

TEACHER AND STUDENT RESOURCE

Build Functions from Relationships



NC Math 1 • NC.M1.F-BF.1

Building and Comparing Function Models

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.F-BF.1 | NC Math 1 mathematics

This sample contains 19 complete selected pages from the 107-page resource, plus this sample contents page. Original printed page numbers are retained. Gaps are intentional.

Included original pages: 1-15, 30-31, 66, 81

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) 66, 81

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

Write a function that describes a relationship between two quantities.

- a. Build linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two ordered pairs (include reading these from a table).
- b. Build a function that models a relationship between two quantities by combining linear, exponential, or quadratic functions with addition and subtraction or two linear functions with multiplication.

T1 Build linear and arithmetic models from descriptions, graphs and ordered pairs.

T2 Build exponential and geometric models from descriptions, graphs and ordered pairs.

T3 Combine function models using addition and subtraction.

T4 Multiply two linear models to describe a relationship.

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, M03, O03, M04, O04, M11, O11, M13, O13, M14, O14, M21, O21, M23, O23, M24, O24

T2: M02, O02, M05, O05, M06, O06, M12, O12, M15, O15, M16, O16, M22, O22, M25, O25, M26, O26

T3: M07, O07, M08, O08, M10, M17, O17, M18, O18, M20, M27, O27, M28, O28, M30

T4: M09, O09, O10, M19, O19, O20, M29, O29, O30

DAILY LEARNING TARGETS

A multi-session teaching path

Session 1: Notice and represent

Learning target: Build linear and arithmetic models from descriptions, graphs and ordered pairs.

Use M01–M04 and selected O01–O04 as a diagnostic. Model O05; ask learners to check its rule with the supplied data.

Session 2: Build and justify

Learning target: Build exponential and geometric models from descriptions, graphs and ordered pairs.

Learning target: Combine function models using addition and subtraction.

Choose from M09–M18 and O09–O18. Partners compare representations, check every given condition, and explain disagreements.

Session 3: Apply and revisit

Learning target: Multiply two linear models to describe a relationship.

Collect independent evidence from M19–M23 and O19–O23. Use M24–M27 and O24–O27 for fresh reteaching examples; select an exit task from each bank.

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. For the optional digital comparisons, use a school-approved graphing calculator or spreadsheet; no paid service or account is required. Enter the supplied rules and tables and record your own results.

Prerequisites

Check signed arithmetic, ratios, exponents and ordered pairs. Distinguish a quantity from its change. Review arithmetic and geometric patterns before scoring evidence.

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.

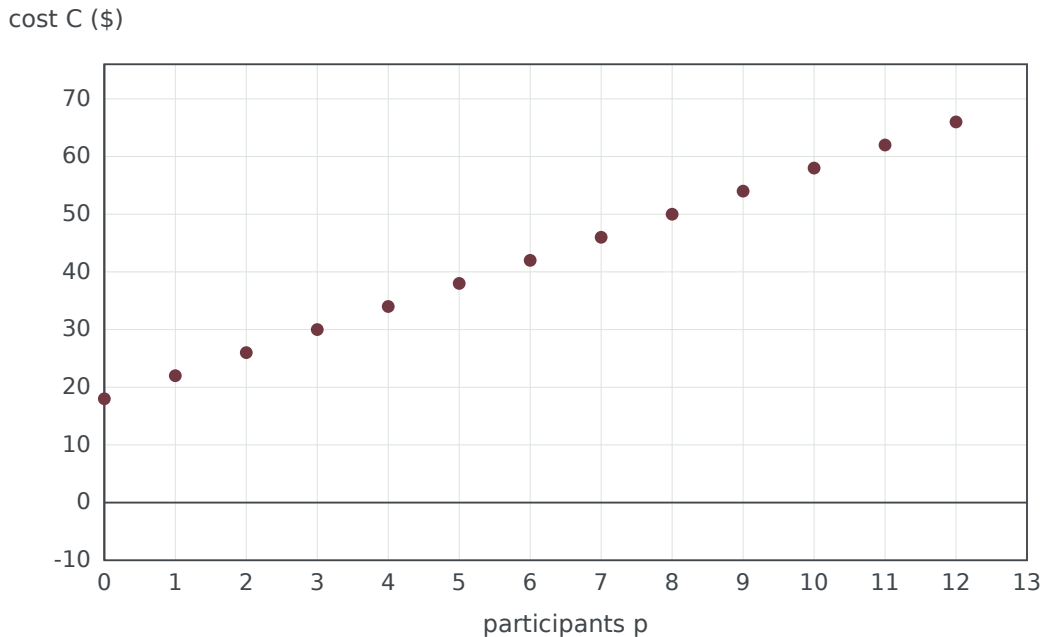
Review convention

Assume the specified model family throughout its stated domain. Finite data alone do not establish a unique arbitrary function. Sequences start at $n=1$ unless stated otherwise. Exponent notation $a \cdot b^x$ means a times b raised to x ; it does not mean $(ab)^x$.

TEACHER MODEL

Two quantities, one checkable model

A club pays \$18 to reserve a room and \$4 per participant. Build $C(p)$, state a domain for at most 12 participants, and check two points.



The fixed cost is $C(0)=18$. Each added participant adds \$4, so $C(p)=4p+18$, for integer p from 0 through 12. $C(3)=30$ and $C(8)=50$. The graph consists of separate points because a participant count is discrete.

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: Build linear and arithmetic models from descriptions, graphs and ordered pairs.

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 graph when present. Invite a first independent response before discussion. Ask, “What do the symbols represent? What evidence supports your claim?”

Core task

Build the linear function through (2, 25) and (6, 45). Show the slope calculation and check both points.

Teacher solution and discussion

$m = (45 - 25) / (6 - 2) = 5$. The intercept is $25 - 5(2) = 15$. Thus $f(x) = 5x + 15$. Substitution gives the two stated outputs.

Evidence and response

Look for the stated initial condition, correct equal-interval change, and a model that matches every supplied observation. Ask learners to test their rule at two known inputs. If a learner adds where the situation multiplies, compare successive differences and ratios using actual data, 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 • T2: Build exponential and geometric models from descriptions, graphs and ordered pairs.

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 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

A branching design has 6 tips at stage 1, then each tip produces 2 tips at the next stage. Build a geometric sequence and show a table and graph of stages 1–4.

Teacher solution and discussion

$a(n)=6 \cdot 2^{n-1}$, $n \geq 1$ integer. The four values are 6, 12, 24, 48. The ratio is 2; plot separate points.

Evidence and response

Look for the stated initial condition, correct equal-interval change, and a model that matches every supplied observation. Ask learners to test their rule at two known inputs. If a learner adds where the situation multiplies, compare successive differences and ratios using actual data, 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 • T4: Multiply two linear models to describe a relationship.

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

A rectangle has length $3x + 1$ cm and width $x + 6$ cm for $x \geq 0$. Draw a labeled rectangle, build its area function in factored and expanded forms, and find the area at $x=2$.

Teacher solution and discussion

Draw a rectangle with the two given side labels. $A(x) = (3x + 1)(x + 6) = 3x^2 + 19x + 6$ cm². At $x=2$ the sides are 7 and 8 cm, giving 56 cm². Side labels, not the drawing scale, determine the area.

Evidence and response

Look for the stated initial condition, correct equal-interval change, and a model that matches every supplied observation. Ask learners to test their rule at two known inputs. If a learner adds where the situation multiplies, compare successive differences and ratios using actual data, 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 • T1: Build linear and arithmetic models from descriptions, graphs and ordered pairs.

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 tile pattern has 14 tiles in stage 1 and adds 4 per stage. Build an explicit arithmetic-sequence function for integer $n \geq 1$. Make a table and plot stages 1–4.

Teacher solution and discussion

$a(n) = 14 + 4(n - 1)$. Values for $n = 1, 2, 3, 4$ are 14, 18, 22, 26. Plot separate points; stage numbers are discrete.

Evidence and response

Look for the stated initial condition, correct equal-interval change, and a model that matches every supplied observation. Ask learners to test their rule at two known inputs. If a learner adds where the situation multiplies, compare successive differences and ratios using actual data, 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 • T4: Multiply two linear models to describe a relationship.

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

A rectangle has length $3x + 2$ cm and width $x + 6$ cm for $x \geq 0$. Draw a labeled rectangle, build its area function in factored and expanded forms, and find the area at $x=2$.

Teacher solution and discussion

Draw a rectangle with the two given side labels. $A(x) = (3x + 2)(x + 6) = 3x^2 + 20x + 12$ cm². At $x=2$ the sides are 8 and 8 cm, giving 64 cm². Side labels, not the drawing scale, determine the area.

Evidence and response

Look for the stated initial condition, correct equal-interval change, and a model that matches every supplied observation. Ask learners to test their rule at two known inputs. If a learner adds where the situation multiplies, compare successive differences and ratios using actual data, 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 • T1: Build linear and arithmetic models from descriptions, graphs and ordered pairs.

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 tile pattern has 15 tiles in stage 1 and adds 5 per stage. Build an explicit arithmetic-sequence function for integer $n \geq 1$. Make a table and plot stages 1–4.

Teacher solution and discussion

$a(n) = 15 + 5(n - 1)$. Values for $n = 1, 2, 3, 4$ are 15, 20, 25, 30. Plot separate points; stage numbers are discrete.

Evidence and response

Look for the stated initial condition, correct equal-interval change, and a model that matches every supplied observation. Ask learners to test their rule at two known inputs. If a learner adds where the situation multiplies, compare successive differences and ratios using actual data, 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: 028 • T3: Combine function models using addition and subtraction.

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

Models $A(t)=9 \cdot (2)^t$ and $B(t)=t^2 + 6$ describe two quantities in liters at integer times $t \geq 0$. Build $A-B$ and $A+B$; evaluate both at $t=2$ and interpret the difference.

Teacher solution and discussion

$D(t)=9 \cdot (2)^t - t^2 - 6$; $S(t)=9 \cdot (2)^t + t^2 + 6$. At $t=2$, $A=36$, $B=10$, $D=26$ L and $S=46$ L. A exceeds B by 26 L then.

Evidence and response

Look for the stated initial condition, correct equal-interval change, and a model that matches every supplied observation. Ask learners to test their rule at two known inputs. If a learner adds where the situation multiplies, compare successive differences and ratios using actual data, 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 linear sensor rule has readings (2, 14) and (5, 23). Which formula gives y in terms of x?

- A. $3x + 8$
- B. $3x + 14$
- C. $9x/7 + 80/7$
- D. $x/3 + 40/3$

Reasoning: _____

M02 | Warm-up | T2

An exponential model has this table. Which rule matches it?

Input x	0	1	2
Output y	3	6	12

- A. $2 \cdot (3)^x$
- B. $3 \cdot (2)^{x+1}$
- C. $3 + 2x$
- D. $3 \cdot (2)^x$

Reasoning: _____

WARM-UP

001 • Show your reasoning

T1: Build linear and arithmetic models from descriptions, graphs and ordered pairs.

Build the linear function through (2, 25) and (6, 45). Show the slope calculation and check both points.

Representation / calculation

Explanation / check

WARM-UP

002 • Show your reasoning

T2: Build exponential and geometric models from descriptions, graphs and ordered pairs.

Build an exponential function from the table and verify all three values.

Input x	0	1	3
Output y	8	16	64

Representation / calculation

Explanation / check

WORKED TEACHER KEYS

M01 / M02**M01 • T1: Build linear and arithmetic models from descriptions, graphs and ordered pairs.****Answer: A. $3x + 8$**

The slope is $(23 - 14)/(5 - 2) = 3$. Then $b = 14 - 3(2) = 8$, so $y = 3x + 8$.

Check each alternative

- A. This expression satisfies the required relationship.
- B. This gives 14 at $x=0$ and 20 at $x=2$; compare with the required values 8 and 14.
- C. This gives $80/7$ at $x=0$ and 14 at $x=2$; compare with the required values 8 and 14.
- D. This gives $40/3$ at $x=0$ and 14 at $x=2$; compare with the required values 8 and 14.

M02 • T2: Build exponential and geometric models from descriptions, graphs and ordered pairs.**Answer: D. $3 \cdot (2)^x$**

$y(0) = 3$; successive ratios are 2. Therefore $y = 3 \cdot (2)^x$.

Check each alternative

- A. This interchanges the initial value and ratio.
- B. This is shifted one step ahead.
- C. This makes additive rather than multiplicative change.
- D. The initial value and common ratio both match.

WORKED TEACHER KEYS

001 / 002**O01 • T1: Build linear and arithmetic models from descriptions, graphs and ordered pairs.**

$m = (45 - 25) / (6 - 2) = 5$. The intercept is $25 - 5(2) = 15$. Thus $f(x) = 5x + 15$. Substitution gives the two stated outputs.

O02 • T2: Build exponential and geometric models from descriptions, graphs and ordered pairs.

$y(0) = 8$, and $y(1)/y(0) = 2$, so $y = 8 \cdot (2)^x$. At $x = 3$ it gives $8 \cdot 2^3 = 64$, as required.