

Phone Plan Showdown — Teacher Guide

Grade 8 · Linear Relationships · 65 min · Consumer math

Lesson overview

Students compare phone plans using tables, graphs, and equations to determine the best value.

Common Core standards

- 8.F.B.4 — Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.
- 8.F.A.2 — Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change.
- 8.EE.C.8.c — Solve real-world and mathematical problems leading to two linear equations in two variables. For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.
- 8.EE.C.8.a — Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.

Materials

- Plan cards
- Graph paper
- Spreadsheet optional
- Calculators

Essential question

Three companies all claim to be the cheapest phone plan — and all three are telling the truth. How?

Learning target

I can model each phone plan as a linear function, compare the plans using tables, graphs and equations, find break-even points, and recommend a plan for a specific customer with evidence.

Success criteria

- I can write $y = mx + b$ for a plan from its monthly fee and per-GB rate, and say what m and b each mean in dollars.
- I can complete a cost table and graph all three plans on shared axes.
- I can find a break-even point from the graph and confirm it with the equations.
- I can recommend a plan for a customer's usage and defend it with slope, intercept and intersection evidence.

Before you teach

- Teacher prep: about 10 minutes.
- Difficulty: on-grade.
- Students should already: Write and interpret $y = mx + b$ — Why Slope Never Changes.
- Students should already: Evaluate a linear function and build its table — Streaming Growth Studio.
- Students should already: Solve a linear equation, including collecting terms — Balance the Books.

Why this matters

This is linear modeling doing its day job: every phone plan, gym membership, ride fare and utility bill is $y = mx + b$ wearing a logo, and 'which is cheapest' has no single answer — it depends on x . The break-even points are the student's first real system of equations: the intersection is the shared solution, which is next lesson's headline. And the consumer skill is genuine: companies advertise the b and hide the m , or advertise the m and hide the b , on purpose.

Vocabulary to define explicitly

Slope (per-GB rate)

The cost added for each additional gigabyte — the m in $y = mx + b$.

Example: Plan A adds \$8 per GB: its line climbs 8 for every 1 across.

Not an example: The monthly fee is not the slope — it is charged once, not per gigabyte.

y-intercept (monthly fee)

The cost at 0 GB — the b , where the line meets the y -axis.

Example: Plan C costs \$50 before a single gigabyte is used.

Not an example: The cheapest plan at 0 GB is not automatically the cheapest plan — that is the whole lesson.

Break-even point

A usage level where two plans cost exactly the same — the intersection of their lines.

Example: Plans A and B both cost \$60 at 5 GB: their lines cross at (5, 60).

Not an example: The point where one line crosses the y -axis is its intercept, not a break-even between plans.

Intersection as a shared solution

A point on both lines satisfies both equations at once — that is why crossing means equal cost.

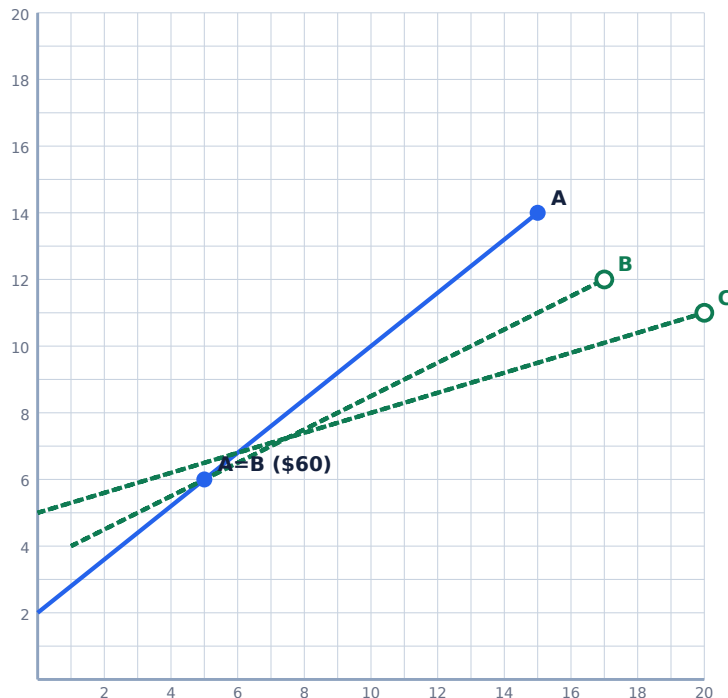
Example: (5, 60) works in $y = 8x + 20$ AND $y = 5x + 35$.

Not an example: A point on just one of the lines tells you about one plan only.

The task

Three carriers compete for the same customers. Plan A: \$20 monthly fee plus \$8 per GB. Plan B: \$35 plus \$5 per GB. Plan C: \$50 plus \$3 per GB. Your consumer-advocate team will model all three as equations, tables and graphs, find every break-even point, and then match real customers to their best plan — with evidence a skeptical customer would accept.

The three plans on one grid. Data in GB across; cost UP IN TENS of dollars (2 means \$20). A and B cross at (5, 6) — that is \$60 at 5 GB.



Cost comparison table — complete every cell in dollars.

Data used	Plan A: $8x + 20$	Plan B: $5x + 35$	Plan C: $3x + 50$
0 GB	\$20	\$35	\$50
2 GB			
5 GB			
8 GB			
10 GB			
15 GB			

Anticipated student strategies — select and sequence

Table, then picture, then algebra — concrete to exact. The $B=C$ break-even at $x = 7.5$ is chosen so the graph alone cannot settle it: the equation-solvers finish what the graph starts, which is precisely the relationship between representations the standard wants.

1. Table sweep

The student fills the cost table and watches the cheapest column change: A at 2 GB, tie at 5, B at 8, C from 10 on.

Share first — the lead changing hands inside one table is the lesson's plot twist, visible without any graph.

2. Graph and read the crossings

The student plots all three lines and reads break-evens where they cross, estimating (5, 60), (6, 68) and (7.5, 72.50).

Connect to the table: the crossing at 5 GB is the table's tie row. Graphs estimate; note that (7.5, 72.50) needs the algebra to nail.

3. Set the equations equal

The student writes $8x + 20 = 5x + 35$ and solves: $3x = 15$, $x = 5$ — the exact break-even, no graph required.

Last and loudest: this is Balance the Books aimed at two plans, and it is the doorway to systems. Have this student derive $B=C$'s $x = 7.5$ that the graph could only estimate.

Lesson script

0-5 min • Warm-up: what do the numbers mean? (We do) • MP2

Goal: Attach meanings to m and b before any computation.

Teacher says: "A company advertises a plan as $y = 6x + 25$. Without calculating anything: what might the 6 be, and what might the 25 be?"

Collect: \$6 per gigabyte, \$25 monthly fee. Ask which quantity a light user cares about, and which a heavy user cares about — the lesson's entire tension in one question.

Ask: Which number changes your bill when your usage changes — and which one never moves?

Listen for: The 6 scales with usage (slope); the 25 is fixed at any usage (intercept).

- Look for: Meanings in dollars, not letters — 'per GB' and 'flat fee' language.

If students struggle: Compute the bill at 0 GB and at 1 GB; the two numbers introduce themselves.

5-12 min • Hook: three ads, all 'cheapest' (We do) • MP3

Goal: Establish that the ads conflict and only mathematics can referee.

Show the three claims: 'Only \$20/month!' (A), 'Just \$5 per GB!' (B), 'Rates as low as \$3!' (C). Vote for the cheapest. Then the reveal: every ad quotes its best number and hides the other. The team's job is to find where each claim is actually true.

Ask: Why might a company advertise one number and bury the other?

Listen for: Each plan IS cheapest for somebody — the ad targets its own best case. Low fee attracts light users; low rate attracts heavy users.

- Look for: The vote splitting — disagreement is the fuel for the investigation.

If students struggle: None needed; the vote is the hook.

12-22 min • Mini-lesson: model Plan A completely (I do) • MP4, MP6

Goal: Model equation → table → graph for one plan, thinking aloud.

Teacher says: "Plan A: twenty dollars a month plus eight per gig. Even if I use nothing, I owe \$20 — there is my intercept. Every gigabyte adds \$8 — there is my slope. So $y = 8x + 20$, and I will plot the intercept first, then climb 8 per step."

Build A's table rows for 0, 2, 5 GB (20, 36, 60), plot (0, 20), then rise-8-run-1 to draw the line. Note the graph trick for the day: the class grid marks cost in TENS of dollars, so \$20 sits at height 2.

- Intercept first, slope second — the two-step graphing routine.
- Say units at every step: dollars, gigabytes, dollars per gigabyte.

Ask: Where will Plan B's line start compared to A's — and will it climb faster or slower?

Listen for: Higher start ($\$35 > \20) but shallower climb ($\$5 < \8): the lines must eventually cross.

- Look for: The 'must eventually cross' inference — it predicts the break-even before anyone computes it.

If students struggle: Trace both slopes with a finger from their intercepts: steeper-from-lower versus shallower-from-higher.

22-42 min • Team investigation: three plans, three representations (You do) • MP1, MP4

Goal: Teams complete the table, graph all three plans, and locate every break-even.

Teams of 3 with Plan Cards and the graphing grid. Required output: full cost table, three labeled lines, and all three break-even points — from the graph where possible, from equations where the graph is ambiguous. $B=C$ at 7.5 GB is deliberately between gridlines.

- Break-even protocol: estimate from the crossing, then set the two equations equal and solve exactly.

- $A=B: 8x + 20 = 5x + 35 \rightarrow x = 5, \60 . $A=C: x = 6, \$68$. $B=C: x = 7.5, \$72.50$.

Ask: Your lines cross at 5 GB. What is true at that exact point — say it in both plan-language and equation-language?

Listen for: Both plans cost \$60 for 5 GB; the point (5, 60) satisfies both equations at once — one point, two truths.

- Look for: Intercept-then-slope graphing, not point-by-point plotting.
- Look for: Equations set equal for the exact break-evens.
- Look for: The winner-by-region summary emerging: A, then B, then C.

If students struggle: Have the team circle the cheapest cell in each table row first — the region structure appears before any graph.

42-55 min • Customer clinic (You do) • MP3, MP4

Goal: Match real customers to plans with slope, intercept and intersection evidence.

Teams draw Customer Cards: Emma (3 GB, budget under \$60), Alex (18 GB), the Family (42 GB — off the grid, equations only), the Traveler (2 GB most months, 12 GB twice a year), the Streamer (unsure, 'somewhere around 6 to 9 GB'). Each recommendation needs a computed cost, a comparison, and one sentence a customer would understand.

Ask: The Streamer doesn't know their usage. What do you tell them that a single number can't?

Listen for: The region answer: below 5 GB take A, 5–7.5 take B, above 7.5 take C — their range straddles a break-even, so the recommendation is conditional.

- Look for: Off-grid customers handled by equations without complaint.
- Look for: The Traveler forcing a judgment: optimize for the usual month or the worst month?

If students struggle: Have the team compute the customer's cost under all three plans first, then argue — numbers before opinions.

55-62 min • Math congress: the regions (We do) • MP3

Goal: Consolidate the winner-by-region picture and the intersection meaning.

Teams post recommendations. Build the class number line of x : A's region, B's region, C's region, fenced by the three break-evens. Close the loop to the hook: all three ads were true — on their own region.

Ask: Could any plan be cheapest for EVERY usage level? What would its line have to do?

Listen for: Start lowest AND climb slowest — but then the others would never win anywhere, and in this market each line wins somewhere.

- Look for: Break-evens quoted as both a usage AND a cost — the full coordinates.

If students struggle: Rebuild the regions from the answer table's cheapest-cell circles.

62–65 min • Exit ticket (You do) • MP6

Goal: Individual evidence on a fresh plan.

Students work alone: model Plan D (\$15 plus \$7 per GB), evaluate it, interpret its slope, and compare it with Plan B at 9 GB.

Misconceptions and how to respond

“The lowest monthly fee is the cheapest plan.”

Compute all three at 10 GB: the \$20 plan costs \$100 and the \$50 plan costs \$80. The fee is one-time; the rate compounds with usage.

“The slope is the monthly fee, since it's the bigger deal.”

Evaluate at 0 GB: only b survives — that is the fee. The slope shows up exactly when usage does.

“Lines crossing means the plans have the same data usage.”

Both plans always allow any usage. Crossing means same COST at that usage: the x is the usage, the y is the shared price.

“Whichever line is on top is winning.”

Top means most expensive — this graph's y is cost. The winner is the LOWEST line in each region.

“Compare plans at one usage level and you're done.”

A wins at 2 GB, C wins at 10. A single x proves nothing global — the regions and their fences are the full answer.

Assessment plan

Formative — for feedback during the lesson

- The warm-up meanings of 6 and 25 — the m/b interpretation is the lesson's foundation stone.
- Cheapest-cell circles in the table during team work: the region structure appearing early.
- Customer clinic reasoning: costs computed under all plans BEFORE the recommendation.

Summative — the graded evidence

The exit ticket (Plan D), scored with the four-criterion rubric.

Real-world connections

- Phone and internet plans — Fee-plus-rate pricing is the industry default — and ads quoting only one of the two numbers are the norm, not the exception.
- Gym memberships — Join-fee-plus-per-visit versus pay-per-visit is the same two-line crossing; the break-even is a visit count.
- Ride fares — Base fare plus per-mile is $y = mx + b$ on wheels; comparing services is a break-even problem.
- Business break-even — Cost line versus revenue line crossing is the founding calculation of every business plan — this lesson with bigger numbers.

Observation checklist

- ☐ Identifies m and b from a verbal plan description, with units.
- ☐ Graphs intercept-first, then slope steps.

- ☐ Confirms graph crossings by setting equations equal.
- ☐ Quotes break-evens as full coordinates (usage AND cost).
- ☐ Recommends by region, not by a single point.
- ☐ Handles off-grid customers (42 GB) by equation without hesitation.

After the lesson — teacher reflection

Answer these while the lesson is fresh. They are the fastest way to improve the second time you teach it.

Which representation did teams reach for first — table, graph or equation — and did the $B=C$ crossing convert any graph-loyalists to algebra?

How did teams resolve the Traveler: usual month or worst month?

Did the 'all three ads are true' framing land in the congress?

Which customer clinic write-up would you show a real customer?

Differentiation and inclusion

Provide partially completed tables; extend with nonlinear add-ons.

- Language support: sentence stems for explaining strategy and reasoning.
- Accessibility: manipulatives, enlarged visuals, oral response options, partner reading.
- Extension: require a second solution path, change a condition, or have students write a challenge for another group.