

TEACHER AND STUDENT RESOURCE

Modeling Linear Relationships



Grade 8 • NC.8.F.4

Functions

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.8.F.4 | Eighth Grade mathematics

This sample contains 18 complete selected pages from the 105-page resource, plus this sample contents page. Original printed page numbers are retained. Gaps are intentional.

Included original pages: 1-14, 31-32, 61, 76

Representative activities

M01: sample PDF page(s) 15; original page(s) 14

M02: sample PDF page(s) 15; original page(s) 14

O01: sample PDF page(s) 16; original page(s) 31

O02: sample PDF page(s) 17; 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.

ALIGNMENT

Standard and learning targets

Analyze functions that model linear relationships.

- Understand that a linear relationship can be generalized by $y = mx + b$.
- Write an equation in slope-intercept form to model a linear relationship by determining the rate of change and the initial value, given at least two (x, y) values or a graph.
- Construct a graph of a linear relationship given an equation in slope-intercept form.
- Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of the slope and y-intercept of its graph or a table of values.

T1 Explain the roles of the parameters in a general linear rule.

T2 Determine a slope-intercept equation from linear data or a graph.

T3 Construct a graph from a slope-intercept equation.

T4 Interpret rate of change and initial value in representations and situations.

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, M10, M28, O01, O18, O30

T2: M02, M04, M05, M07, M09, M13, M14, M18, M19, M21, M23, M24, M25, M27, M29, O02, O04, O06, O09, O11, O14, O16, O17, O19, O22, O23, O27, O28

T3: M08, M15, M22, O05, O07, O10, O12, O15, O20, O24, O25

T4: M03, M06, M11, M12, M16, M17, M20, M26, M30, O03, O08, O13, O21, O26, O29

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

Check ordered pairs, input/output order, reading numbered scales, signed-number arithmetic, and the meaning of horizontal and vertical axes. Teach these separately before collecting independent 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.

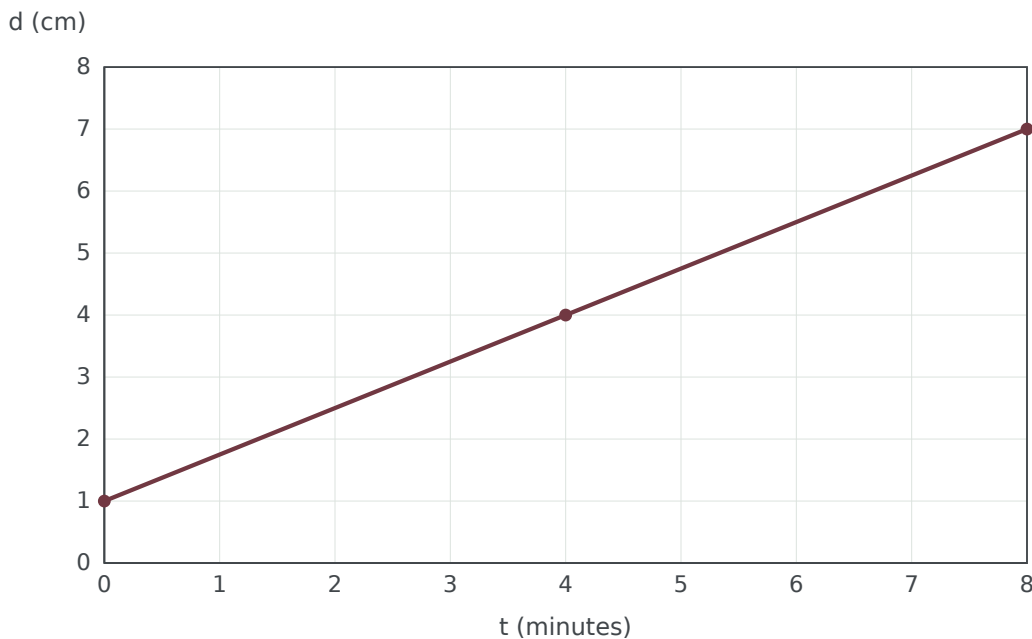
Review convention

A finite table describes only its displayed domain unless a broader rule or linear model is explicitly given. Do not infer a unique future rule from a short list of values.

TEACHER MODEL

Build, graph, and interpret a linear model

A liquid depth increases at a constant rate. It is 4 cm after 4 minutes and 7 cm after 8 minutes. Let t be elapsed minutes and d be depth in cm. Find the model, interpret its parameters, and describe a graph for $0 \leq t \leq 8$.



Say: “The two observations are (4, 4) and (8, 7). A linear model uses the output change divided by the input change.” Calculate $m = (7 - 4)/(8 - 4) = 3/4$ cm/minute. Say: “The first observed output is not the initial depth because its input is 4.” Substitute: $4 = (3/4)(4) + b$, so $b = 1$ cm. Write $d = (3/4)t + 1$. Check both observations: $d(4) = 4$ and $d(8) = 7$. Mark axes t (minutes) and d (cm), plot (0, 1), (4, 4), and (8, 7), and draw the straight segment for $0 \leq t \leq 8$. Explain: the graph starts at depth 1 cm and rises 3 cm for each 4 minutes. Ask learners to connect m to rise/run and b to the y-intercept. State that the constant rate and a container that does not overflow are modeling assumptions.

REUSABLE REASONING GUIDE

Represent, justify, interpret

Name: _____ Date: _____

Givens and input/output meaning**Representation and calculation****Justification or check****Conclusion, domain and units**

WARM-UP

Teaching script

Core: 001 • T1: Explain the roles of the parameters in a general linear rule.

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 input and output represent? What evidence supports your claim?”

Core task

For $y = -3x + 8$, identify the rate of change and initial value. Find the outputs at $x = 0$ and $x = 1$. Explain how those outputs connect to the two parameters.

Teacher solution and discussion

The slope is $m = -3$ and the initial value is $b = 8$. At $x = 0$, $y = -3(0) + 8 = 8$; at $x = 1$, $y = -3(1) + 8 = 5$. The input rises by 1 while the output changes by $5 - 8 = -3$, confirming the slope. The point $(0, 8)$ is the y-intercept. Assess both the values and the connection to change and starting output.

Evidence and response

Look for a claim tied to specific inputs, outputs, changes or graph features. If a learner only names an answer, ask which values or parts of the graph support it. If axes are reversed, reteach input/output order with one pair, 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 • T3: Construct a graph from a slope-intercept equation.

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

Construct the graph of $y = 2x - 1$ on the blank coordinate grid. Calculate and plot the outputs for $x = -2, 0$, and 2 . Draw the portion of the line within the grid and explain how its slope and y-intercept appear.

Teacher solution and discussion

Calculate $y(-2) = -5$, $y(0) = -1$, and $y(2) = 3$. Plot $(-2, -5)$, $(0, -1)$, and $(2, 3)$, then draw one straight line through them across the window. The displayed line reaches the bottom boundary at $(-2.5, -6)$ and top boundary at $(3.5, 6)$. The y-intercept is $(0, -1)$; moving right 1 raises y by 2. Assess accurate plotting and construction, not only identification of slope and intercept.

Evidence and response

Look for a claim tied to specific inputs, outputs, changes or graph features. If a learner only names an answer, ask which values or parts of the graph support it. If axes are reversed, reteach input/output order with one pair, 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 • T2: Determine a slope-intercept equation from linear data or a graph.

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

The pairs $(-6, 5)$ and $(2, 1)$ belong to a linear relationship. Write its slope-intercept equation. Explain how to find the value at $x = 0$ from either given pair, and check the other pair.

Teacher solution and discussion

The slope is $m = (1 - 5)/(2 - (-6)) = -4/8 = -1/2$. From $(2, 1)$, $b = 1 - (-1/2)(2) = 2$. Equivalently, move 6 input units right from $x = -6$; y falls 3, giving $5 - 3 = 2$ at zero. The equation is $y = -(1/2)x + 2$. Checks: at -6 , $y = 3 + 2 = 5$; at 2 , $y = -1 + 2 = 1$. Assess both parameter calculations and the connection to the output at zero.

Evidence and response

Look for a claim tied to specific inputs, outputs, changes or graph features. If a learner only names an answer, ask which values or parts of the graph support it. If axes are reversed, reteach input/output order with one pair, 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: Determine a slope-intercept equation from linear data or a graph.

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 linear relationship includes $(2, 1)$ and $(6, 9)$. One partner proposes $y = 2x + 1$; another proposes $y = 2x - 3$. Decide which model fits. Explain the initial-value error in the other model, and verify both given points.

Teacher solution and discussion

The rate is $(9 - 1)/(6 - 2) = 8/4 = 2$. Using $(2, 1)$, $b = 1 - 2(2) = -3$. Therefore $y = 2x - 3$ is correct: it gives 1 at $x = 2$ and 9 at $x = 6$. The rule $y = 2x + 1$ treats the output at $x = 2$ as though it were the output at $x = 0$; it instead gives 5 and 13. Assess comparison through substitution and an explanation of why first listed output need not equal b .

Evidence and response

Look for a claim tied to specific inputs, outputs, changes or graph features. If a learner only names an answer, ask which values or parts of the graph support it. If axes are reversed, reteach input/output order with one pair, 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: 019 • T2: Determine a slope-intercept equation from linear data or a graph.

Optional bank: M19–M23; 019–023. 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 019, 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 pump fills a small tank at a constant rate. The tank has 3 liters at $t = 2$ minutes and 5 liters at $t = 6$ minutes. Find a slope-intercept model $V(t)$, interpret both parameters, and construct its graph for $0 \leq t \leq 8$ minutes. Assume the tank has room throughout.

Teacher solution and discussion

The rate is $(5 - 3)/(6 - 2) = 2/4 = 1/2$ liter/minute. Using $(2, 3)$, $b = 3 - (1/2)(2) = 2$ liters. Therefore $V = (1/2)t + 2$. The tank starts with 2 liters and gains 0.5 liter each minute. Plot $(0, 2)$, $(2, 3)$, $(6, 5)$, and $(8, 6)$, then draw the straight segment over $0 \leq t \leq 8$. Label t (minutes) and V (liters). Assess derivation, units, plotted observations, and domain endpoints.

Evidence and response

Look for a claim tied to specific inputs, outputs, changes or graph features. If a learner only names an answer, ask which values or parts of the graph support it. If axes are reversed, reteach input/output order with one pair, 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 • T3: Construct a graph from a slope-intercept equation.

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 input/output labels, then use a fresh item to check transfer without the prior cue.

Core task

Construct the graph of $y = -3$ on the blank grid. Plot outputs for $x = -4, 0$, and 4 . State the slope and initial value, and explain why this is included in the form $y = mx + b$.

Teacher solution and discussion

For all three inputs the output is -3 , so plot $(-4, -3)$, $(0, -3)$, and $(4, -3)$. Draw the horizontal line across the grid, from $(-6, -3)$ to $(6, -3)$. The slope is 0 because the output change is 0 for nonzero input changes. The initial value is -3 , and $y = -3$ can be written $y = 0x - 3$. Assess a horizontal line at the correct height and the connection to the general form.

Evidence and response

Look for a claim tied to specific inputs, outputs, changes or graph features. If a learner only names an answer, ask which values or parts of the graph support it. If axes are reversed, reteach input/output order with one pair, 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: Determine a slope-intercept equation from linear data or a graph.

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 linear relationship includes $(1, 1)$ and $(3, 7)$. Determine the rate and initial value, write the equation, and construct its graph on the blank grid. Include the y-intercept and both given points.

Teacher solution and discussion

The slope is $(7 - 1)/(3 - 1) = 6/2 = 3$. From $(1, 1)$, $b = 1 - 3 = -2$, so $y = 3x - 2$. Plot $(0, -2)$, $(1, 1)$, and $(3, 7)$, then draw the line across the displayed window. It reaches the left boundary at $(-2, -8)$ and the top boundary at $(4, 10)$. Both given points satisfy the equation. Assess independent derivation and actual construction, with the intercept placed at $(0, -2)$.

Evidence and response

Look for a claim tied to specific inputs, outputs, changes or graph features. If a learner only names an answer, ask which values or parts of the graph support it. If axes are reversed, reteach input/output order with one pair, 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**

For the linear rule $y = mx + b$, what does substituting $x = 0$ show about the graph?

- A. The graph must pass through $(0, m)$.
- B. The graph must pass through $(0, b)$.
- C. The graph must pass through (m, b) .
- D. The graph must pass through $(b, 0)$.

Reasoning: _____

M02 | Warm-up | T2

A linear relationship includes $(2, 7)$ and $(5, 19)$. What is its rate of change?

- A. $\frac{1}{4}$
- B. 12
- C. 4
- D. 6

Reasoning: _____

WARM-UP

001 • Show your reasoning

T1: Explain the roles of the parameters in a general linear rule.

For $y = -3x + 8$, identify the rate of change and initial value. Find the outputs at $x = 0$ and $x = 1$. Explain how those outputs connect to the two parameters.

Representation / calculation

Explanation / check

WARM-UP

002 • Show your reasoning

T2: Determine a slope-intercept equation from linear data or a graph.

A linear relationship contains $(-2, 1)$ and $(4, 10)$. Find its rate of change and write its equation in slope-intercept form. Check both pairs.

Representation / calculation

Explanation / check

WORKED TEACHER KEYS

M01 / M02**M01 • T1: Explain the roles of the parameters in a general linear rule.****Answer: B. The graph must pass through (0, b).**

Substitute $x = 0$: $y = m(0) + b = b$. Therefore (0, b) is on the graph and is its y-intercept. The rate m does not determine the y-coordinate at $x = 0$.

Check each alternative

- A. At $x = 0$, the output is b , which need not equal m .
- B. Correct: $x = 0$ gives $y = b$.
- C. Substituting $x = m$ gives $y = m^2 + b$, which need not equal b .
- D. The coordinates are reversed; $(b, 0)$ need not satisfy the rule.

M02 • T2: Determine a slope-intercept equation from linear data or a graph.**Answer: C. 4**

The change in output is $19 - 7 = 12$ and the change in input is $5 - 2 = 3$. The rate is $12/3 = 4$ output units per input unit. Both differences must use the same order.

Check each alternative

- A. $1/4$ reverses the output-change/input-change ratio.
- B. 12 is the output change over 3 input units, not over 1.
- C. Correct: $(19 - 7)/(5 - 2) = 12/3 = 4$.
- D. 6 results from $12/2$, but the input change is 3.

WORKED TEACHER KEYS

001 / 002**001 • T1: Explain the roles of the parameters in a general linear rule.**

The slope is $m = -3$ and the initial value is $b = 8$. At $x = 0$, $y = -3(0) + 8 = 8$; at $x = 1$, $y = -3(1) + 8 = 5$. The input rises by 1 while the output changes by $5 - 8 = -3$, confirming the slope. The point $(0, 8)$ is the y-intercept. Assess both the values and the connection to change and starting output.

002 • T2: Determine a slope-intercept equation from linear data or a graph.

The rate is $m = (10 - 1)/(4 - (-2)) = 9/6 = 3/2$. Substitute $(-2, 1)$: $1 = (3/2)(-2) + b = -3 + b$, giving $b = 4$. Thus $y = (3/2)x + 4$, or $y = 1.5x + 4$. Checks: at -2 the output is 1; at 4 it is $6 + 4 = 10$. Assess consistent subtraction order and calculation of the initial value, not just the slope.