

TEACHER AND STUDENT RESOURCE

Creating Systems from Shared Conditions



NC Math 2 • NC.M2.A-CED.3

Creating Equations

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-CED.3 | 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

Create systems of linear, quadratic, square root, and inverse variation equations to model situations in context.

T1 Create systems with quadratic and linear relationships that describe the same quantities and simultaneous conditions.

T2 Create systems containing square-root models while retaining original inputs, domains and output signs.

T3 Create systems containing inverse-variation models with correct denominators, units and positive or integer restrictions.

T4 Critique or construct models by checking shared variables, independent conditions, unit consistency and contextual feasibility.

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, M04, O04, M07, O07, M09, O09, M11, O11, M15, O15, M19, O19, M23, O23, M24, O24

T2: M02, O02, M05, O05, M06, O06, M10, O10, M13, O13, M21, O21, M25, O25

T3: M03, O03, M08, O08, M12, O12, M17, O17, M26, O26, M28, O28, M29, O29

T4: M14, O14, M16, O16, M18, O18, M20, O20, M22, O22, M27, O27, M30, O30

DAILY LEARNING TARGETS

A multi-session teaching path

Session 1 Identify and represent

Learning target: Create systems with quadratic and linear relationships that describe the same quantities and simultaneous conditions.

Learning target: Create systems containing square-root models while retaining original inputs, domains and output signs.

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: Create systems containing square-root models while retaining original inputs, domains and output signs.

Learning target: Create systems containing inverse-variation models with correct denominators, units and positive or integer restrictions.

Learning target: Critique or construct models by checking shared variables, independent conditions, unit consistency and contextual feasibility.

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

Session 3 Transfer independently

Learning target: Create systems with quadratic and linear relationships that describe the same quantities and simultaneous conditions.

Learning target: Create systems containing square-root models while retaining original inputs, domains and output signs.

Learning target: Create systems containing inverse-variation models with correct denominators, units and positive or integer restrictions.

Learning target: Critique or construct models by checking shared variables, independent conditions, unit consistency and contextual feasibility.

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

Define variables and units, create one-variable models, use area/perimeter and the Pythagorean Theorem, solve simple quadratic/root/inverse equations, and interpret ordered pairs.

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.

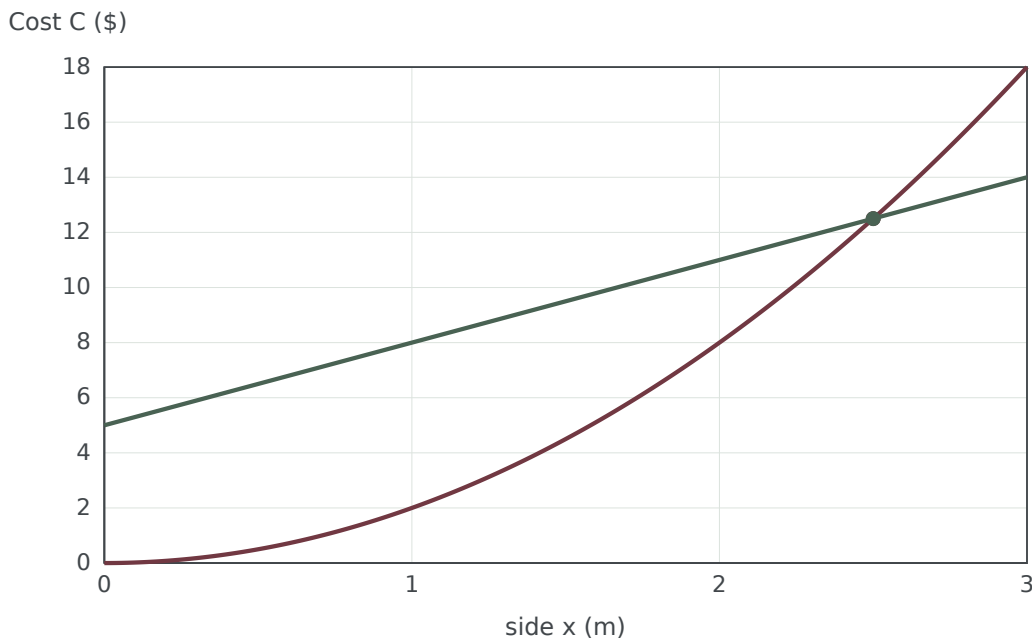
Review convention

Every equation in a system must refer to the declared quantities. A shared output variable must have the same units in every equation. State denominators and radical domains before manipulating equations. Check candidate pairs in all original equations and then in contextual restrictions. Independent constraints add information; multiplying an existing equation does not create new information.

TEACHER MODEL

Keep each pricing rule intact

A square print has side $x \geq 0$ meters. Shop A charges \$2 per square meter. Shop B charges \$3 per meter of side plus a \$5 setup fee. Create a system for equal cost C and identify the feasible intersection.



Define C as dollars charged by either shop at the same side length. Shop A gives $C = 2x^2$; Shop B gives $C = 3x + 5$. The system keeps both rules intact. Equate them: $2x^2 = 3x + 5$, so $(2x - 5)(x + 1) = 0$. The algebraic inputs are 2.5 and -1, but only $x = 2.5$ meets $x \geq 0$. Both charges are \$12.50 there. The burgundy quadratic and green line meet at $(2.5, 12.5)$ in the physical domain. A negative-input algebraic intersection is not a valid square size.

VISUAL ANCHOR

From conditions to a system

Use one row per independent relationship. Keep the original quantities visible before eliminating a variable.

Context condition	Possible equation	Meaning of a shared pair
Rectangle area and perimeter	$xy=40$; $x+y=13$	Both side lengths satisfy both measurements
Sensor and target	$y=3\sqrt{t}$; $y=12$	One time reaches the required output
Shared fixed fee	$C=72/n$; $C=9$	One group size gives the stated individual cost
Two pricing plans	$C=x^2$; $C=2x+3$	One input has equal dollar charges

Do not equate unrelated units or unrelated times. A system can have no feasible pair, one feasible pair, or several; its context determines what counts as a valid solution.

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: Create systems with quadratic and linear relationships that describe the same quantities and simultaneous conditions.

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. Name the variables and units, then assign one equation to each stated condition. Ask what a shared solution would mean before any substitution.

Core task

A rectangle has perimeter 26 cm and area 40 cm². Define two variables, create a system for both conditions, and solve for its dimensions. Explain why exchanging the variables does not produce a different-shaped rectangle.

Teacher solution and discussion

Let $x, y > 0$ be adjacent side lengths in centimeters. The system is $x + y = 13$ and $xy = 40$. Substitute $y = 13 - x$: $x(13 - x) = 40$, so $x^2 - 13x + 40 = (x - 5)(x - 8) = 0$. The ordered pairs are (5, 8) and (8, 5), both describing one 5-by-8 cm rectangle. Checks: $2(5 + 8) = 26$ and $5 \times 8 = 40$.

Evidence and response

Look for a separately justified relationship for every condition, consistent variable roles, explicit domains and units, and an interpreted simultaneous pair. A correct algebraic intersection is not automatically feasible. Require the original system even when the learner can solve a reduced equation mentally.

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 • T2: Create systems containing square-root models while retaining original inputs, domains and output signs.

Optional bank: M05–M08; 005–008. 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 005, including its visual when present. Model each relationship separately and state its domain. Show why shared variables use the same quantity and reference time. Solve only after the complete system is visible, then check every equation.

Core task

A right triangle has base $x > 0$ cm, vertical leg 4 cm and hypotenuse y cm. The hypotenuse is 2 cm longer than the base. Create a system using a square-root equation and a linear equation, solve, and check the triangle.

Teacher solution and discussion

The system is $y = \sqrt{x^2 + 16}$ and $y = x + 2$. Since $x > 0$ makes both sides positive, squaring $\sqrt{x^2 + 16} = x + 2$ gives $x^2 + 16 = x^2 + 4x + 4$, so $x = 3$ and $y = 5$. Check $3^2 + 4^2 = 5^2$ and $5 = 3 + 2$. The positive pair (3, 5) satisfies the original root equation.

Evidence and response

Look for a separately justified relationship for every condition, consistent variable roles, explicit domains and units, and an interpreted simultaneous pair. A correct algebraic intersection is not automatically feasible. Require the original system even when the learner can solve a reduced equation mentally.

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 • T1: Create systems with quadratic and linear relationships that describe the same quantities and simultaneous conditions.

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. Ask learners to justify denominators, radical scope and changing inputs. Use a candidate pair as evidence: substitute in every original relation and then test the contextual restrictions.

Core task

Two models are $h = -t^2 + 6t + 1$ and $h = -2t^2 + 8t + 1$ meters, with the same time t in seconds. Create a system for equal heights. Find all pairs with $t \geq 0$ and $h \geq 0$, and distinguish the shared initial position from a later meeting.

Teacher solution and discussion

Use both height equations simultaneously. Subtracting gives $t^2 - 2t = 0$, so $t = 0$ or 2 . At $t = 0$, $h = 1$; at $t = 2$, $h = 9$. Both pairs $(0, 1)$, $(2, 9)$ meet $t \geq 0$ and $h \geq 0$. The first is their common initial position; the later meeting is at 2 s and 9 m.

Evidence and response

Look for a separately justified relationship for every condition, consistent variable roles, explicit domains and units, and an interpreted simultaneous pair. A correct algebraic intersection is not automatically feasible. Require the original system even when the learner can solve a reduced equation mentally.

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 • T4: Critique or construct models by checking shared variables, independent conditions, unit consistency and contextual feasibility.

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 modeler, units checker, solver and skeptic roles. Challenge redundant conditions, mixed-unit equalities, missing domains and unsupported assumptions. Each learner records a complete corrected system.

Core task

A group of n workers has cost per person $C=80/n$ dollars and completion time $T=40/n$ hours. The requirements are exactly \$10 per person and exactly 5 hours. Write a consistent system using n , C , T , find a common worker count if one exists, and explain why $C=T$ is not one of the equations.

Teacher solution and discussion

Use $C=80/n$, $C=10$, $T=40/n$ and $T=5$, with positive integer n . The cost equations give $n=8$, and the time equations also give $n=8$, so $(n, C, T)=(8, 10, 5)$ satisfies all requirements. $C=T$ would equate different measured quantities and is not requested; the shared unknown is the worker count.

Evidence and response

Look for a separately justified relationship for every condition, consistent variable roles, explicit domains and units, and an interpreted simultaneous pair. A correct algebraic intersection is not automatically feasible. Require the original system even when the learner can solve a reduced equation mentally.

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: Create systems with quadratic and linear relationships that describe the same quantities and simultaneous conditions.

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 the system before giving algebra support. Preserve the original variable definitions and restrictions so an incorrect setup is not hidden by later correct manipulation.

Core task

A vendor sells integer x items at $18-2x$ dollars each, with cost $2x+24$ dollars. Inventory limits x to 0 through 5. Create the break-even system, solve the algebraic comparison, and identify every feasible break-even pair under the inventory limit.

Teacher solution and discussion

Let y be the common dollars. Use $y=x(18-2x)$, $y=2x+24$, with integer $0 \leq x \leq 5$. Equality gives $-2x^2+16x-24=0$, or $(x-2)(x-6)=0$. Algebraic pairs are (2, 28) and (6, 36). Only (2, 28) is feasible because six items exceed inventory. Check revenue $2 \times 14 = \$28$ and cost $4 + 24 = \$28$.

Evidence and response

Look for a separately justified relationship for every condition, consistent variable roles, explicit domains and units, and an interpreted simultaneous pair. A correct algebraic intersection is not automatically feasible. Require the original system even when the learner can solve a reduced equation mentally.

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: Create systems with quadratic and linear relationships that describe the same quantities and simultaneous conditions.

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 the observed modeling gap: perimeter factor, root-factor extraction, shifted rate denominator or clock origin. Rebuild that relationship, then require a fresh whole-system check.

Core task

A student models a rectangle of perimeter 22 cm and area 28 cm^2 with $x+y=22$ and $xy=28$. Correct only the erroneous equation, solve the corrected system, and show why the original sum equation would not check for your dimensions.

Teacher solution and discussion

Correct the perimeter equation to $x+y=11$; keep $xy=28$. Then $x(11-x)=28$ gives $(x-4)(x-7)=0$. The side lengths are 4 and 7 cm. Their actual perimeter is $2(4+7)=22$ and area is 28, but $4+7=11$, not 22, so the original sum equation fails.

Evidence and response

Look for a separately justified relationship for every condition, consistent variable roles, explicit domains and units, and an interpreted simultaneous pair. A correct algebraic intersection is not automatically feasible. Require the original system even when the learner can solve a reduced equation mentally.

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 • T3: Create systems containing inverse-variation models with correct denominators, units and positive or integer restrictions.

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. Ask for a new system, all contextual restrictions, and a justified feasibility or construction decision. A claimed common pair must satisfy every original equation with consistent units.

Core task

A rectangular display has area 60 m^2 and perimeter 32 m. Its labeled width x must be at most 8 m. Create an inverse-linear system for positive width x and length y , solve all algebraic dimension pairs, and select the pair that respects the width requirement.

Teacher solution and discussion

The system is $y=60/x$ and $y=16-x$, with $x>0$, $y>0$ and $x\leq 8$. Equating gives $x^2-16x+60=(x-6)(x-10)=0$. Pairs are (6, 10) and (10, 6). Only width 6 m with length 10 m meets $x\leq 8$. Check area 60 and perimeter $2(6+10)=32$. The extra width label matters even though the two pairs describe congruent rectangles.

Evidence and response

Look for a separately justified relationship for every condition, consistent variable roles, explicit domains and units, and an interpreted simultaneous pair. A correct algebraic intersection is not automatically feasible. Require the original system even when the learner can solve a reduced equation mentally.

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 rectangle has perimeter 20 m and area 21 m². With positive side lengths x and y , which system models both conditions?

- A. $x+y=20$ and $xy=21$
- B. $2xy=20$ and $x+y=21$
- C. $x^2+y^2=21$ and $x+y=10$
- D. $x+y=10$ and $xy=21$

Reasoning: _____

M02 | Warm-up | T2

A sensor output is twice the square root of elapsed time $t \geq 0$. Calibration requires output $y=6$. Which system uses t and y consistently?

- A. $y=2\sqrt{t}$ and $y=6$
- B. $t=2\sqrt{y}$ and $y=6$
- C. $y=\sqrt{2t}$ and $y=6$
- D. $y=2t^2$ and $t=6$

Reasoning: _____

WARM-UP

001 • Show your reasoning

T1: Create systems with quadratic and linear relationships that describe the same quantities and simultaneous conditions.

A rectangle has perimeter 26 cm and area 40 cm². Define two variables, create a system for both conditions, and solve for its dimensions. Explain why exchanging the variables does not produce a different-shaped rectangle.

Representation / calculation

Explanation / check

WARM-UP

002 • Show your reasoning

T2: Create systems containing square-root models while retaining original inputs, domains and output signs.

A sensor has output $y=3\sqrt{t}$ units at $t\geq 0$ seconds. Calibration requires output 12 units. Create a two-variable system, find its solution pair, and interpret both coordinates.

Representation / calculation

Explanation / check

WORKED TEACHER KEYS

M01

M01 • T1: Create systems with quadratic and linear relationships that describe the same quantities and simultaneous conditions.

Answer: D. $x+y=10$ and $xy=21$

Perimeter gives $2x+2y=20$, or $x+y=10$; area gives $xy=21$. Both must hold for the same two side lengths.

Check each alternative

- A. The sum of two adjacent sides is half the perimeter, not the full perimeter.
- B. This interchanges an area product with a perimeter sum.
- C. The sum of squared side lengths is not the rectangle area.
- D. Perimeter gives $2x+2y=20$, or $x+y=10$; area gives $xy=21$. Both must hold for the same two side lengths.

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 • T2: Create systems containing square-root models while retaining original inputs, domains and output signs.

Answer: A. $y=2\sqrt{t}$ and $y=6$

The same output y must satisfy the sensor rule and the calibration target. Thus $y=2\sqrt{t}$ and $y=6$, with $t \geq 0$.

Check each alternative

- A. The same output y must satisfy the sensor rule and the calibration target. Thus $y=2\sqrt{t}$ and $y=6$, with $t \geq 0$.
- B. This reverses input and output in the sensor relationship.
- C. Twice the square root means the factor 2 is outside the radical.
- D. This changes the family and sets the input rather than the output target.

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: Create systems with quadratic and linear relationships that describe the same quantities and simultaneous conditions.**

Let $x, y > 0$ be adjacent side lengths in centimeters. The system is $x + y = 13$ and $xy = 40$. Substitute $y = 13 - x$: $x(13 - x) = 40$, so $x^2 - 13x + 40 = (x - 5)(x - 8) = 0$. The ordered pairs are $(5, 8)$ and $(8, 5)$, both describing one 5-by-8 cm rectangle. Checks: $2(5 + 8) = 26$ and $5 \times 8 = 40$.

Evidence to assess

Require defined positive side variables, both independent constraints, complete solution pairs, two contextual checks, and the dimension-label interpretation.

WORKED TEACHER KEYS

002

002 • T2: Create systems containing square-root models while retaining original inputs, domains and output signs.

The system is $y=3\sqrt{t}$ and $y=12$, with $t \geq 0$. Equating outputs gives $3\sqrt{t}=12$, so $\sqrt{t}=4$ and $t=16$. The solution pair $(t, y)=(16, 12)$ means the sensor reaches the required 12 units at 16 seconds. Substitution verifies both equations.

Evidence to assess

Require two equations sharing the same output, the time domain, the correctly ordered pair with units, and checks in both equations.