

TEACHER AND STUDENT RESOURCE

Model Situations with Systems



NC Math 1 • NC.M1.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.M1.A-CED.3 | NC Math 1 mathematics

This sample contains 19 complete selected pages from the 92-page resource, plus this sample contents page. Original printed page numbers are retained. Gaps are intentional.

Included original pages: 1-15, 30-31, 60, 75

Representative activities

M01: sample PDF page(s) 16; original page(s) 15

M02: sample PDF page(s) 16; original page(s) 15

O01: sample PDF page(s) 17; original page(s) 30

O02: sample PDF page(s) 18; original page(s) 31

Selected teacher prompts and keys: original page(s) 60, 75

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 equations and inequalities to model situations in context.

T1 Create systems of linear equations with shared variables.

T2 Create systems of linear inequalities with contextual constraints.

T3 Combine exact requirements and inequality constraints.

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, M02, M05, M09, M11, M12, M15, M19, M21, M22, M25, M29, O01, O02, O05, O09, O11, O12, O15, O19, O21, O22, O25, O29

T2: M03, M04, M06, M08, M10, M13, M14, M16, M18, M20, M23, M24, M26, M28, M30, O03, O04, O06, O08, O10, O13, O14, O16, O18, O20, O23, O24, O26, O28, O30

T3: M07, M17, M27, O07, O17, O27

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

Translate a single linear relation, distinguish at least/at most/exactly, substitute ordered pairs, compute unit rates, and distinguish counts from continuous measurements.

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

Define every variable and its units. Separate the mathematical model from restrictions imposed by context. For counted objects use nonnegative integers; for measurements use the stated real interval. Accept algebraically equivalent models with all original restrictions. A model is valid only under its stated assumptions.

TEACHER MODEL

Two conditions, one feasible choice

A service schedules x hours on machine A at \$2/hour and y hours on machine B at \$5/hour. It needs at least 6 total machine-hours and has at most \$36. Times x, y are nonnegative reals. Model both requirements and verify a feasible pair.

System: $x + y \geq 6$; $2x + 5y \leq 36$. Require $x+y \geq 6$ hours and $2x+5y \leq 36$ dollars. Check (3,5): $8 \geq 6$ and $31 \leq 36$. Both constraints must hold simultaneously. Say: “The same x and y appear in both conditions. A choice must satisfy both, not just one. Units tell me which expressions belong together.”

VISUAL ANCHOR

Build one relation per condition

For the machine-hours teacher model, organize quantities before writing symbols. Each row becomes a constraint. The same variables are used throughout.

Quantity	Expression	Requirement
Total machine-hours	$x + y$	At least 6 hours
Total cost (dollars)	$2x + 5y$	At most \$36
Allowed times	$x \geq 0$ and $y \geq 0$	Real hours

Check the choice $x=3$ and $y=5$: total time 8 hours, cost \$31. Both requirements hold. A choice that satisfies only one row is not feasible.

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 of linear equations with shared variables.

Optional bank: M01–M04; 001–004. 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 001, including its graph when present. Invite a first independent response before discussion. Ask, “What do the symbols represent? What evidence supports your claim?”

Core task

A theater sells 14 tickets: child tickets cost \$5 and adult tickets cost \$8; total receipts are \$94. Let x be child tickets and y be adult tickets, both nonnegative integers. Create a system, including the domain restrictions. Explain the meaning and units of each relation, then give and check one pair that satisfies all conditions.

Teacher solution and discussion

System: $x + y = 14$; $5x + 8y = 94$. First equation counts tickets; second sums dollars. A check is $(x,y)=(6,8)$: $6+8=14$ and $5(6)+8(8)=94$. Counts must be nonnegative integers. Domain: $x \geq 0$ and $y \geq 0$, both integers.

Evidence and response

Look for a claim tied to specific terms, factors, operations or graph features. If a learner only names an answer, ask which values or parts of the graph support it. If a sign or operation is mishandled, reconstruct that step with a numerical analogy, then collect a fresh response. A selected option alone does not identify a unique misconception.

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: Create systems of linear equations with shared variables.

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 graph when present. Think aloud through the core task. Say, “I will identify the quantities first, then build a representation and check it against the stated domain.” Hide the worked key until after predictions.

Core task

Two displays contain 19 models altogether. The first has 5 more models than the second. Let x and y be the first and second counts, nonnegative integers. Create a system, including the domain restrictions. Explain the meaning and units of each relation, then give and check one pair that satisfies all conditions.

Teacher solution and discussion

System: $x + y = 19$; $x - y = 5$. Total $x + y = 19$; difference $x - y = 5$. Check $x = 12$, $y = 7$: total 19, difference 5. Equivalently the second equation can be $x = y + 5$. Domain: $x \geq 0$ and $y \geq 0$, both integers.

Evidence and response

Look for a claim tied to specific terms, factors, operations or graph features. If a learner only names an answer, ask which values or parts of the graph support it. If a sign or operation is mishandled, reconstruct that step with a numerical analogy, then collect a fresh response. A selected option alone does not identify a unique misconception.

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 of linear equations with shared variables.

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 graph when present. Have learners propose the next step, then ask a partner to verify it using the original representation. Record more than one valid explanation.

Core task

Plan A costs \$12 plus \$6 per hour. Plan B costs \$26 plus \$4 per hour. Let $x \geq 0$ be hours and $y \geq 0$ be a common cost in dollars. Model when the two plans cost the same. Create a system, including the domain restrictions. Explain the meaning and units of each relation, then give and check one pair that satisfies all conditions.

Teacher solution and discussion

System: $y = 12 + 6x$; $y = 26 + 4x$. Each equation describes one bill. They share x and y , so both must hold. At $x=7$ hours, both cost $y=\$54$; check $12+6(7)=54$ and $26+4(7)=54$. Nonnegative real hours are allowed. Domain: $x \geq 0$ and $y \geq 0$, both real numbers.

Evidence and response

Look for a claim tied to specific terms, factors, operations or graph features. If a learner only names an answer, ask which values or parts of the graph support it. If a sign or operation is mishandled, reconstruct that step with a numerical analogy, then collect a fresh response. A selected option alone does not identify a unique misconception.

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 • T2: Create systems of linear inequalities with contextual constraints.

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 graph when present. Assign reader, representer, checker and explainer roles. Each learner first makes a private prediction; compare reasoning and resolve differences with the data.

Core task

A service schedules x hours on machine A at \$6/hour and y hours on machine B at \$9/hour. It needs at least 14 total machine-hours and has at most \$128. Times x, y are nonnegative reals. Create a system, including the domain restrictions. Explain the meaning and units of each relation, then give and check one pair that satisfies all conditions.

Teacher solution and discussion

System: $x + y \geq 14$; $6x + 9y \leq 128$. Require $x+y \geq 14$ hours and $6x+9y \leq 128$ dollars. Check (7,9): $16 \geq 14$ and $123 \leq 128$. Both constraints must hold simultaneously. Domain: $x \geq 0$ and $y \geq 0$, both real numbers.

Evidence and response

Look for a claim tied to specific terms, factors, operations or graph features. If a learner only names an answer, ask which values or parts of the graph support it. If a sign or operation is mishandled, reconstruct that step with a numerical analogy, then collect a fresh response. A selected option alone does not identify a unique misconception.

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 of linear equations with shared variables.

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 graph when present. Provide the printed task and neutral access supports. Preserve the first independent response; do not point to the requested answer or select a method for the learner.

Core task

Plan A costs \$14 plus \$7 per hour. Plan B costs \$30 plus \$5 per hour. Let $x \geq 0$ be hours and $y \geq 0$ be a common cost in dollars. Model when the two plans cost the same. Create a system, including the domain restrictions. Explain the meaning and units of each relation, then give and check one pair that satisfies all conditions.

Teacher solution and discussion

System: $y = 14 + 7x$; $y = 30 + 5x$. Each equation describes one bill. They share x and y , so both must hold. At $x=8$ hours, both cost $y=\$70$; check $14+7(8)=70$ and $30+5(8)=70$. Nonnegative real hours are allowed. Domain: $x \geq 0$ and $y \geq 0$, both real numbers.

Evidence and response

Look for a claim tied to specific terms, factors, operations or graph features. If a learner only names an answer, ask which values or parts of the graph support it. If a sign or operation is mishandled, reconstruct that step with a numerical analogy, then collect a fresh response. A selected option alone does not identify a unique misconception.

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 • T2: Create systems of linear inequalities with contextual constraints.

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 graph when present. Start with the learner’s prior evidence. Rebuild one representation with explicit terms and operations, then use a fresh item to check transfer without the prior cue.

Core task

A service schedules x hours on machine A at \$7/hour and y hours on machine B at \$10/hour. It needs at least 16 total machine-hours and has at most \$161. Times x, y are nonnegative reals. Create a system, including the domain restrictions. Explain the meaning and units of each relation, then give and check one pair that satisfies all conditions.

Teacher solution and discussion

System: $x + y \geq 16$; $7x + 10y \leq 161$. Require $x+y \geq 16$ hours and $7x+10y \leq 161$ dollars. Check (8,10): $18 \geq 16$ and $156 \leq 161$. Both constraints must hold simultaneously. Domain: $x \geq 0$ and $y \geq 0$, both real numbers.

Evidence and response

Look for a claim tied to specific terms, factors, operations or graph features. If a learner only names an answer, ask which values or parts of the graph support it. If a sign or operation is mishandled, reconstruct that step with a numerical analogy, then collect a fresh response. A selected option alone does not identify a unique misconception.

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: Create systems of linear inequalities with contextual constraints.

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 graph when present. Ask for a concise claim supported by the representation. Collect the response before sharing a solution; use it to choose the next instructional step.

Core task

A shipment uses x small crates and y large crates. A small crate holds 7 equipment units and a large one holds 10. At least 154 units must fit, using no more than 20 crates. Counts x, y are nonnegative integers. Create a system, including the domain restrictions. Explain the meaning and units of each relation, then give and check one pair that satisfies all conditions.

Teacher solution and discussion

System: $7x + 10y \geq 154$; $x + y \leq 20$. Combined capacity $7x + 10y$ must be ≥ 154 ; total crates $x + y \leq 20$. Witness (8,10) holds 156 units using 18 crates. Capacity may exceed demand; equality is not required. Domain: $x \geq 0$ and $y \geq 0$, both integers.

Evidence and response

Look for a claim tied to specific terms, factors, operations or graph features. If a learner only names an answer, ask which values or parts of the graph support it. If a sign or operation is mishandled, reconstruct that step with a numerical analogy, then collect a fresh response. A selected option alone does not identify a unique misconception.

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 theater sells 8 tickets: child tickets cost \$2 and adult tickets cost \$5; total receipts are \$31. Let x be child tickets and y be adult tickets, both nonnegative integers. Which system represents all stated conditions?

- A. $x + y = 11$; $5x + 2y = 31$
- B. $x + y = 11$; $2x + 5y = 31$
- C. $x + y = 8$; $5x + 2y = 31$
- D. $x + y = 8$; $2x + 5y = 31$

Reasoning: _____

M02 | Warm-up | T1

A shop blends x kg of nuts priced \$4/kg with y kg priced \$9/kg. The blend must weigh 8 kg and its ingredients cost exactly \$62. Here x, y are nonnegative real masses. Which system represents all stated conditions?

- A. $x + y = 8$; $4x + 9y = 62$
- B. $x + y = 9$; $4x + 9y = 62$
- C. $x + y = 8$; $9x + 4y = 62$
- D. $x + y = 9$; $9x + 4y = 62$

Reasoning: _____

WARM-UP

001 • Show your reasoning

T1: Create systems of linear equations with shared variables.

A theater sells 14 tickets: child tickets cost \$5 and adult tickets cost \$8; total receipts are \$94. Let x be child tickets and y be adult tickets, both nonnegative integers. Create a system, including the domain restrictions. Explain the meaning and units of each relation, then give and check one pair that satisfies all conditions.

Representation / calculation

Explanation / check

WARM-UP

002 • Show your reasoning

T1: Create systems of linear equations with shared variables.

A shop blends x kg of nuts priced \$7/kg with y kg priced \$15/kg. The blend must weigh 14 kg and its ingredients cost exactly \$170. Here x, y are nonnegative real masses. Create a system, including the domain restrictions. Explain the meaning and units of each relation, then give and check one pair that satisfies all conditions.

Representation / calculation

Explanation / check

WORKED TEACHER KEYS

M01 / M02**M01 • T1: Create systems of linear equations with shared variables.****Answer: D. $x + y = 8$; $2x + 5y = 31$**

First equation counts tickets; second sums dollars. A check is $(x,y)=(3,5)$: $3+5=8$ and $2(3)+5(5)=31$. Counts must be nonnegative integers.

Check each alternative

- A. The stated total is 8, not 11. The per-unit prices are assigned to the opposite variables.
- B. The stated total is 8, not 11. Second relation matches.
- C. First relation matches. The per-unit prices are assigned to the opposite variables.
- D. Correct: both relations match the stated conditions.

M02 • T1: Create systems of linear equations with shared variables.**Answer: A. $x + y = 8$; $4x + 9y = 62$**

Mass balance: $x+y=8$ kg; cost balance: $4x+9y=62$ dollars. A check is $(x,y)=(2,6)$: $2+6=8$ and $4(2)+9(6)=62$. Fractional kilograms are permitted.

Check each alternative

- A. Correct: mass and dollar totals both match.
- B. The required mass is 8 kg, not 9 kg.
- C. The ingredient prices are assigned to the opposite mass variables.
- D. The required mass is 8 kg, not 9 kg. The ingredient prices are assigned to the opposite mass variables.

WORKED TEACHER KEYS

001 / 002**001 • T1: Create systems of linear equations with shared variables.**

System: $x + y = 14$; $5x + 8y = 94$. First equation counts tickets; second sums dollars. A check is $(x,y)=(6,8)$: $6+8=14$ and $5(6)+8(8)=94$. Counts must be nonnegative integers. Domain: $x \geq 0$ and $y \geq 0$, both integers.

002 • T1: Create systems of linear equations with shared variables.

System: $x + y = 14$; $7x + 15y = 170$. Mass balance: $x+y=14$ kg; cost balance: $7x+15y=170$ dollars. A check is $(x,y)=(5,9)$: $5+9=14$ and $7(5)+15(9)=170$. Fractional kilograms are permitted. Domain: $x \geq 0$ and $y \geq 0$, both real numbers.