Linear Relationships: Tables, Equations, and Graphs

Summary

Model real world linear data using tables, graphs, rules and expressions

Main Core Tie

Mathematics Grade 8

Strand: FUNCTIONS (8.F) Standard 8.F.5

Additional Core Ties

Mathematics Grade 8

Strand: FUNCTIONS (8.F) Standard 8.F.4

Materials

Ti-73's
Transparency: Types of Graphs for starter
Graphing calculator and TI Viewscreen
Centimeter Cubes, Color Tiles, Pattern Blocks
Worksheets: It All Depends On…, Linear Relations Using Tables, Equations and graphs, Painted Towers, Polygon Trains, Square Patio
Journal Page: Representing Linear Relationships

- Equations Cards
  A deck of playing cards for each pair of students

Background for Teachers

Enduring Understanding (Big Ideas):
Linear relationships
Essential Questions:

Where can situations when the value of one variable depends on the value of another be found in real life?
How can a graph, a table, an ordered pair, or an algebraic rule help you describe the relationship between two variables?
How can I represent an equation using ordered pairs? How is graphing a linear equation from ordered pairs similar to graphing a linear equation using a table?
How can I recognize an equation that will produce a linear graph?

Skill Focus:
Creating tables, graphs and equations to model linear data
Vocabulary Focus:
Relationship, function, independent variable, dependent variable, linear relationship, linear function, linear graph, x-axis, y-axis, ordered pairs
Ways to Gain/Maintain Attention (Primacy):
Writing, cooperative learning, stories, comparing-categorizing, music, manipulatives, game

Instructional Procedures

Starter:
Put the attached page with types of graphs on the overhead. Help students read the graph by identifying the x and y axis lines. This will help them focus on what type of graph they are looking at. Have students write a rule for each column. Discuss.

Lesson Segment 1: Where can situations where the value of one variable depends on the value of another be found in real life? How does changing the value of the independent variable affect the value of the dependent variable?

Discuss the concept of relationships using the It All Depends On… worksheet. Have students suggest how changing the independent variable will affect the independent variable. To get the student moving a bit, you may want to have them do Mix-Freeze-Pair to write the last four statements.

Have students write examples in the first two lines of the Journal Page

Lesson Segment 2: How can a graph, table, or equation help you represent or describe a linear relationship?

A graph can show us the relationship between two variables. The starter showed some graphs that represent relationships. In this lesson, we will focus only on relationships whose graphs are straight lines like those in the left column of the Starter. We call those linear relationships because the graph of the relation creates a line.

On the graphing calculator, set the window so it looks like this. Type each of these equations into the graphing calculator and display them one at a time. Have students sketch these as examples to complete the Frayer model on the journal page. Have them show the A, B, C and D, since you will be referring to these.

$y = x$
$y = x + 1$
$y = 1/2x$
$y = - x$

As you type in each equation, graph it and use the trace Key to find six ordered pairs on the line. Then, use the table to view many ordered pairs from that linear graph.

A table can help us identify linear relationships. After students have sketched the examples of linear graphs, have them copy six values from the table into the corresponding tables on the journal page. The values in the table will indicate a linear relationship IF the ratios of the change in the y values over the change in the x values between ordered pair is equivalent or proportional.

Have students find the ratio for the change in Y/change in X values for the six ordered pairs in the table. Discuss whether the change for each table produces equivalent ratios. Have student write 5 proportions from the table. For example:

X	Y
-1	-1
0	0
1	1
2	2
3	3
4	4

ratios for change in y/change in x
y = x

1/1= 1/1
2/2 = 2/2
3/3 = 3/3
4/4 = 4/4
5/5 = 5/5

Writing Equations (algebraic rules)

An equation (algebraic rule) can help us identify linear relationships. Show students that in order to graph those linear relationships, you had to type an algebraic rule or an equation into the graphing calculator for each. Show the equations in Y=. Have the students write the equations on bottom of the journal page. Do this for B, C, and D. Point out that all four equations have a y and x (dependent and independent) variable, and that there are no exponents in the expression. Ask students in each small group to look at the equation for graph A and think about how the equation describes how y relates to x. After discussion an equation (rule), have the students choose a number for X and together use the equation to find Y without looking at the table on the calculator. Choose two or three numbers for x they did not use in their tables on the journal page.

Cooperative Sharing Game-Red Rover: Practice using the equation to find values for Y by playing Red Rover where teams choose a person to come to their team to explain the rule and show how the

new ordered pair was created by using that rule. In Red Rover, students work with their own team for a minute. Then, each team calls a person from another team to come over to their table to sit down and explain what was done. If the Rover explains correctly, the Rover's team earns two points. If not, the team they visit earns the 2 points.

Lesson Segment 3: How can a graph, a table, an equation or ordered pairs help you describe the relationship between two variables? How is graphing a linear equation from ordered pairs similar to graphing a linear equation using a table?

Use the following TI-73 activity to work with the students to write an equation for the relationship for x and y using a table to identify the pattern, and then graph that relation.

Using Table Set/Ask Feature to Write Equations

To find patterns leading to the writing of equations, type an equation in . Select and set the dependent and independent variables to Aask@. Select and type a value in the X column. (Use numbers like -1, 0, 1, 1.5, 2…Tell students you have performed an operation on that number (x) to get a result (y). Place the curser in the Y column and push . Discuss what operation(s) might have been performed on X to get Y. Have students predict what they think the rule might be, and write that as an equation. Tell students you will try their prediction on another value for X. If their prediction IS the correct equation, the value for Y will be the result. Type another value in the X column and push in the corresponding position in the Y column. Ask students if the same operation(s) they discussed was used on this new value for X to get the resulting value in the Y column. If not, tell them you want them to find an operation(s) that could be used for both the first and second X values you showed them to get the resulting Y values. Have them develop a "rule". Write their rule as an equation. To check their rule, type a third value in the X column. Ask them to perform their rule on that value. Then press for the corresponding value in the Y column and see if they got the same result.

Enter two or three more values in the X column. Have students copy the table, write the equation and graph the ordered pairs on the *Linear Relations Using Tables, Equations and Graphs* worksheet. You may choose not to press for the remaining Y values asking students to substitute the given value for X and find the value for the Y column. Note: You will need to discuss the minimum and maximum values to be shown for the x and y-axes, so their calculator graphs will look like the graphs on their worksheets.

Some possible linear equations you may wish to try might be:

y = x + 1
y = 2x
y = x -- 4,
y = 2 x or y = x/2
y = 2x + 1
y = ½ x + 1

Manipulatives:

Help students work with manipulatives to represent real-world linear relationships using ordered pairs from tables, equations, and graphs. Use *Painted Towers, Polygon Trains, and Square Patio* worksheets

Ordered Pairs as solutions to an equation:

Ordered pairs can be solutions for an equation. Review with students that the values in a table represent the solutions to an equation. In the activities done to this point the value for x has been given to the students. For example, in Painted Towers, we used x to represent the number of cubes, and the table gave us values for x. In Polygon Trains, we used Pattern Blocks to model values for x, the number of cars in the train.

Q. Think-Team-Share: Which variable in an ordered pair (x, y) did we decide would be independent (see It All Depends On…)? *Independent* means we get to *choose*. So, if the value for x is not provided, we can choose a value, substitute the value in an equation, and solve for the corresponding

value of y that "depends" on x.
Model the following equations having the class choose values for x and working together to solve for y. Then, type the equation in the TI-73 and look in the table for the values they chose. Set up a "friendly" window, so students can trace the line and see their values. To do this set the window as follows: x-min=-28.2, x-max = 28.2, xscl = 2, y-min=-18.9, y-max=18.9, yscl=2
a) y = 3x + 1
b) 3x + y = 20
Game-Team Challenge: Each team is given an equation card (attached). The team must find three ordered pair solutions for their equation. Then each team takes a turn challenging the class to find an ordered pair that would be a solution to the equation. Have a team use the Smart Pal to show the equation and their three solutions. They can put the Smart Pal on the overhead projector to do this. Students should be given a minute to work with their team to find another solution. Then the challenging team selects a student to tell the class the solution they have found and to explain how they did it. If correct, the responder's team gets a little treat or points and another team then challenges the class.
Game-Finding Y War: Post these three equations on the board.

a) y = 2x
y = -2x
y = 2x + 6

Give each pair of students a deck of cards. Red cards indicate negative integers. Black cards are positive integers. In a turn, each player chooses a card from the top of the deck. This card represents x. The player then chooses any one of the three equations to substitute x in and to find the value for y. The player must record on paper the equation and the ordered pair solution for each turn. The player whose y value is the greatest keeps both theirs and their opponent's card and the game proceeds for a given time limit. At the end of the time, the player who has kept the most cards wins.
Practice: Use the Practice Writing Equations From Tables worksheet. Have the student write the equation that represents the relationship between x and y and have them find two more ordered pairs that could be solutions to the equation, or select a few word problems relating to a linear relationship from a text where tables, graphs, equations and ordered pair solutions for linear relationships can be practiced. (McDougall Littell Pre-Algebra p. 151 #22, p.152 # 23, #32c, p. 163 #19a)
Lesson Segment 4: Closure
Do Three-Step-Interview to have students express their answers to the essential questions of this lesson. Have students write the answers to the essential questions on the back of the Frayer Model page for their journals.

Assessment Plan

Discussion, performance task, observation

Bibliography

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