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Descriptions of Resources

This Chapter Resource Book is organized by lessons within the chapter in order to make your planning easier. The following materials are provided:

Tips for New Teachers These teaching notes provide both new and experienced teachers with useful teaching tips for each lesson, including tips about common errors and inclusion.

Parent Guide for Student Success This guide helps parents contribute to student success by providing an overview of the chapter along with questions and activities for parents and students to work on together.

Prerequisite Skills Review Worked-out examples are provided to review the prerequisite skills highlighted on the Study Guide page at the beginning of the chapter. Additional practice is included with each worked-out example.

Strategies for Reading Mathematics The first page teaches reading strategies to be applied to the current chapter and to later chapters. The second page is a visual glossary of key vocabulary.

Lesson Plans and Lesson Plans for Block Scheduling This planning template helps teachers select the materials they will use to teach each lesson from among the variety of materials available for the lesson. The block-scheduling version provides additional information about pacing.

Warm-Up Exercises and Daily Homework Quiz The warm-ups cover prerequisite skills that help prepare students for a given lesson. The quiz assesses students on the content of the previous lesson. (Transparencies also available)

Activity Support Masters These blackline masters make it easier for students to record their work on selected activities in the Student Edition.

Alternative Lesson Openers An engaging alternative for starting each lesson is provided from among these four types: ***Application, Activity, Graphing Calculator,*** or ***Visual Approach.*** (Color transparencies also available)

Graphing Calculator Activities with Keystrokes Keystrokes for four models of calculators are provided for each Technology Activity in the Student Edition, along with alternative Graphing Calculator Activities to begin selected lessons.

Practice A, B, and C These exercises offer additional practice for the material in each lesson, including application problems. There are three levels of practice for each lesson: A (basic), B (average), and C (advanced).

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CHAPTER 3

Tips for New Teachers

For use with Chapter 3

Lesson 3.1

COMMON ERROR Some students only check their solution in one of the equations of the system. Students who correctly graph one equation of the system but make a mistake graphing the other equation will not find anything wrong if they only check the solution in the first equation. Remind students that they must make sure the solution satisfies *both* equations.

TEACHING TIP Give your students a system where the solutions are not integer numbers—see the activity on page 146 of the textbook. When they solve it by graphing, the two lines will not intersect at a lattice point, making it very difficult to determine the exact solution. Point out that this "inaccuracy" of the graphing method makes it necessary to find another method(s) to solve linear systems. You can use the same example to introduce Lesson 3.2 to show students that the algebraic methods yield exact answers.

Lesson 3.2

INCLUSION Systems of linear equations might have too many steps and options for some students. Make sure that students know what to do before they actually "jump" into the problem and get lost in the numbers. Ask students to develop an *action plan* before solving the problem. Their *action plan* should say what method they will use to solve the system—you can also ask them why they chose that method. The plan should also specify how to solve the system. In other words, they should state what variable they will solve for and in which equation, or what variable they will eliminate and how they will do that. You might want to ask your students to write this *action plan* down so that they can refer to it while they are solving the system.

Lesson 3.3

COMMON ERROR There might be some students who can graph a system of linear inequalities but do not understand what their graph means or how to use it to write some possible solutions. Remind your students that linear inequalities can have infinitely many solutions, so rather than making a list of them we just graph them. When students have trouble understanding inequalities, ask them to use their graphs to write at least three ordered pairs that are possible solutions for each system of inequalities.

TEACHING TIP Make sure to solve a word problem where the solutions *must* be integers. For instance, students could find how many nickels and dimes they would have if they know they have at most 13 coins and no more than one dollar in total. For this problem, the variables represent number of nickels and number of dimes. Discuss with your students whether they should shade the region representing the solution. How could they show only possible solutions? Are there infinitely many solutions to this problem?

Lesson 3.4

COMMON ERROR After solving some linear programming exercises, students might point out that the vertex of the feasible region with the smallest coordinates is always the minimum for the objective function. In the same manner, the vertex with the largest coordinates would always be the maximum of the objective region. This is true as long as the objective function is of the form $C = Ax + By$, where A and B are *both positive.* Complete an exercise where either A, B, or both are negative numbers to show students that their trick does not always work. For example, you can set up a problem where students need to maximize the profit of a company with some constraints for income and expenses. This situation will result in A and B having opposite signs.

INCLUSION Writing the *constraints* and the *objective function* for a word problem is a difficult task for some students. Those students with poor reading comprehension might need to underline, circle, and look for key words in order to make sense of the problem. Remind students that even if the problem does not state it, they must consider whether their variables can be negative. This might result in two more constraints.

Lesson 3.5

TEACHING TIP Students might struggle making sense of a three-dimensional coordinate system

Tips for New Teachers

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because they cannot visualize how it is represented on the paper. You can help your students by providing them with a concrete example of a three-dimensional coordinate system. Choose one corner of your classroom where the two walls and the floor form right angles: this is your origin. The two lines where the walls and the floor meet are the x- and y-axes; the line where the two walls intersect is the z-axis. Students are more likely to understand now why they need a third coordinate in space: two points with the same x- and y-coordinates can have different altitude, determined by their z-coordinate. Practice asking students where points with negative coordinates will be with respect to the classroom—to the left, behind, above. Finally, tell students that the classroom is an *octant* and ask them how many classrooms could get together at the origin: they should be able to see that there are eight octants.

TEACHING TIP Students already know functions of two or more variables, although they might not be linear. For instance, they know that the interest they get from a bank account depends on the principal, the time the money is left in the bank, and the interest rate. The interest they earn is a function of three variables, although this is not a linear function. Ask your students what other examples they know of functions of two or more variables. Then you can ask them whether these functions are linear.

LESSON 3.6

TEACHING TIP You can use pieces of cardboard to show your students the different relative positions of three planes in space, as shown on page 177.

COMMON ERROR Systems of linear equations in three variables require students to carefully plan and organize their work. Some students use two equations to eliminate a variable and another two equations to eliminate a *different* variable. As a consequence, they get two equations with three variables again. These students might go back and continue trying to combine equations hoping that eventually they will get an equation with just one variable. Once again, it pays to spend some time thinking before actually solving the system. Students should know which variable they will eliminate first and which equations they will use to do so before attempting to manipulate the equations.

Outside Resources

BOOKS/PERIODICALS

Heid, M. Kathleen, Jonathan Choate, Charlene Sheets, and Rose Mary Zbiek. *Algebra in a Technological World: Addenda Series, Grades 9–12.* Addresses the teaching and learning of high school algebra in light of changes brought about by graphing calculators. Reston, VA: NCTM, 1995.

Edwards, Thomas G., and Kenneth R. Chelst. "Promote Systems of Linear Inequalities with Real-World Problems." *Mathematics Teacher* (February, 1999), pp. 118–123.

SOFTWARE

Harvey, Wayne, and Judah L. Schwartz. *The Function Supposer: Explorations in Algebra.* Newton, MA: Education Development Center, 1992.

VIDEOS

Algebra in Simplest Terms. Linear equations. Burlington, VT: Annenburg/CPB Collection, 1991.

CHAPTER 3

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Parent Guide for Student Success

For use with Chapter 3

Chapter Overview **One way that you can help your student succeed in Chapter 3 is by discussing the lesson goals in the chart below. When a lesson is completed, ask your student to interpret the lesson goals for you and to explain how the mathematics of the lesson relates to one of the key applications listed in the chart.**

Lesson Title	*Lesson Goals*	*Key Applications*
3.1: Solving Linear Systems by Graphing	Graph and solve systems of linear equations in two variables. Use linear systems to solve real-life problems.	• Vacation Costs • Book Club • Floppy Disk Storage
3.2: Solving Linear Systems Algebraically	Use algebraic methods to solve linear systems. Use linear systems to model real-life situations.	• Catering • Cross-Training • Renting an Apartment
3.3: Graphing and Solving Systems of Linear Inequalities	Graph a system of linear inequalities to find the solutions of the system. Use systems of linear inequalities to solve real-life problems.	• Heart Rate • Weightlifting Records • Biology
3.4: Linear Programming	Solve linear programming problems and use linear programming to solve real-life problems.	• Bicycle Manufacturing • Juice Blends • Nutrition
3.5: Graphing Linear Equations in Three Variables	Graph linear equations in three variables and evaluate linear functions of two variables. Use functions of two variables to model real-life situations.	• Landscaping • Transportation • Radio Commercials
3.6: Solving Systems of Linear Equations in Three Variables	Solve systems of linear equations in three variables and use linear systems in three variables to model real-life situations.	• Sports • Chinese Restaurant • Voting

Test-Taking Strategy

Plan Ahead. *Before you jump in to solve a problem, take the time to* ***read the question carefully*** *and to* ***identify any helpful shortcuts.*** You may wish to look with your student at the test and review exercises in the book.

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Parent Guide for Student Success

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Key Ideas **Your student can demonstrate understanding of key concepts by working through the following exercises with you.**

Lesson	Exercise
3.1	On vacation, you need to drive 245 miles across a state in 4 hours. Two roads cross the state, an interstate highway where you can drive at the speed limit of 65 miles per hour and a state highway where you can average 50 miles per hour. You want to see some of the scenery along the state highway. How long should you drive on each highway?
3.2	Which algebraic method is easier to use to solve the system? Use the method you chose to solve it. $y = 4x - 3$ $3x - 2y = -4$
3.3	You are working in a store where you need to make a mixture of cashews and walnuts. The mixture should weigh at least 4 pounds, cost a maximum of \$12, and have more than a pound of cashews. Cashews cost \$3 per pound and walnuts cost \$2 per pound. You prefer to weigh only whole numbers of pounds. Use the graph of a system of inequalities to find three combinations of cashews and walnuts you can use in the mixture.
3.4	Find the minimum and maximum values of the objective function $C = 4x + y$, subject to the given constraints. $x \geq 0$ $\quad x + y \leq 4$ $y > 0$ $\quad x + 3y \leq 6$
3.5	If $z = f(x, y) = 2x - 4y + 7$, find $f(-2, 1)$.
3.6	Use any algebraic method to solve the system. $2x - 3y - z = 7$ $x - 2y = 1$ $2x + 2z = 4$

Home Involvement Activity

Directions: Pick a number. Subtract 3 from your first number to get a second number. Take 3 times the first number plus two times the second number to get a third number. Subtract the third number from 5 times the first number. The result is 6. Try the trick for several first numbers. Then, use equations and substitution to see why the trick works.

Answers

3.1: 3 h on interstate and 1 h on state highway **3.2:** substitution; $(2, 5)$ **3.3:** 2 lb of each, 2 lb of cashews and 3 lb of walnuts, 3 lb of cashews and 1 lb of walnuts **3.4:** minimum is 2 at $(0, 2)$, maximum is 13 at $(3, 1)$ **3.5:** -1 **3.6:** $(5, 2, -3)$ **Activity:** $y = x - 3$ and $z = 3x + 2y$. By substitution, $z = 5x - 6$ and $5x - z = 6$.

CHAPTER 3

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Strategies for Reading Mathematics

For use with Chapter 3

Strategy: Using Worked-out Examples as a Guide

The worked out examples in each lesson can be used as a model when you solve the exercises. For example, the same sequence of steps can be used to solve both problems below. The Example is from Lesson 3.5.

EXAMPLE

a. Write the linear equation $3x + 2y + 4z = 12$ as a function of x and y.

b. Evaluate the function when $x = 1$ and $y = 3$.

SOLUTION

a.

$3x + 2y + 4z = 12$	Write original equation.
$4z = 12 - 3x - 2y$	Isolate z-term.
$z = \frac{1}{4}(12 - 3x - 2y)$	Solve for z.
$f(x, y) = \frac{1}{4}(12 - 3x - 2y)$	Replace z with $f(x, y)$.

b. $f(1, 3) = \frac{1}{4}(12 - 3(1) - 2(3))$
$= \frac{3}{4}$

EXERCISE

a. Write the linear equation $8x + 6y + 3z = 24$ as a function of x and y.

b. Evaluate the function when $x = 2$ and $y = 1$.

SOLUTION

a.

$8x + 6y + 3z = 24$
$3z = 24 - 8x - 6y$
$z = \frac{1}{3}(24 - 8x - 6y)$
$f(x, y) = \frac{1}{3}(24 - 8x - 6y)$

b. $f(2, 1) = \frac{1}{3}(24 - 8(2) - 6(1))$
$= \frac{2}{3}$

STUDY TIP

Using Worked-out Examples as a Guide

Find an example in the textbook similar to a given exercise. Use it as a model by carrying out each step in the worked-out solution for the problem in the exercise.

Questions

1. Use the function at the above right to find each value.
   a. $f(1, 5)$ **b.** $f(\frac{3}{2}, 2)$ **c.** $f(0, 0)$
2. Using the above example as a model, write the linear equation $5x - 2y - z = 20$ as a function of x and y, and evaluate the function when $x = 2$ and $y = 4$.
3. Tell which example in Lesson 3.5 you would use as a model for solving each problem.
   a. Sketch the graph of $8x + 6y + 3z = 24$.
   b. Plot the ordered triple $(4, -1, -1)$.
   c. Evaluate the linear equation $2x + 7y - 3z = 10$ when $x = -2$ and $y = 2$.

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Strategies for Reading Mathematics

For use with Chapter 3

Visual Glossary

The Study Guide on page 138 lists the key vocabulary for Chapter 3 as well as review vocabulary from previous chapters. Use the page references on page 138 or the Glossary in the textbook to review key terms from prior chapters. Use the visual glossary below to help you understand some of the key vocabulary in Chapter 3. You may want to copy these diagrams into your notebook and refer to them as you complete the chapter.

GLOSSARY

System of linear equations in two variables (p. 139) Two equations of the form $Ax + By = C$ and $Dx + Ey = F$ where x and y are variables, A and B are not both zero, and D and E are not both zero.

Solution of a system of linear equations (p. 139) An ordered pair (x, y) that satisfies each equation of the system.

Three-dimensional coordinate system (p. 170) A coordinate system determined by three mutually perpendicular axes. When taken pair-wise, these axes form 3 coordinate planes that divide space into eight parts called octants.

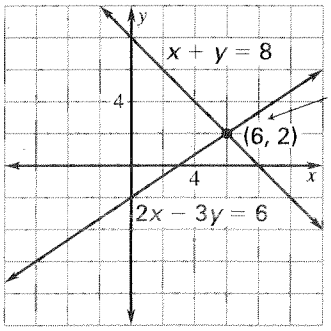
z-axis (p. 170) A vertical line through the origin and perpendicular to the xy-coordinate plane in a three-dimensional coordinate system.

Solving a System of Linear Equations Graphically

You can solve a system of two linear equations in two unknowns by finding the point in the plane where their graphs intersect.

$2x - 3y = 6$

$x + y = 8$



The solution is the point of intersection, (6, 2).

Graphing in a Three-Dimensional Coordinate System

You can sketch the graphs of points and planes in three-dimensional space by using a representation of a three-dimensional coordinate system.