



SAN DIEGO CITY SCHOOLS

Department of Mathematics

Instructional Module to Enhance the Teaching of

**PRENTICE HALL PRE-ALGEBRA
California Edition 2001**

GRADE 7

Module 8

**Linear Functions and
Graphing**

KEY MATHEMATICAL CONCEPTS FOR GRADE SEVEN

THE BIG IDEAS:

By the end of grade seven, students will:

- Know the properties of, and compute with, rational numbers by manipulating numbers and equations. Know and use different representations of fractional numbers (fractions, decimals, and percents) and are proficient at changing from one to another. Understand and use factoring of numerators and denominators and properties of exponents.
Note: Negative fractions are formally introduced and studied for the first time.
- Increase their facility with ratio and proportion, compute percents of increase and decrease, and compute simple and compound interest.
- **Graph linear functions and understand the idea of slope and its relation to ratio. Solve simple linear equations and inequalities over the rational numbers.**
- Know the Pythagorean Theorem and solve problems in which they compute the length of an unknown side.
Note: The Pythagorean Theorem is probably the first true theorem that the students will have seen.
- Know how to compute the surface area and volume of basic three-dimensional objects and understand how area and volume change with a change in scale.
- Make conversions between different units of measurement. Know and use various forms of displays for data sets.

(Notes from Mathematics Framework for California Public Schools, Grade Seven, p149-152.)

Key Mathematical Concepts Addressed: Chapter 8, Linear Functions and Graphing

- AF 1.1 Write linear equations
- AF 1.5 Graph equations with two variables; graph linear inequalities
- ***AF 3.3 Graph linear functions; use slope and y-intercept to graph linear functions**
- ***AF 3.4 Plot values of quantities whose ratios are always the same in order to understand slope**
- ***NS 1.7 Write function rule to find commission**
- SDAP 1.2 Represent two variables using a scatter plot; use scatter plots to find trend lines and equations for trend lines

*** Key Standard**

MODULE 8: LINEAR FUNCTIONS & GRAPHING

DAY 1: LESSON 8 – 1A; pp. 384-385

LESSON FOCUS:	Relating Graphs to Events (Graphs from this lesson may be used each day in place of the suggested Warm Up/Routine.)
CA STANDARD:	AF 1.5
Purpose of Lesson:	At the end of the lesson, students will be able to use graphs to show real world relationships visually.
Warm-up/ Routine(s):	Number Sense: Find three consecutive numbers whose sum equals 228. With your partner, write an equation & solve. (Answer: 75, 76, 77) Be prepared to share your solution & your thinking about the problem.
LAUNCH: Appendix	Whole Class: Use overheads of graphs 1-3, located in Appendix. Show graph #1, <u>Distance Traveled</u> . Have students talk to one another to determine what the graph might be saying. Students share out how the graph might be labeled & what information it may be providing. Repeat with graphs 2 & 3.
EXPLORE:	Duplicate copies (1 per partnership or small group) of graph #4, <u>Water Level in Bathtub</u> & blank graph. Students label graph #4 & write a short description of what this graph is saying. They next design their own graph. Label & give brief written description. Share out results.
Practice:	p. 385, #4, Critical Thinking
SUMMARIZE:	Students share out from Exploration.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	p. 385, #5-9; choose two to sketch, label & give a brief description of what each graph is saying.

MODULE 8: LINEAR FUNCTIONS & GRAPHING

DAY 2: LESSON 8 – 1 & 2; pp. 386-395

LESSON FOCUS:	Build tables from real life situations - identify relations & functions.																														
CA STANDARD:	AF 1.5, AF 3.3, 3.4 Key Standards MR 2.3																														
Purpose of Lesson:	At the end of the lesson, students will be able to begin identifying relations & functions -build tables from real life situations - graph linear equations.																														
Warm-up/ Routine(s):	Number Sense: Refer to Routine/WarmUp Bank OR have students share one or two homework graphing results.																														
LAUNCH: <u>Vocab:</u> relation, domain, range, function CPM FFA 2 Chapter 9 Reference	<p>"There are a number of high school friends who are all interested in going to college. They work whenever they can at the Sports Arena parking cars, taking tickets, working in the concession stands, etc. Their families cannot afford tuition costs so they put away a portion of whatever they earn in a college fund. They are worried about whether they will be able to save enough. Over the next few days, we'll be investigating some problems that deal with their efforts."</p> <p>On overhead, share the following table with students:</p> <table style="margin-left: 40px; border-collapse: collapse;"> <tr> <td style="border-bottom: 1px solid black; padding: 2px 10px;">x</td> <td style="padding: 2px 10px;">-1</td> <td style="padding: 2px 10px;">0</td> <td style="padding: 2px 10px;">1</td> <td style="padding: 2px 10px;">2</td> <td style="padding: 2px 10px;">3</td> <td style="padding: 2px 10px;">4</td> <td style="padding: 2px 10px;">5</td> <td style="border-bottom: 1px solid black; padding: 2px 10px;">x</td> </tr> <tr> <td style="padding: 2px 10px;">y</td> <td style="padding: 2px 10px;">4</td> <td style="padding: 2px 10px;">1</td> <td style="padding: 2px 10px;">-2</td> <td style="padding: 2px 10px;">-5</td> <td></td> <td></td> <td></td> <td></td> </tr> </table> <p>Together, complete the table & determine a rule. <i>Can anyone decide from the table if graphing this will result in a line or a curve? Why do you think so?</i> Graph together. Describe the direction of the graph as it goes from left to right.</p>	x	-1	0	1	2	3	4	5	x	y	4	1	-2	-5																
x	-1	0	1	2	3	4	5	x																							
y	4	1	-2	-5																											
EXPLORE: CPM FFA 2 Chapter 9 Reference	<p>Kristie, Isabelle, Connie & Julie work part-time in one of the concession stands at the arena. One Saturday, each girl earned \$15. Over the next week:</p> <p style="margin-left: 40px;">a) Kristie saves an additional @\$2.50 per day. b) Isabelle saves an additional \$1.50 per day.</p> <p>Construct a table like the one below. Let x represent the days & y the cash on hand. Day 0 is Saturday.</p> <table style="margin-left: 40px; border-collapse: collapse;"> <tr> <td style="border-bottom: 1px solid black; padding: 2px 10px;">Day (x)</td> <td style="padding: 2px 10px;">0</td> <td style="padding: 2px 10px;">1</td> <td style="padding: 2px 10px;">2</td> <td style="padding: 2px 10px;">3</td> <td style="padding: 2px 10px;">4</td> <td style="padding: 2px 10px;">5</td> <td style="padding: 2px 10px;">6</td> <td style="padding: 2px 10px;">7</td> <td style="border-bottom: 1px solid black; padding: 2px 10px;">x</td> </tr> <tr> <td style="padding: 2px 10px;">Kristie</td> <td style="padding: 2px 10px;">\$15</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td style="padding: 2px 10px;">Isabelle</td> <td style="padding: 2px 10px;">\$15</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table> <p><i>How much money will each girl have on the following Saturday (day 7)?</i> Write an equation for each girl's situation that shows how much money she will have on any given day.</p>	Day (x)	0	1	2	3	4	5	6	7	x	Kristie	\$15									Isabelle	\$15								
Day (x)	0	1	2	3	4	5	6	7	x																						
Kristie	\$15																														
Isabelle	\$15																														
Practice:	c) Connie spends \$2 per day. Add her data to the table. Find her total on day 7 & write an equation.																														
SUMMARIZE:	Partner Talk/Write: Looking at our data, have we any functions represented? Why or why not? Share out with class.																														
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.																														
Homework:	d) Julie neither spends nor saves any additional money. Add Julie's data to the table.																														

MODULE 8: LINEAR FUNCTIONS & GRAPHING

DAY 3: LESSON 8 – 1 & 2; pp. 386-395

LESSON FOCUS:	Graph equations with one & two variables. Finding solutions.
CA STANDARD:	AF 1.5, AF 3.3, 3.4 Key Standards MR 2.3
Purpose of Lesson:	At the end of the lesson, students will be able to determine if a set of ordered pairs is or is not a solution for an equation - write equations from a data table, graph linear equations, compare & interpret graphs.
Warm-up/ Routine(s):	<i>Is each ordered pair a solution of $4x - 3y = 6$?</i> 1. (3,2) <i>yes</i> 2. (-3, -2) <i>no</i> 3. (0,2) <i>no</i> 4. (1.5,0) <i>yes</i> 5. (2,0) <i>no</i>
LAUNCH: CPM FFA 2 Chapter 9 Reference	Complete table from day 2 Exploration on chart paper with class. Have table groups discuss equations that were written for each girl. Share out as a class.
EXPLORE: CPM FFA 2 Chapter 9 Reference *Builds upon results found Day 2.	In partnerships or in small groups: create a graph to compare the four girls' financial situations - use large chart graph paper if available. <ol style="list-style-type: none"> a) On same set of axes, graph the cash on hand for each girl. Use a different color for each girl. Label each graph with the girl's name & equation. b) <i>What is similar about the four graphs?</i> c) Compare graphs for Krisitie & Isabelle. Describe direction of the graph for both girls. d) Compare Connie's graph to Krisitie's & Isabelle's. Describe. e) Compare Julie's with the others. Describe what you see.
Practice:	<i>If this trend continued for an additional week, what would each girl's situation be by day 14?</i>
SUMMARIZE:	Share charts as a class. Look for similarities/differences. Encourage students to use mathematical languages in describing their findings. & representations of the problem situations.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework: CPM FFA 2 Chapter 9 Reference	The girls have another friend, Maleya, who doesn't work with them at the arena (She did not make \$15 on Saturday.). She has been able to save \$2.50 per day since Sunday by babysitting. Construct a table for Mayela & graph her data. Compare to Kristie's graph. Will Mayela & Kristie ever have the same amount of money at the same time? Explain your answer.

MODULE 8: LINEAR FUNCTIONS & GRAPHING

DAY 4: LESSON 8 – 3; pp. 397- 408

LESSON FOCUS:	Solve equations with two variables - Find & identify rate of change from a data table. Describe direction & steepness of lines.																
CA STANDARD:	AF 1.5, AF 3.3, 3.4 Key Standards MR 2.3																
Purpose of Lesson:	At the end of the lesson, students will be able to describe lines that show positive/negative rate of change - extend tables with two variables & graph results.																
Warm-up/ Routine(s):	TE p. 391, Transparency, Daily Skills Warm Up, 8-2, # 1-3																
LAUNCH:	Share findings from homework with table group. Answer the following: <i>When will Mayela have more money than Connie? More than Julie? Will she ever have more money than Isabelle? How can you tell?</i>																
EXPLORE: CPM FFA 2 Chapter 9 Reference	<p>Mr. Drawsalot is the landscape architect for the new museum near the sports arena. He was asked to draw a picture of what the front of the building will look like five years after it is finished including the row of trees across the front. The trees will be three feet tall when planted & in his drawing, the trees are 13 feet tall.</p> <p>Assuming the trees grow the same amount each year, complete the table. Let $x = 0$ be the year the trees are planted.</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="border-bottom: 1px solid black;">Year (x)</td> <td style="border-bottom: 1px solid black;">0</td> <td style="border-bottom: 1px solid black;">1</td> <td style="border-bottom: 1px solid black;">2</td> <td style="border-bottom: 1px solid black;">3</td> <td style="border-bottom: 1px solid black;">4</td> <td style="border-bottom: 1px solid black;">5</td> <td style="border-bottom: 1px solid black;">x</td> </tr> <tr> <td style="border-bottom: 1px solid black;">Height (y)</td> <td style="border-bottom: 1px solid black;">3</td> <td></td> <td></td> <td></td> <td></td> <td style="border-bottom: 1px solid black;">13</td> <td></td> </tr> </table> <p>Graph the data from your table. Label it with its equation. What is the change in time from one x value to the next? The change in height from one y value to the next?</p>	Year (x)	0	1	2	3	4	5	x	Height (y)	3					13	
Year (x)	0	1	2	3	4	5	x										
Height (y)	3					13											
Practice:	<i>What part of the equation shows the rate of change? What ratio describes the growth rate of the trees?</i>																
SUMMARIZE:	Quickwrite: What is meant by the term "rate of change"? Give an example. Share at table & as class.																
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.																
Homework: CPM FFA 2 Chapter 9 Reference	<ul style="list-style-type: none"> ▪ Add year 10 and 20 to your data table. ▪ <i>What is the change in height from year 5 to 10? 10 feet</i> ▪ Write the rate of change (five year growth rate) as a ratio with units. ▪ <i>If the bottom of the sign for the museum is 35 feet above the ground, how many years will it take for the trees to reach the sign? 16 yrs.</i> ▪ <i>If the sign is 12 feet tall, in how many years will the trees block it? 22</i> 																

MODULE 8: LINEAR FUNCTIONS & GRAPHING

DAY 5: LESSON 8 – 2-3; pp. 391-408

LESSON FOCUS:	Solve equations with two variables - Find & identify rate of change from a data table.																				
CA STANDARD:	AF 1.5, AF 3.3, 3.4 - Key standards MR 2.3																				
Purpose of Lesson:	At the end of the lesson, students will be able to find/identify rate of change from a data table. Conjecture that rate of change is the same between any two points on the same line.																				
Warm-up/ Routine(s):	TE p. 391, Transparency, Daily Skills Warm Up, 8-2, # 4 & 5																				
LAUNCH: CPM FFA 2 Chapter 9 Reference	Sherice works in one of the concession stands. She fills lemonade cups at a rate of four per minute. <i>How many cups can she fill in 6 minutes? In 10 minutes?</i>																				
EXPLORE: CPM FFA 2 Chapter 9 Reference	If Sherice fills c cups in t minutes, write an equation that relates c and t . Draw a graph to show the relationship between time & the number of cups filled. <i>Which value is on the horizontal axis?</i> <i>Which value is on the vertical axis?</i> Label your graph.																				
Practice:	You are given two values in the following table. Assuming that the rate of change is constant, complete the table. <table style="margin-left: 20px; border-collapse: collapse;"> <tr> <td style="border-bottom: 1px solid black; padding: 2px 10px;">x</td> <td style="padding: 2px 10px;">-6</td> <td style="padding: 2px 10px;">-3</td> <td style="padding: 2px 10px;">0</td> <td style="padding: 2px 10px;">3</td> <td style="padding: 2px 10px;">6</td> <td style="padding: 2px 10px;">9</td> <td style="padding: 2px 10px;">12</td> <td style="padding: 2px 10px;">15</td> <td style="border-bottom: 1px solid black; padding: 2px 10px;">x</td> </tr> <tr> <td style="padding: 2px 10px;">y</td> <td></td> <td></td> <td style="padding: 2px 10px;">2</td> <td style="padding: 2px 10px;">0</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>	x	-6	-3	0	3	6	9	12	15	x	y			2	0					
x	-6	-3	0	3	6	9	12	15	x												
y			2	0																	
SUMMARIZE:	Class discussion: Have students create a list of other "real life" instances when they might encounter problems/situations that deal with "rate of change".																				
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.																				
Homework:	Complete the practice table. Graph the relationship in the table. Describe the direction of the line. <i>(How could you tell from the table if the graph would be a line or a curve?)</i> Calculate the rate of change between $x=0$ and $x=3$. Use the formula: rate of change = $\frac{\text{change in } y\text{-values}}{\text{change in } x\text{-values}}$																				

MODULE 8: LINEAR FUNCTIONS & GRAPHING

DAY 6: LESSON 8 – 3; pp. 397- 402

LESSON FOCUS:	Using slope and y-intercept to graph linear functions. Plot values of quantities whose ratios are always the same in order to understand slope.
CA STANDARD:	AF 3.3, AF 3.4 - Key standards
Purpose of Lesson:	At the end of the lesson, students will be able to find the slope of a line & use slope-intercept form in graphing a linear equation.
Warm-up/ Routine(s):	TE p. 397, Daily Skills Warm-Up, (writing ratios in simplest form) #5-8.
LAUNCH: p. 397	<p>You can calculate the slope of a line using the same methods you used to find the rate of change.</p> <p>Part 1: Finding the Slope of a Line: slope = $\frac{\text{vertical change}}{\text{horizontal change}} = \frac{\text{rise}}{\text{run}}$</p> <p>Use Examples 1a & 1b as examples of finding slope.</p> <p>Do TRY THIS, #2, together as a class.</p> <p>Note: The place where the line crosses the y axis is called the y-intercept.</p>
EXPLORE: Reference p. 398, Try This, #5 & 6	<p>Graph the following and find the slope of the line:</p> <p>1) inches to feet (or feet to yard)</p> <p>2) minutes of phone call at a cost of 5 cents a minute</p> <p><i>What is the y intercept for each?</i></p>
Practice:	p. 398, Example 3: A store sells sugar in bulk for 25 cents per pound. Graph the relation (pounds of sugar, cost). Find the slope & y-intercept.
SUMMARIZE:	<p>QUICKWRITE:</p> <p><i>If your friend/s were absent today, how would you describe to them what slope is?</i></p> <p>(Slope is a measure that describes the "tilt" of a line.)</p>
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	p. 400, Practice & Problem Solving, #10-12 and p. 401 #16, 18, 20

MODULE 8: LINEAR FUNCTIONS & GRAPHING

DAY 7: LESSON 8 – 4; pp. 404 - 408

LESSON FOCUS:	Write rules for linear functions
CA STANDARD:	NS 1.7 - Key standard
Purpose of Lesson:	At the end of the lesson, students will begin to be able to write linear equations in function notation and write function rules.
Warm-up/ Routine(s):	TE 404, Daily Warm-Up, Finding slope of a line, #1-5
LAUNCH: TE 404 p. 405	<i>Connecting to Students' Lives</i> To write a function rule for a table, LOOK FOR A PATTERN. Use Example 2 (Do not have students open book yet!) Do Additional Examples 2-3, After Lesson 1 & 2; TE 405
EXPLORE: p. 406	Have students in partners write a rule for tables 2&3, p 406. <i>Can they use the graph, #4, to write a function rule?</i> After they have had some time to explore, work with them to develop the formula $y = mx + b$ and $f(x) = mx + b$
Practice:	Assign from p. 407, #11 and # 15
SUMMARIZE:	Have students share their understandings of writing a function rule. Chart their responses to come back to later for clarification/addition.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework: p. 407	Tables #12-14, graphs #18-20 and Writing: #21

* Chapter 8-5 *Optional* Interpret and draw scatter plots - This could be used as a Routine/WarmUp

* Chapter 8-6 Embedded throughout chapter - May be addressed if the students need additional practice.

MODULE 8: LINEAR FUNCTIONS & GRAPHING

DAY 8: LESSON 8 – 7; pp. 420 - 425

LESSON FOCUS:	Solving Systems of Linear Equations
CA STANDARD:	AF 1.1, AF 1.5
Purpose of Lesson:	At the end of the lesson, students will be able to solve systems of linear equations by graphing and to solve problems by solving systems of linear equations.
Warm-up/ Routine(s):	Share homework responses to p. 407, #21, <i>Writing problem</i> . Share rules found for tables & graphs from homework. OR Daily Skills Warm Up, TE p. 420
LAUNCH: p. 421 Textbook closed	Use problem from Example 3 to set the stage for the Exploration piece. As a table group: Find two numbers with a sum of 6 and a difference of 4. Let x be the greater number & y be the lesser number. <u>Equation 1:</u> Sum is 6. $x + y = 6$ <u>Equation 2:</u> Difference is 4. $x - y = 4$ Graph the equations as a group on the overhead.
EXPLORE: p. 422 Textbook closed	Partner work: <i>Different Ways to Solve a Problem</i> . You can solve some problems involving two variables by writing & graphing a system of equations, or you may be able to use one variable to write & solve an equation. p. 422; <i>Measurement</i> : A carpenter cuts an 8 ft. board into 2 pieces. One piece is 3 times as long as the other. <i>What is the length of each piece?</i>
Practice:	p. 421, TRY THIS #5
SUMMARIZE:	Share solutions & strategies to solve. Compare with the two methods presented on p. 422.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework: p. 423	Check for Understanding: p. 243, # 1 -3, #10 a-c OR TE p. 423, Daily Cumulative Review, #1-4, #8-10.

MODULE 8: LINEAR FUNCTIONS & GRAPHING

DAY 9: LESSON 8 – 8; pp. 426 - 431

LESSON FOCUS:	Graphing Linear Inequalities
CA STANDARD:	AF 1.1, 1.5; MR 3.1
Purpose of Lesson:	At the end of the lesson, students will be able to graph linear inequalities and build understanding that a graph of a linear inequality is a region of the coordinate plane.
Warm-up/ Routine: TE pp. 425-6	Assessment: Checkpoint 2, TE p. 425 OR Daily Skills Warm Up, TE p. 426, #1-4. Use #5 as a lead in to the Launch - graph as $y = -3x + 2$
LAUNCH: p. 426 TE p. 426 Textbook closed	Then graph as $y > -3x + 2$. Ask: "Do points on the <i>boundary line</i> make this inequality true?" Change solid line to dashed line to illustrate. (Refer to EXAMPLE 1, p. 426.) Then graph as $y \geq -3x + 2$ Test points to identify in which region points fall in order to make the inequality true.
EXPLORE: p. 427 Textbook closed	EXAMPLE 2, p 427, help students to establish what x and y are. Ask how the inequality might be written - Individual & Partner think time - partner talk. Share out thoughts. Have student partners explore graphing the inequality & shading in the appropriate region. Graph on large graphing paper & post. Share results.
Practice: p. 429	Test Prep, p. 429, # 11 - 13.
SUMMARIZE:	The graph of a linear inequality is a region (or part) of the coordinate plane. See <i>Closure</i> , TE 429. QUICKWRITE: <i>What is the difference between the graph of a linear <u>equality</u> and the graph of a linear <u>inequality</u>? WHY?</i>
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	<i>Check for Understanding:</i> p. 429, #1-6 AND #10, a-c

MODULE 8: LINEAR FUNCTIONS & GRAPHING

DAY 10: CHAPTER 8; ASSESSMENT

LESSON FOCUS:	Linear Functions and Graphing
CA STANDARD:	NS 1.7 Key Standard, AF 3.3, 3.4 Key Standards AF 1.1, 1.5 ; SDAP 1.2; MR 2.3, 3.1
Purpose of Lesson:	To assess the students' understanding of the concepts and skills found in chapter 8
Warm-up/ Routine(s):	Number Sense: Choose from Routine/Warm-Up Bank OR p. 430, #42, Writing.
LAUNCH:	Assessment - teacher selected
EXPLORE:	
Practice:	Choose from ENRICHMENT - TE pgs. 419, 425, 431
SUMMARIZE:	
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections. QUICKWRITE: REFLECTION <i>In chapter 8 I learned more about _____</i> <i>Now I know how to _____</i> <i>I'm still not sure about _____</i>
Homework:	p. 438, Cumulative Review, students select 12 of the 16 problems to complete.

MODULE 8: LINEAR FUNCTIONS & GRAPHING

DAY 11: LESSON 8 – 5/6 *Optional*

LESSON FOCUS:	Scatter Plots - <i>Could be used as Routines/Warm-Ups that go over a few days to review data/stats/multiple representations from first of the year.</i> Reasoning Strategy: Solve by Graphing - Embedded throughout Chapter.
CA STANDARD:	SDAP 1.2
Purpose of Lesson:	
Warm-up/ Routine(s):	
LAUNCH:	
EXPLORE:	
Practice:	
SUMMARIZE:	Share student statements from Exploration. A scatter plot is a graph that shows the relationship between two sets of data.
Closure:	Time to reflect back on the purpose of the lesson, and help students make meaningful connections.
Homework:	