Same Rate, Every Time

Teacher		**Class**	Grade 7
Subject	Math	**Topic**	Proportional relationships
Date		**Room**	
Lesson length	60 minutes	**Country**	United States

Students learn to recognize proportional relationships by testing ratios. They build the same relationship as a table, graph, and equation.

Curriculum links

- Recognize and represent proportional relationships between quantities. (Determine when two quantities are in a proportional relationship.) [2]
- Identify and/or compute the constant of proportionality (unit rate). [2]
- Recognize that the graph of any proportional relationship will pass through the origin. [2]

Learning objectives

- Students will recognize proportional relationships by testing for equivalent ratios in tables and graphs.
- Students will represent the same proportional relationship as a table, graph, and equation y = kx.
- Students will identify the constant of proportionality and explain points (0,0) and (1,r).

Success criteria

- I can test ratios to decide if two quantities are proportional.
- I can make a table, graph, and equation for the same proportional relationship.
- I can find k and explain what (0,0) and (1,r) mean.

What students already know

Ask: If 2 notebooks cost $4.00, what should 4 notebooks cost if the rate stays the same? Listen for $8.00 and doubling both quantities.

Key words

proportional relationship	two amounts that grow together while keeping the same ratio [12]
constant of proportionality	the single number k you multiply x by to get y in y = k x [11]
unit rate	how much of the second amount matches one of the first amount [6]
origin	the starting point (0,0) on a coordinate grid where every proportional graph begins [3]

Materials

- projected slides 1-12
- video clip 1 on slide 6 and video clip 2 on slide 8
- large paper, rulers, colored pencils
- half-filled organizer with verbal description and first table row
- mini whiteboards and markers
- Worksheet Task C handouts

Before the lesson

- Print Worksheet Task C for each pair and half-filled organizers for support
- Test slide 6 video clip 1 (0:00–3:49) and slide 8 video clip 2 (0:00–5:00) with sound
- Set out large paper, rulers, and colored pencils for pairs
- Draw example table and axes for $2.00 per notebook on the board

Lesson outline

0–5 min **Starter** 5 min · Whole class

Activate ideas about same-rate relationships and set up the poster challenge.

YOU DO

1. Show Slide 1 title and Slide 2 objectives and read them aloud.
2. Use the hook: Can you show the same math four different ways on one page so clearly that another student could learn it from your poster?
3. Show Slide 5 vote and take a quick show of hands for cooking, sports, shopping, travel.
4. Link answers to today: we will test if the rate really stays the same.

STUDENTS DO

1. Vote on Slide 5 and give a quick example, like price per item.
2. Repeat the poster goal to a partner.

Say: Today we hunt for relationships where the rate never changes. You will make a poster that shows the same proportional example as a description, table, equation, and graph. First, where do you already see same-rate math in life?

Ask: Where do you notice same-rate relationships most? (Shopping and prices, recipes, speed, travel distance.) · If doubling one thing doubles the other, what does that suggest? (The ratio stays the same, so it might be proportional.)

Check understanding: Thumbs up if doubling one thing doubles the other sounds proportional. If unsure, give the notebook example: 1 for $2.00, 2 for $4.00.

Support: Offer sentence starter: I see the same rate when ___ costs ___. **Stretch:** Ask for a quick non-example where doubling would not double the other.

Use: Slides 1-2, Slide 5

5–15 min **Teaching** 10 min · Whole class

Teach three checks for proportional relationships in tables and graphs.

YOU DO

1. Show Slide 3 steps: divide y by x, check if answer stays same, check graph is straight through (0,0).
2. Show Slide 4 cards for table, graph, and equation.
3. Play video clip 1 on Slide 6 (0:00–3:49) to model equivalent ratios and line through origin.
4. Model worked example with $2.00 per notebook on the board.

STUDENTS DO

1. Copy the 3 checks and the $2.00 example.
2. Signal thumbs up when they hear unit rate in the video.

Say: To decide if two quantities are in a proportional relationship, test for equivalent ratios in a table [3]. Divide y by x for each pair. If you get the same number every time and the graph is a straight line through (0,0), it is proportional [17].

Worked example: Table: 1 notebook costs $2.00, 2 cost $4.00, 3 cost $6.00. Divide: 2/1=2, 4/2=2, 6/3=2. Same result every time, so proportional [17]. Equation is y = 2x, where 2 is dollars per notebook. Graph points (0,0), (1,2), (2,4), (3,6) make a straight line through the origin [16].

Ask: How do we test a table for proportional? (Divide y by x for each row; if every division gives the same result it is proportional [17].) · What must the graph look like? (Points make a straight line that passes through the origin (0,0) [17].)

Check understanding: Mini whiteboards: table x: 1,2,3 and y: 3,6,9 proportional? Hold up yes with k=3. Reteach dividing y by x if many say no.

Support: Give a table where first two y divided by x divisions are already filled in, so students only check last two rows [4]. **Stretch:** Add a table with 1/2 pound for $1.50 and ask for the unit rate with fractions.

Use: Slides 3-4, Slide 6 Video clip 1 (0:00–3:49)

15–25 min **Teaching** 10 min · Whole class

Connect tables to equations y = kx and meaning of (0,0) and (1,r).

YOU DO

1. Show Slide 7 key words and define constant of proportionality and unit rate.
2. Play video clip 2 on Slide 8 (0:00–5:00) on writing y = kx.
3. Model finding k by dividing y by x and labeling (1,r) on graph.
4. Contrast with y = 2x + 5 which is not proportional because of the extra +5 [11].

STUDENTS DO

1. Write y = 2x and label k, (0,0), and (1,2) on their own sketch.
2. Write in words what (0,0) and (1,2) mean for price.

Say: Every proportional relationship can be written as y = k x, where k is the fixed number that links them [11]. In proportional relationships, the unit rate is the slope of the line [6]. Point (1,r) shows the unit rate, and (0,0) shows zero gives zero. Explain what a point (x,y) means, with special attention to (0,0) and (1,r) where r is the unit rate [3].

Worked example: Apples: 5 apples cost $10.00, so $10.00 divided by 5 is $2.00 per apple [11]. k = 2, equation y = 2x. Plot (0,0), (1,2), (5,10). (0,0) means 0 apples cost $0.00. (1,2) means 1 apple costs $2.00, the unit rate. A line like y = 3x + 2 is straight but not proportional because when x = 0, y = 2 instead of 0 [17].

Ask: If you buy zero pounds of apples, what do you pay, and where must the graph start? ($0.00, so every proportional price graph starts at (0,0).) · What does (1,2) tell us in the apple example? (1 apple costs $2.00, which is the unit rate and k in y = 2x.)

Check understanding: Exit-style cold call: why is y = 2x + 5 not proportional? Listen for extra +5 breaks constant ratio and line misses origin. Show both graphs side by side if confused [14].

Support: Provide sentence frames: At 0 pounds the cost is 0 dollars because ___ . At 1 apple the cost is ___ dollars, which is the unit rate. **Stretch:** Ask what would happen to (0,0) with a $5.00 delivery fee and why that would no longer be proportional.

Use: Slides 7-8, Slide 8 Video clip 2 (0:00–5:00)

25–50 min **Main activity** 25 min · Pairs

Pairs represent one proportional rate four ways on a poster.

YOU DO

1. Show Slide 9 task and assign each pair a rate like $2.00 per notebook or 60 miles in 1 hour and 120 miles in 2 hours [11].
2. Hand out large paper, rulers, colored pencils, and Worksheet Task C to structure table to equation work.
3. Circulate, check y divided by x is constant, graph is straight through (0,0), equation is y = kx with (1,r) labeled.
4. Stop at 20 minutes for 2 pairs to share how they highlighted k in same color across representations [15].

STUDENTS DO

1. Build table with at least 4 equivalent pairs, find k, write y = kx.
2. Draw graph with ruler through (0,0), label (1,r), highlight k in same color everywhere.

Say: Build one proportional example together. Make a table where y divided by x is constant, graph it as a straight line through (0,0) [3], and write y = k x [11]. Highlight the constant in the same color in the table, equation, and graph so the link is clear [15]. Use equivalent ratios by scaling in tandem to extend the table [4].

Worked example: Rate: 60 miles per hour. Table: (1,60), (2,120), (3,180). Check: 60/1=60, 120/2=60, 180/3=60. k=60, equation y = 60x. Graph is straight through (0,0). (1,60) is the unit rate: 1 hour goes 60 miles.

Ask: How do you know your table is proportional? (Each y divided by x gives the same number, like x=1,y=3; x=2,y=6; x=3,y=9 gives 3 every time [17].) · Where do I see k on your poster? (In table as y divided by x, in equation as coefficient of x, on graph at (1,r) [17].)

Check understanding: Teacher checks each poster for same y/x, line through origin, and y=kx. If graph misses origin, prompt to add (0,0) and recheck.

Support: Give a half-filled organizer with the verbal description and first table row done, so students only extend the pattern by scaling in tandem [4]. **Stretch:** Add a price in cents per ounce with a decimal constant like y = 2.5x and graph it accurately.

Use: Slide 9, Worksheet Task C

50–60 min **Plenary** 10 min · Whole class

Check recognition of proportional vs. not and confirm key ideas.

YOU DO

1. Show Slide 10 compare chart and have pairs sort y=3x vs y=3x+2 as proportional or not.
2. Show Slide 11 mystery: stand charges $3.00 for 2 cups, $6.00 for 4 cups. Ask cost for 6 cups.
3. Run Slide 12 quick quiz on whiteboards and collect as exit check.
4. Return to Slide 2 success lines and have students self-rate.

STUDENTS DO

1. Sort examples and hold up proportional or not with reason.
2. Answer quiz and self-rate I can statements.

Say: Proportional needs all three: ratio y divided by x stays same, graph is straight through (0,0), equation is y = k x with no extra [17]. Use that to judge each case and defend your choice with one reason like same y divided by x or line through (0,0) [3].

Worked example: Mystery: $3.00 for 2 cups gives $1.50 per cup. $6.00 for 4 cups also $1.50 per cup. Same rate every time, so 6 cups cost $9.00. Table 1,3; 2,6; 3,9 gives k=3, y=3x. Graph straight but crossing y at 2 is not proportional because it must go through origin.

Ask: Table x:1,2,3 y:3,6,9. Proportional? What is k? (Yes. 3/1=3, 6/2=3, 9/3=3, so y = 3x.) · Graph is straight but crosses y at 2. Proportional? (No. Must be straight and pass through (0,0).)

Check understanding: Whiteboard quiz for all; if >1/3 miss origin rule, redraw y=2x vs y=2x+5 through (0,0) vs (0,5) quickly.

Support: Mark the origin (0,0) in color on every graph so students check if line goes through it [2]. **Stretch:** Include tricky y = 2x + 5 and ask why the extra +5 breaks the constant ratio.

Use: Slides 10-12

Common mistakes

Mistake	How to spot it	How to fix it
Thinking any straight line is proportional	Student calls y = 3x + 2 proportional because it goes up steadily	Check (0,0): when x=0, y=2 not 0, so line misses origin and ratio y/x is not constant [17].
Thinking y = 2x + 5 is proportional because both numbers increase	Student A says it is proportional, Student B says not	Rewrite as y = kx with no extra; +5 breaks the form y = kx, so divide y by x to show ratios differ [11].
Finding k from one row only without checking all rows	Student divides once and stops, missing non-equivalent ratios	Divide y by x for every row; scaling in tandem must give equivalent ratios every time [4].

Support

- Give half-filled organizer with verbal description and first table row done to extend by scaling
- Pre-fill first two y divided by x steps and mark (0,0) in color to check origin
- Provide sentence frames for explaining (0,0) and (1,r) as unit rate

Stretch

- Add fractional table like 1/2 pound for $1.50 to find unit rate with fractions
- Add decimal constant like y = 2.5x with accurate graphing and steeper-slope comparison
- Create an almost-proportional mistake equation for a partner to find and fix

For the LSE or teaching assistant

Stay with target pairs in main activity; prompt divide y by x each row, check line includes (0,0), point to highlighted k across table, equation, graph.

Check for understanding

Question	Answer
Table x 2,4,6 and y $3.00,$6.00,$9.00. Proportional? What is k and equation?	$1.50 per unit; y = 1.5x
Equation y = 4x + 1. Proportional? Why?	No, extra +1 means not y = kx and graph misses (0,0).

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What do (0,0) and (1,60) mean if y = 60x for miles per hour?	(0,0) 0 hours 0 miles; (1,60) 1 hour 60 miles, the unit rate.

Homework

Find one home price example, test y divided by x, and write if proportional with k.

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