeters. Explain the meaning of s^2 and $4s$, including the units of each. Identify a value of s for which the numerical values coincide, while the physical quantities still differ.

Representation / calculation

Explanation / check

WARM-UP

002 • Show your reasoning

T1: Interpret quadratic terms, factors, coefficients, exponents, and grouped quantities in context.

A rectangular banner is x meters wide and $x+3$ meters long. Interpret both factors in $x(x+3)$, then expand it and explain what the two terms of x^2+3x represent as area pieces.

Representation / calculation

Explanation / check

WORKED TEACHER KEYS

M01

M01 • T1: Interpret quadratic terms, factors, coefficients, exponents, and grouped quantities in context.

Answer: B. Multiplying the side length by itself to form area.

The area is $x \times x = x^2$. The exponent counts two equal factors of the side length; the resulting unit is square meters.

Check each alternative

- A. Doubling would be $2x$, which is a length, not the area of the square.
- B. The area is $x \times x = x^2$. The exponent counts two equal factors of the side length; the resulting unit is square meters.
- C. The exponent is not an added constant.
- D. The area depends on x ; it is not fixed at 2.

Evidence to assess

Assess accurate representation, a valid justification, and a conclusion consistent with the domain and units. Accept equivalent reasoning or another construction meeting every condition. An answer alone does not establish a unique misconception.

WORKED TEACHER KEYS

M02

M02 • T1: Interpret quadratic terms, factors, coefficients, exponents, and grouped quantities in context.

Answer: B. The two side lengths whose product is the area.

The factor x is the width and $x+5$ is the length, each in meters. Their product is the rectangular area in square meters.

Check each alternative

- A. Each factor is a length, not an area.
- B. The factor x is the width and $x+5$ is the length, each in meters. Their product is the rectangular area in square meters.
- C. The stated context is geometric area, not a purchase count.
- D. Neither factor is the full perimeter $2x+2(x+5)$.

Evidence to assess

Assess accurate representation, a valid justification, and a conclusion consistent with the domain and units. Accept equivalent reasoning or another construction meeting every condition. An answer alone does not establish a unique misconception.

WORKED TEACHER KEYS

001**001 • T1: Interpret quadratic terms, factors, coefficients, exponents, and grouped quantities in context.**

s^2 is area in cm^2 ; $4s$ is perimeter in cm. At $s=4$, both numerical values are 16, but one measures square centimeters and the other centimeters. Equal numerical values do not make area and length the same quantity.

Evidence to assess

Assess the factor interpretation of the exponent, units, and distinction between equal numbers and different physical quantities.

WORKED TEACHER KEYS

002**002 • T1: Interpret quadratic terms, factors, coefficients, exponents, and grouped quantities in context.**

The factors are width x and length $x+3$. Splitting the length into x and 3 partitions the banner into an x -by- x square and an x -by-3 strip. Their areas are x^2 and $3x$ m², totaling x^2+3x . The grouped factor $x+3$ is the whole length.

Evidence to assess

Require both factor meanings and a valid geometric interpretation of both expanded terms.