

Strategies
To
Achieve
Mathematics
Success



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SCHOOL-HOME CONNECTIONS *(Reproducibles)*

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CAMS® and STAMS® Program Overview

The CAMS® and STAMS® program is a powerful integrated program of assessment and data-driven instruction. The program focuses on the critical math concepts and skills that students need to advance to the next grade level. The CAMS® Series and the STAMS® Series work together effectively to ensure that your students gain a solid understanding of the key math concepts and skills. This knowledge will ultimately help them become independent problem solvers and succeed on high-stakes state tests.

Features

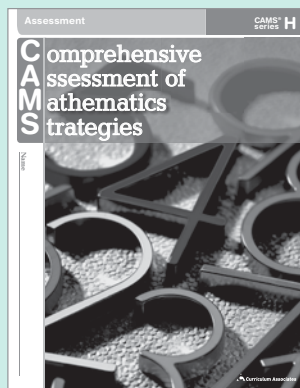
Data-driven instruction with a pretest, a post test, and benchmarks (see page 8)

Emphasis on errors as opportunities for learning (see pages 19 and 23)

Highly scaffolded lessons with gradual release of responsibility (see pages 14–25)

Embedded professional development in supportive easy-to-use teacher guide (see pages 14–25)

Interactive Whiteboard Lessons to enhance instruction (see pages 11 and 15)



**Books C–H
(Grades 3–8)**

Assessment

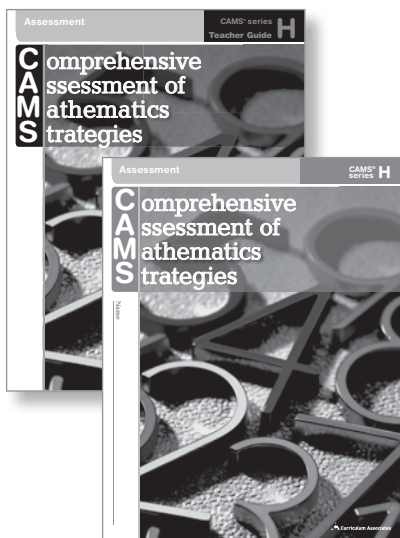
Use the CAMS® *Assessment Series* to gather information for targeting instruction and measuring progress.



**Books C–H
(Grades 3–8)**

Instruction

Use the STAMS® *Instruction Series*, with Interactive Whiteboard Lessons, for in-depth teaching of the 16 concepts and skills that will help students succeed at grade level.



Assessment with CAMS® Series

Quickly identify which of the 16 foundational math concepts and skills your students find most difficult and use the results to monitor progress.

- A pretest diagnoses students' strengths and weaknesses and guides their placement in the *STAMS® Instruction Series*.
- Four benchmarks assess class progress throughout the year.
- A post test assesses students' mastery of concepts and skills following instruction with the *STAMS® Series*.
- Tracking forms and charts facilitate data collection and student self-assessment encourages reflection.



Instruction with STAMS® Series

Provide students with explicit instruction of the 16 foundational math concepts and skills—those topics identified as the most important instructional goals for each grade level.

Student Book

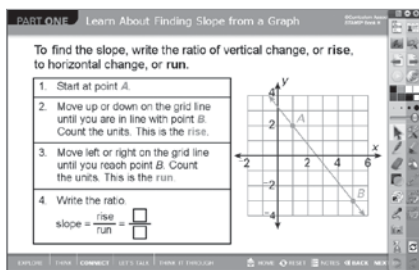
Designed for the struggling student, lessons are highly visual, engaging, and clearly presented. Each five-part lesson uses three levels of scaffolding to make sure students master the critical math concepts and skills.

1. *Scaffolded student support*—Instructional support is removed gradually to build student independence as they move through each lesson.
2. *Scaffolded student accountability*—Practice problems build student accountability by requiring students to use increasing degrees of higher-level thinking to analyze and explain their answers.
3. *Scaffolded problem-solving experience*—Practice problems slowly increase in difficulty to build student proficiency and confidence.

Teacher Guide

Step-by-step support helps teachers easily differentiate instruction and present each lesson most effectively.

- Modeling helps teachers introduce each skill simply and confidently.
- Useful tips and embedded professional development guide instruction.
- Detailed easy-to-follow instructions minimize planning time.



Interactive Whiteboard Lessons

Optional Interactive Whiteboard Lessons with manipulable models enhance instruction. They can be used to preview lessons or review previous lessons from any level.

Getting Started

1 Diagnose with CAMS® Pretest

- Use the CAMS® Pretest, a comprehensive diagnostic test, to place students in the STAMS® Series. Pretest questions correspond to each of the 16 STAMS® lessons so results clearly identify which topics students need to study.
- Administer the Pretest on five successive days, prior to presenting corresponding STAMS® lessons. See the CAMS® teacher guide for more details.

2 Instruct with STAMS® Lessons

- Pinpoint specific lessons in the STAMS® student book to remediate particular areas that need improvement or reinforcement.
- Alternatively, have students complete all of the lessons in the STAMS® student book to build and reinforce grade-level foundational math concepts and skills.

3 Monitor Progress with Benchmarks

- Assess progress in all 16 foundational topics with the four 16-item CAMS® Benchmarks.
- Monitor students' progress at four points during the year. See the Pacing Chart to the right for suggested intervals.
- Record and analyze mastery levels with class tracking charts in the CAMS® teacher guide.

4 Assess Mastery with CAMS® Post Test

- Use the CAMS® Post Test to assess students' mastery of each of the 16 math concepts and skills taught in the STAMS® Series.
- Administer the Post Test on five successive days, following instruction of all 16 STAMS® lessons.

Suggested Pacing Chart for Book H of the CAMS® and STAMS® Program

Day(s)	Lesson	CAMS® Assessment Series	STAMS® Instruction Series	Minutes
1–5		CAMS® Pretest		30–45/day
6–10	1	Exponents		30–45/day
11–15	2	Square Roots		30–45/day
16–20	3	Solve Two-Step Equations		30–45/day
21–25	4	Two-Step Equations with Rational Numbers		30–45/day
26		CAMS® Benchmark 1		30–45
27–31	5	Linear and Nonlinear Equations		30–45/day
32–36	6	Slope		30–45/day
37–41	7	Graph Linear Equations		30–45/day
42–46	8	Solve Systems Graphically		30–45/day
47		CAMS® Benchmark 2		30–45
48–52	9	Solve Systems Algebraically		30–45/day
53–57	10	Special Pairs of Angles		30–45/day
58–62	11	Angle Sums		30–45/day
63–67	12	Triangle Similarity		30–45/day
68		CAMS® Benchmark 3		30–45
69–73	13	Pythagorean Theorem		30–45/day
74–78	14	Distance Formula		30–45/day
79–83	15	Mean, Median, Range		30–45/day
84–88	16	Scatter Plots		30–45/day
89		CAMS® Benchmark 4		30–45
90–94		CAMS® Post Test		30–45/day

Note: Allocate 19 weeks for full implementation of the CAMS® and STAMS® program, with each lesson spanning 5 school days.

CAMS[®] and STAMS[®] Grade-Level Foundational Skills

All 16 concepts and skills covered in each level of the *STAMS[®] Series* align to NCTM Focal Points and Connections for that grade. Lesson topics have been carefully sequenced so students move from basic skills to more complex content within each grade and between grades as well.

The focus of the *STAMS[®] Series* progresses from number sense and computational skills in early grades to pre-algebra in later grades.

Additional lessons included to address Common Core State Standards.
See Table of Contents.

Book C (Grade 3)

Place Value
Add and Subtract
Multiplication Concepts
Fact Strategies
More Fact Strategies
Division Concepts
Fact Families
Fraction Concepts
Model Equivalent Fractions
Benchmark Fractions
Comparing Fractions
Fractions Greater Than 1
Plane Figures
Length
Perimeter
Pictographs and Bar Graphs

Book D (Grade 4)

Multiplication Properties
Multiply Mentally
Multiply by 1-Digit Numbers
Multiply by 2-Digit Numbers
Relate Division to Multiplication
Divide Without Regrouping
Divide with Regrouping
Equivalent Fractions
Simplify Fractions
Decimal Place Value
Compare and Order Decimals
Relate Decimals to Fractions
Angles
Understand Area
Area of Rectangles
Line Plots

Book E (Grade 5)

Multiply 3-Digit Numbers
Divide Mentally
Estimate Quotients
1-Digit Divisors
Zeros in the Quotient
2-Digit Divisors
Understand Mixed Numbers
Add and Subtract Like Fractions
Compare Unlike Fractions
Add and Subtract Unlike Fractions
Add and Subtract Mixed Numbers
Add and Subtract Decimals
Area
Surface Area
Understand Volume
Line Graphs

Book F (Grade 6)

Multiply Whole Numbers by Fractions
Multiply Fractions
Divide Whole Numbers by Fractions
Divide Fractions by Fractions
Multiply and Divide by Powers of Ten
Multiply Decimals
Divide Decimals by Whole Numbers
Divide by Decimals
Understand Ratios
Understand Percent
Unit Rates
Ratios in Tables of Data
Solve Equations Using Number Sense
Solve Equations Using Inverse Operations
Use Formulas
Volume

Book G (Grade 7)

Understand Integers
Add and Subtract Integers
Multiply and Divide Integers
Evaluate Expressions
Solve Linear Equations
Equations with Rational Numbers
Proportional Relationships
Solve Proportions
Rate Problems
Percent as a Ratio
Percent Problems
Similarity
Circles
Cylinders
Circle Graphs
Theoretical Probability

Book H (Grade 8)

Exponents
Square Roots
Solve Two-Step Equations
Two-Step Equations with Rational Numbers
Linear and Nonlinear Equations
Slope
Graph Linear Equations
Solve Systems Graphically
Solve Systems Algebraically
Special Pairs of Angles
Angle Sums
Triangle Similarity
Pythagorean Theorem
Distance Formula
Mean, Median, Range
Scatter Plots

STAMS® Instruction Overview

Each level of the *STAMS® Series* has 16 interrelated lessons designed to help students build mathematical competency. Emphasizing depth over breadth, each five-day, five-part lesson targets two closely-related aspects of a single concept or skill. Highly scaffolded lessons offer gradual release of responsibility from the teacher to the student. Part One and Part Two introduce the skill with modeled and guided instruction. Part Three and Part Four (modeled and guided practice) and Part Five (independent practice) have students work with growing accountability for their learning as they practice and apply the skills taught.

STAMS® lessons are optimally designed to be used in conjunction with the *CAMS®* assessments, as described on page 9. (See the *CAMS®* teacher guide for more detail.) However, teachers have found that the built-in flexibility also makes *STAMS®* lessons perfect for a variety of other uses.

Alternative Implementations

Other scenarios for using the *STAMS®* lessons with your class include the following:

Whole Group (at grade level)

State test review—Use the *STAMS®* lessons as a review for the entire class. The 16 weeks of lessons allow you to finish well before your state test date.

Small Group (at or below grade level)

Reteaching support—Use the *STAMS®* lessons with small groups to reteach skills that students are still struggling to master. See pages 12–13 for more information.


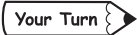

Individual (at or below grade level)

Tutoring or independent work—As you become aware of specific gaps in a student’s background knowledge, assign the corresponding *STAMS®* lesson.

Tip: *STAMS®* lessons are best used with teacher guidance, as students learn best when they are directed by knowledgeable, supportive teachers. However, the student book lessons are written to be inviting and accessible even to struggling students. If you do assign *STAMS®* lessons as independent class work, be sure to circulate and monitor students as they work.

Week at a Glance

Suggested Lesson Pacing

	Monday	Tuesday
	modeled and guided instruction	
	Part One	Part Two
Direct instruction Interactive Whiteboard (IWB) <i>(optional)</i> 	Introduce new skill with student book pages. 20 minutes Use IWB Lesson in place of Part One in student book.	Introduce new skill with student book pages. 20 minutes Use IWB Lesson in place of Part Two in student book.
Independent work 	Practice new skill. 10 minutes	Practice new skill. 10 minutes
Assessment 	Check <i>Your Turn</i> answer.	Check <i>Your Turn</i> answer.
Additional Activity <i>(optional)</i>	<i>Hands-on Activity</i> 15 minutes	<i>Reteaching Activity</i> 15 minutes



To download your
Interactive Whiteboard Lessons
 and a User Guide, go to
CurriculumAssociates.com/STAMS/IWB.

Use the password STAMSIWB
 to access your grade-level lessons.
 Promethean software is required to present
 these lessons. A free download of ActivInspire
 Personal Edition is available at
<http://support.prometheanplanet.com>.

Additional Instruction

Interactive Whiteboard (IWB) Lessons

Interactive Whiteboard Lessons are available for each lesson in the student book. The IWB Lessons offer students opportunities to question and explore mathematical concepts in greater depth.

- IWB Lessons can be used to supplement instruction in Part One and Part Two of each lesson.
- IWB Lessons can also recap and review previous lessons from any level before beginning instruction.
- Features, such as cloning and dragging objects, and whiteboard tools, such as highlighters, keep students actively engaged in learning.
- Teacher notes lead you through the modeled and guided instruction to maximize each lesson's instructional impact.
- For additional Interactive Whiteboard tips, see page 15.

Additional Common Core Lessons

The Common Core State Standards for Mathematics presents some math concepts and skills at different grade levels than the NCTM Focal Points and state standards have recommended. To address that discrepancy in grade-level content and anticipated differences in schools' timelines for implementing the Common Core State Standards (CCSS), the *STAMS® Series* offers Additional Lessons at the back of each book, C–G.

- Additional Lessons for CCSS are organized and labeled in the same topic groupings as the 16 foundational grade-level lessons.
- Refer to the Table of Contents for when to use each Additional Lesson. (Or you may wish to postpone those lessons until later in the year, after your state assessments are completed.)

Wednesday	Thursday	Friday
modeled and guided practice		independent practice
Part Three	Part Four	Part Five
Model multiple-choice problem; analyze answers. 10 minutes	Model extended-response problem. 10 minutes	
Review Parts One and Two as necessary.	Review Parts One and Two as necessary.	
Practice solving multiple-choice problems. 20 minutes	Practice solving extended-response problem. 20 minutes	Solve problems in test-prep format. 30 minutes
Check <i>Your Turn</i> answers.	Check <i>Your Turn</i> answer.	Check <i>Your Turn</i> answers. <i>Use Assessment and Remediation.</i> 15 minutes
<i>Vocabulary Activity</i> 15 minutes	<i>Real-World Connection</i> plus <i>School-Home Connection</i> 15 minutes	<i>Challenge Activity</i> 15 minutes

Using STAMS® Lesson Features for Differentiation

STAMS® lessons support several approaches to differentiated instruction. Work with small groups or individuals as needed by taking advantage of these lesson features.

Knowing how and when to differentiate

Effective differentiation is based on identifying where students are struggling. The ongoing assessment features help you stay informed about student progress.

- Observe student work with *Your Turn* on a daily basis to see which students are off track.
- Use *Error Alerts* to help recognize and correct common mistakes and misconceptions as soon as they surface.
- Use Assessment and Remediation to identify misconceptions or gaps in understanding at any point in the lesson. The activities listed can provide individual or small-group remediation (see page 23).

For ELL students

- For any students who struggle with the language of math, preview math vocabulary (see page 15).
- Throughout the instruction, refer to *ELL Support* tips that alert you to potential language obstacles.
- Use the *Vocabulary Activity* to help students tie new math terms to words they already understand.

For struggling students

- Use the *Hands-on Activity*, *Reteaching Activity*, and *Real-World Connection* to give students other ways to access the skill.
- Review concepts visually with Interactive Whiteboard Lessons.

For confident students

- Provide students an opportunity to extend their understanding of the concepts in the lesson with the *Challenge Activity*.

Modeled Instruction

Lesson 8 SOLVE SYSTEMS GRAPHICALLY
UNIT ONE: Learn About Systems of Equations

ADDITIONAL ACTIVITIES

Hands-on Activity
 Use string to model systems of equations.
Materials: grid paper with large squares; string; pins or tape and cardboard backing
 Organize students in small groups and distribute grid paper, string, and pins or tape and cardboard backing. Have them draw horizontal and vertical axes through the middle of the grid paper. On the board, write this system of equations:

$$\begin{cases} y = 3x \\ y = 0.5x + 5 \end{cases}$$

 Have students plot ordered pairs for each equation and use pins or tape to attach a piece of string through the points that lie on each line. Have students read the coordinates of the point where the strings cross. Then ask, "What is the solution of the system?" (2, 6)

Reteaching Activity
 Use grids to model systems with no solution.
Materials: grid paper
 Distribute grid paper to each student. Have them draw axes along the left side and the bottom of the page. On the board, write this system of equations:

$$\begin{cases} y = 2x + 4 \\ y = 2x + 1 \end{cases}$$

 Have students plot points for each equation, graph the lines, and then count the number of squares between the two lines for each x -value. (3) Ask, "Does the distance between the lines increase, decrease, or stay the same as you move from left to right?" (stay the same) "If the lines stay the same distance apart, will they ever meet?" (no) Guide students to understand that if the lines never meet, there is no ordered pair that is a solution of both lines, so the system has no solution.

Vocabulary Activity
 Play "What Am I?" to reinforce terms.
Materials: index cards for each pair
 Have students write the vocabulary words on index cards, mix up the cards, and place them facedown in a stack. The first student picks a card and gives an example of the vocabulary word. For example, if a student picks *intersection*, he or she might draw two intersecting lines and circle the intersection. The other player tries to guess the word. Continue until all the cards have been used. Conclude the activity by having student pairs work together to agree on the best example for each vocabulary word and draw or write that on the back of its card.

Real-World Connection
 Identify everyday examples of systems of linear equations.
 Tell students that solving systems of linear equations can help them make everyday decisions. For example, by representing different pricing plans as linear equations and solving the system, they can determine the best plan for their needs. Have students name real-life situations that they can model with systems of linear equations to help them make informed decisions.

School-Home Connection
 Inform families about systems of equations.
 Give each student a copy of the reproducible School-Home Connection for Lesson 8 (page 177) to share with the family. The activity included in the letter has the family use birthdays to graph lines.

Challenge Activity
 Write word problems involving systems of equations.

$$\begin{cases} y = 4x & y = 3x + 20 \\ y = 2x + 10 & y = 5x \end{cases}$$

 Have students work in pairs, with each student writing a word problem that involves a scenario that can be modeled with one of the systems. After students have written their problems, have them exchange with their partner to solve. A possible situation could be saving money over periods of time.

Guided Instruction

Think It Through

Fill in the blanks as you solve the problem.

One gym charges \$400 initiation fee plus \$60 per month. Another gym charges \$100 initiation fee plus \$80 per month. The number of months that you work out is represented by x . The number of dollars that you pay is represented by y .

Write the equations for the two gyms. What do you know about the number of months that you work out?

Graph the equations on the coordinate plane. What do you know about the number of months that you work out?

Read the word problem and the equations. What do you know about the number of months that you work out?

Your Turn How can you use the graphs to solve this problem?

What is the solution of the system of equations? How many months will you work out? How much will you pay? How many months will you work out? How much will you pay?

Algebra Solve Systems Graphically 97

Using Related STAMS® Lessons to Remediate

STAMS® lessons are sequenced within each grade, and from grade to grade, to make instruction easy at the appropriate level. For any particular topic, use the Related STAMS® Lessons feature in the teacher guide to find a lesson, from the same grade level or from an earlier grade, that meets the student’s needs.

Review within the grade level

- If a student isn’t succeeding with a lesson, your first resource is reviewing prerequisite skills in related lessons in the same book. In most cases these skills were taught in an earlier lesson.
- A careful review of Part One and Part Two of Related STAMS® Lessons can help a student quickly get back on track.

Review at a lower grade level

- Sometimes lessons cover prerequisite skills from a previous grade’s book.
- Again, a review of Part One and Part Two of Related STAMS® Lessons can help a student quickly get back on track.
- A student who frequently needs to review material from a previous level may need consistent instruction at that level before that student can succeed in the core program at grade level.
- Consider administering the CAMS® Pretest from the previous level. These results will help you place the student more appropriately.

To review skills from related lessons, you might:

- Use the corresponding Interactive Whiteboard Lessons and review only Part One and Part Two.
- Use the appropriate student book lesson and work with the student through either Part One and Part Two, or all five parts.

...be able to:
...nts in the coordinate plane.
...raph equations in two variables.
...Solve equations for given values of x .

RELATED STAMS® LESSON

- Book H – Lesson 7

Graph Linear Equations has students plot points as well as use the slope and y -intercept to graph lines.

VOCABULARY

PAGE 74

Linear equation: an equation whose graph is a straight line

Point: a pair of numbers

Lesson 8 SOLVE SYSTEMS GRAPHICALLY

LESSON OBJECTIVES

Students will:

- Understand systems of equations.
- Determine the solution of a system of equations by graphing.

PREREQUISITES

Students should be able to:

- Plot points in the coordinate plane.
- Graph equations in two variables.
- Solve equations for given values of x .

RELATED STAMS® LESSON

Book H – Lesson 7

Graph Linear Equations has students plot points as well as use the slope and y -intercept to graph lines.

VOCABULARY

PAGE 74

Linear equation: an equation whose graph is a straight line

Point: a pair of numbers

MATH BACKGROUND

A solution of a linear equation in terms of x is an ordered pair (x, y) that makes the equation true. Two linear equations form a system, and a solution of the system is an ordered pair that is a solution to both equations. In this lesson, students will learn how to find the solution of a system by graphing. Graphs show that there are three possible solutions of a system of two linear equations:

- The lines intersect and the system has exactly one solution—the ordered pair that corresponds to the point of intersection. This is the case that will be encountered most frequently.
- The lines are parallel and the system has no solution (because the lines do not intersect).
- The lines coincide (they are the same line) and the system has infinitely many solutions. (This case is not explicitly covered in the lesson.)

This lesson uses the most basic method of graphing equations—plotting points. Encourage students to use what they learned in Lesson 7 about the slope-intercept form, $y = mx + b$, to check their graphs.

This 12-page section guides teachers through a sample lesson plan from the *STAMS*® teacher guide, which shows facsimiles of the student book lesson. Numbered boxes call out and describe the key features in both the teacher guide and student book.

INTRODUCTION

Lesson 8 SOLVE SYSTEMS GRAPHICALLY

1 LESSON OBJECTIVES

Students will:

- Understand systems of equations.
- Determine the solution of a system of equations by graphing.

2 PREREQUISITES

Students should be able to:

- Plot points in the coordinate plane.
- Graph equations in two variables.
- Solve equations for given values of x .

3 RELATED STAMS® LESSON

- **Book H – Lesson 7**
Graph Linear Equations has students plot points as well as use the slope and y -intercept to graph lines.

4 VOCABULARY

PAGE 74

- **linear equation:** an equation whose graph is a straight line
- **ordered pair:** a pair of numbers used to represent the location of a point in the coordinate plane
- **solution of an equation:** a value of the variable or variables that makes an equation true
- **system of linear equations:** a set of two or more linear equations
- **intersection:** the point at which two or more lines meet

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- **parallel lines:** lines that never meet

PAGE 77

- **coinciding lines:** lines that lie on top of each other

5 MATH BACKGROUND

A solution of a linear equation in terms of x and y is an ordered pair (x, y) that makes the equation true. Two linear equations form a system, and a solution of the system is an ordered pair that is a solution of both equations. In this lesson, students will learn how to find the solution of a system by graphing. Graphs show that there are three possible cases for solutions of a system of two linear equations.

- The lines intersect and the system has exactly one solution—the ordered pair that corresponds to the point of intersection. This is the case that students will encounter most frequently.
- The lines are parallel and the system has no solution (because the lines do not intersect).
- The lines coincide (they are the same line) and the system has infinitely many solutions. (This case is not explicitly covered in the lesson.)

This lesson uses the most basic method of graphing equations—plotting points. Encourage students to use what they learned in Lesson 7 about the slope-intercept form, $y = mx + b$, to check their graphs.

6 Interactive Whiteboard
Visualize Solving Systems of Equations by Graphing

Go to the *Interactive Whiteboard Lessons* to bring Parts One and Two to life. Use features such as sliding screens with additional practice to deepen students' understanding of solving systems of equations graphically.

90 Solve Systems Graphically

Algebra

Best Practices

Math Vocabulary

Knowledge of math terminology is critical to students' understanding of new concepts and skills. To master math vocabulary, students must see and use the words in context frequently, both orally and in writing.

- As students encounter new terms in text, model the correct pronunciation of each word and have students repeat the word.
- Model the correct use of math terms as you present each lesson.
- Suggest that students highlight or underline new vocabulary as they encounter it.
- Ask students to state or write the definition in their own words and/or use the word in context.
- Encourage students to use math terms whenever they are communicating their ideas about math.

1

Lesson Objectives: Identifies skills-related goals for students.

2

Prerequisites: Lists critical concepts/skills required for success with the lesson.

3

Related STAMS® Lessons: Identifies precursor lessons that lay the foundation for the concepts/skills students are about to learn.

4

Vocabulary: Lists key math terms from the lesson, with definitions.

5

Math Background: Supports teacher understanding of why the lesson content is important for students to learn.

6

Interactive Whiteboard: Enhances instruction by turning the lesson into an engaging and visual experience.

Tips for using the Interactive Whiteboard Lessons:

- Click on and preview the teacher notes before teaching the lesson. Print out these notes for easy reference.
- Introduce the skills taught in Part One and Part Two with the Interactive Whiteboard Lessons. Have students follow along in their books so they will know where to find explanations and examples they may need to review later.
- Use the Interactive Whiteboard Lessons as a quick recap before Part Three and Part Four.
- Access Interactive Whiteboard Lessons from previous levels to quickly review topics in Related STAMS® Lessons.
- Encourage student participation. Allow plenty of time for students to use the interactive whiteboard features to work out problems.
- Rename, save, and print out the work done on the interactive whiteboard to share with students.

To download the Interactive Whiteboard Lessons and a User Guide, go to CurriculumAssociates.com/STAMS/IWB. Use the password STAMSIWB.

PART ONE

PART TWO

Modeled Instruction

Lesson 8 SOLVE SYSTEMS GRAPHICALLY
PART ONE: Learn About Systems of Equations

1

Explore How can you find the solution of a system of equations from a graph?

The graph of a linear equation is a line formed by the ordered pairs (x, y) that are solutions of the equation.

$(2, 3): 3 = \frac{1}{2}(2) + 2$ $(4, 4): 4 = \frac{1}{2}(4) + 2$
 $3 = 1 + 2$ $4 = 2 + 2$

A system of linear equations is a set of two or more linear equations.

How can you use a graph to find the solution of a system of equations?



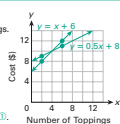
2

Think This system shows the costs of a pizza at two pizza shops: $y = \text{cost in dollars}$ and $x = \text{number of toppings}$.

① $y = x + 6$
② $y = 0.5x + 8$

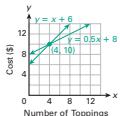
Graph both equations by plotting points. Choose values for x , and then use the equation to find the corresponding y values.

$(2, 8)$ and $(6, 12)$ are solutions of equation ①.
 $(2, 9)$ and $(6, 11)$ are solutions of equation ②.



Connect The solution of a system is an ordered pair (x, y) that is a solution of each equation. To find the solution using a graph, find the point where the lines intersect, or meet.

The solution of the system is $(4, 10)$. So, a pizza with 4 toppings costs \$10 at both pizza shops.



3

Let's Talk How could you use the graph to decide which pizza shop to choose?

Guided Instruction

4

Think It Through

Fill in the blanks as you solve the problem.

One gym charges a \$60 initiation fee, plus \$20 per month. Another gym charges \$40 per month with no initiation fee. This system shows the membership fees at the two gyms, where x represents the number of months and y represents the cost in dollars.

① $y = 20x + 60$
② $y = 40x$

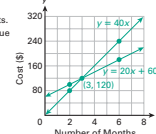
For how many months of membership is the cost the same at both gyms? What is the cost?

Graph both lines by plotting points.

Use the equation to find the y -value for each given value of x .

$(2, 100)$ and $(6, 180)$ are solutions of equation ①.

$(2, 80)$ and $(6, 240)$ are solutions of equation ②.



Check your solution by substituting the coordinates of the point of intersection into each equation. If both equations are true, then the solution is correct.

Find the point where the lines intersect.

The solution of the system is $(3, 120)$.

Solution: A 3 -month membership costs $\$120$ at both gyms.

5

Your Turn Now, use what you know to solve this problem.

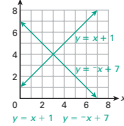
1. What is the solution of the system of equations shown in the graph?

Solution of system: $(3, 4)$

How do you know?

The lines intersect at this point.

Check your solution.



$y = -x + 1$ $y = -x + 7$
 $4 = -3 + 1$ $4 = -3 + 7$
 $4 = 4$ $4 = 4$

If two lines are parallel, the lines do not intersect, and there are no solutions of the system. If two lines lie on top of each other, the lines coincide, and there are an infinite number of solutions of the system. Otherwise, there is exactly one solution of the system.

6 AT A GLANCE

Students activate their background knowledge about linear equations and then learn about graphing a system of linear equations.

7 STEP BY STEP

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- Introduce the **Question** at the top of the page.
- Have students study the graph shown in **Explore** and connect the points shown with how they satisfy the equation: $3 = \frac{1}{2}(2) + 2$ and $4 = \frac{1}{2}(4) + 2$.
- Read **Think** with students. Emphasize that the x -values of the points are randomly chosen, and the y -values are calculated by substituting the x -values into the equations.
- Discuss **Connect** with students. Help them understand that the point where the lines intersect is a solution of both lines because it lies on both lines.

8

Tip: Have students substitute 4 for x and 10 for y in both equations. Students should see that $(4, 10)$ is a solution of both equations.

9

ELL Support: Help students connect *intersect* with a traffic intersection, which is where roads *meet* or *cross*.

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- Read the **Think It Through** problem with students.
- Help students determine that the x -value of the intersection point is the number of months at which the gyms will cost the same amount and the y -value is the total cost.

- Monitor students as they complete **Your Turn**. Then discuss the correct answer.

10

Error Alert: Students who answered $(4, 3)$ have reversed the coordinates.



ADDITIONAL ACTIVITY

See **Hands-on Activity** (page 97).

Student Book

- 1 Focus Question:** Sets a purpose for student learning. Gets students thinking about the answer arrived at through Explore/Think/Connect.
- 2 Explore/Think/Connect:** Provide students with a proven routine to apply to all math problems. **Explore** activates students' prior knowledge and introduces the concept/skill. **Think** presents leading questions or statements to get students thinking about the concept/skill. **Connect** answers the focus question.
- 3 Let's Talk:** Develops students' ability to communicate effectively about math through an engaging peer-learning activity.
- 4 Think It Through:** Walks students through the thinking process for solving an example problem.
- 5 Your Turn:** Reinforces instruction with independent practice.

Teacher Guide

- 6 At a Glance:** Sums up what students do in each lesson part.
- 7 Step by Step:** Provides an explicit walk-through of the steps for guiding students through each lesson part.
- 8 Tip:** Provides on-the-spot information the teacher can use to build students' understanding of the concept/skill.
- 9 ELL Support:** Targets at point-of-use a language issue that may be affecting English language learners' ability to understand the math.
- 10 Error Alert:** Addresses common errors or misconceptions that lead students to an incorrect answer.

Modeled & Guided Instruction

Teacher Led

After prompting students to tap into their prior knowledge, the teacher uses step-by-step examples to model the new concept/skill and guide instruction.

Best Practices

Think-Aloud

The ability to verbalize mathematical thinking and strategies to others strengthens conceptual understanding and problem-solving skills.

- To foster effective discussion, plan carefully when grouping students for Let's Talk. Consider skill levels, social skills, and English language proficiency.
- Circulate and provide tips or encouragement as students work together to discuss math ideas. Guide the discussion as needed.
- During Think It Through, allow students to work in pairs or groups and talk aloud as they follow the steps to solve the problem.

COMPONENTS OF MATH INSTRUCTION

Math Strategies	Examples in STAMS® Series	Research Says
<p>Computational Fluency Computational fluency is having quick recall of number facts and knowledge, and the ability to apply multiple computational methods.</p>	<p>Student Book Problems in each lesson part reinforce grade appropriate methods for computing.</p>	<p>“Efficient, accurate computational fluency is key to students’ success in higher-level mathematics necessary for the workplace.” — <i>National Research Council, 2001</i></p>
<p>Conceptual Understanding Conceptual understanding is the knowledge of why math processes and rules work.</p>	<p>Student Book Students develop conceptual understanding in Part One and Part Two and demonstrate their knowledge in Part Three, Part Four, and Part Five.</p>	<p>“Students with conceptual understanding know more than isolated facts and methods. They understand why a mathematical idea is important and the kinds of context problem-solving in which it is useful.” — <i>National Research Council, 2001</i></p>
<p>Error Analysis Error analysis is an explanation of the patterns of mistakes students make. It allows teachers to provide targeted instruction that will help correct the errors.</p>	<p>Student Book</p> <ul style="list-style-type: none"> • Part Three: Check <p>Teacher Guide</p> <ul style="list-style-type: none"> • Part One and Part Two: Error Alert feature • Part Three: Answer Analysis • Assessment and Remediation chart 	<p>“Research has shown that building upon students’ prior knowledge and directly addressing misconceptions can lead to increased learning.” — <i>Swan, 2002; Askew, 2002</i></p>
<p>Math Vocabulary Math vocabulary is the group of content-area words, or Tier 3 words, that are most often specific to math text and used rarely in other contexts.</p> <p>Controlled Vocabulary Controlled vocabulary is the use of words at a lower reading level. It allows students to learn new concepts without struggling with reading issues.</p>	<p>Student Book</p> <ul style="list-style-type: none"> • Students must use math language in their explanations for solving the extended-response problems in Part Four and Part Five. • Math vocabulary words are boldfaced. • Key terms are defined explicitly. • The Let’s Talk activities in Part One and Part Two provide opportunities for students to use math language in context. • Each lesson uses controlled vocabulary to make new math knowledge more accessible and understandable. <p>Teacher Guide</p> <ul style="list-style-type: none"> • Vocabulary Activity • Definitions of key math terms are provided for each lesson. 	<p>“Tier Three words should be taught at point of contact, or as they occur in text.” — <i>Beck, McKeown, & Kagan, 2002</i></p> <p>“Without a basic knowledge of these terms, students will have difficulty understanding information they read or hear. Knowledge of important terms is critical to understanding any subject.” — <i>Marzano & Pickering, 2005</i></p> <p>“Research has demonstrated that vocabulary learning occurs most successfully through instructional environments that are language-rich, actively involve students in using language, require that students both understand spoken or written words and also express that understanding orally and in writing, and require students to use words in multiple ways over extended periods of time.” — <i>CCSSO/NGA, 2010</i></p>

For a full report and bibliography, go to CurriculumAssociates.com/STAMS/research.

COMPONENTS OF MATH INSTRUCTION *(continued)*

Math Strategies	Examples in STAMS® Series	Research Says
<p>Meaningful Practice</p> <p>Meaningful practice is problem solving that requires students to apply learned concepts and skills.</p>	<p>Student Book</p> <ul style="list-style-type: none"> • Part One through Part Four: Your Turn • Part Five: Independent practice 	<p>“Meaningful practice: to gain deeper understanding of topic—practice that focuses on building conceptual understanding related to skills and procedures.”</p> <p>— <i>Marzano et al, 2000</i></p>
<p>Multiple Representations</p> <p>Multiple representations are the ways in which a teacher or student represents a math idea, including spoken, written, symbolic, and concrete formats.</p>	<p>Student Book</p> <p>Symbolic, pictorial, spoken, and written methods are used throughout each lesson part to instruct students.</p>	<p>“Each of the different types of representation adds a new layer or a new dimension to the understanding of the concept being represented. Some students find some representations easier to understand than others.”</p> <p>— <i>Mendieta, 2006</i></p>
<p>Procedural Knowledge</p> <p>Procedural knowledge is the understanding of when and how to use mathematical procedures effectively. It aids in automatic recall of facts, allowing for further study of new math concepts and skills.</p>	<p>Student Book</p> <p>Through scaffolding, students develop procedural knowledge in Part One through Part Four. By Part Five they become independent problem solvers.</p>	<p>“Students need to be efficient and accurate in performing basic computation with whole numbers without having to rely on tables or other aids. They also need to know reasonably efficient and accurate ways to add, subtract, multiply, and divide multi-digit numbers, both mentally and with pencil and paper.”</p> <p>— <i>National Research Council, 2001</i></p>

GENERAL INSTRUCTIONAL STRATEGIES

Strategies	Examples in STAMS® Series	Research Says
<p>Differentiated Instruction</p> <p>Differentiated instruction is an instructional approach that supports students of varying abilities to learn the same content. Various techniques or strategies include grouping students by ability level, pairing students for peer learning, or providing off-level lessons that are parallel to students’ abilities.</p>	<p>Teacher Guide</p> <ul style="list-style-type: none"> • The Differentiating Instruction section in the Overview provides suggestions on ways to meet the needs of all students. • Reteaching Activity for students still struggling to learn the skill • Challenge Activity for students who have mastered the skill • Related STAMS® Lessons that direct teachers to precursor skills 	<p>“Although differentiated instruction is not a new idea, the differentiation movement has recently taken center stage as a means of meeting the needs of all students in the classroom. It is an organized, yet flexible way of proactively adjusting teaching and learning to meet students where they are and help all students achieve maximum growth as learners.”</p> <p>— <i>Tomlinson, 1999</i></p>
<p>Explicit Instruction</p> <p>Explicit instruction is a method of teaching in which topics are broken down into small parts and taught individually. It involves explanation, demonstration, and practice in a structured environment.</p>	<p>Student Book</p> <ul style="list-style-type: none"> • Part One and Part Two: Modeled problem solving with scaffolded student participation • Part Three and Part Four: Modeled practice • Part Five: Independent practice <p>Teacher Guide</p> <ul style="list-style-type: none"> • Step by Step provides guidance for teachers to most effectively walk students through a concept. 	<p>“Explicit instruction with students who have mathematical difficulties has shown consistently positive effects on performance with word problems and computation. Results are consistent for students with learning disabilities, as well as other students who perform in the lowest third of a typical class.”</p> <p>— <i>NMAP, 2008</i></p>

GENERAL INSTRUCTIONAL STRATEGIES (continued)

Strategies	Examples in STAMS® Series	Research Says
<p>Family Engagement</p> <p>Family engagement is a strategy that involves and engages parents, guardians, and other family members in a student’s school life, with the goal of boosting student success.</p>	<p>Teacher Guide</p> <ul style="list-style-type: none"> • School-Home Connection 	<p>“It is well-documented—and plain common sense—that parental involvement in a child’s education boosts student learning and improves both behavior and attendance.”</p> <p>— <i>A. Duncan, 2010</i></p>
<p>Metacognition</p> <p>Metacognition is “thinking about thinking” to identify what skills or strategies need to be activated or improved to achieve the next learning goal (see also Think Aloud).</p>	<p>Student Book</p> <ul style="list-style-type: none"> • Part One and Part Two: Let’s Talk and Think it Through • Part Three: Solve and Check <p>Teacher Guide</p> <ul style="list-style-type: none"> • Throughout the lesson, students answer “why questions” posed by the teacher. 	<p>“Individual reflection or interaction with others (both teachers and peers) encourages students to communicate and explain their thinking.”</p> <p>— <i>Reys, Suydam, Lindquist, & Smiths, 1998</i></p> <p>This reflection moves students beyond simple fact recall into deeper thinking of explaining “how” and “why.”</p>
<p>Prior Knowledge</p> <p>Prior knowledge is the previous experience and knowledge that a student has about a topic that aid learning.</p>	<p>Student Book</p> <ul style="list-style-type: none"> • Part One and Part Two: Explore <p>Teacher Guide</p> <ul style="list-style-type: none"> • Prerequisites • Related STAMS® Lessons 	<p>“Students learn better when new knowledge is connected to things they already know and understand”</p> <p>— <i>Hiebert and Carpenter, 1992; Hiebert et al, 1997</i></p>
<p>Real-world Connections</p> <p>Real-world connections are links that are made between mathematics concepts and real-life situations.</p>	<p>Student Book</p> <ul style="list-style-type: none"> • Part One through Part Five: Word problem contexts <p>Teacher Guide</p> <ul style="list-style-type: none"> • Real-World Connection • School-Home Connection 	<p>“A synthesis of findings from a small number of high-quality studies indicates that if mathematical ideas are taught using ‘real-world’ contexts, then students’ performance on assessments involving similar “real-world” problems is improved.”</p> <p>— <i>NMAP, 2008</i></p>
<p>Scaffolded Instruction</p> <p>Scaffolded instruction is the gradual withdrawal of instructional support as a student learns a new concept, skill, or task.</p>	<p>Student Book</p> <p>The instructional design of Part One through Part Five of every lesson provides a gradual release of responsibility from the teacher to the student.</p>	<p>“There is ample evidence that students are more successful in school and find it more satisfying if they are taught in ways that are responsive to their readiness levels.”</p> <p>— <i>Vygotsky, 1986</i></p>
<p>Targeted Instruction</p> <p>Targeted instruction is the teaching of focused math concepts and skills that are essential to learning higher-order mathematics.</p>	<p>Student Book</p> <p>Lessons in the student book are designed to provide deep instruction of key math concepts and skills. Sixteen key topics for each grade level address NCTM Focal Points and Connections.</p>	<p>“When instruction focuses on a small number of key areas of emphasis, students gain extended experience with core concepts and skills. Such experience can facilitate deep understanding, mathematical fluency, and an ability to generalize.”</p> <p>— <i>NCTM, 2006</i></p>

GENERAL INSTRUCTIONAL STRATEGIES (continued)

Strategies	Examples in STAMS® Series	Research Says
<p>Teacher Effectiveness Support Teacher effectiveness support is the inclusion of “best practices” suggestions that allow teachers to maximize their effectiveness and knowledge of mathematics.</p>	<p>Teacher Guide</p> <ul style="list-style-type: none"> • Math Background • ELL Support • Error Alert • Point-of-use tips • Best Practices 	<p>Recent federal initiatives, such as the ESEA renewal and Race to the Top grant, have centered around the effectiveness of an individual teacher on student achievement. “The mathematics preparation of elementary and middle school teachers must be strengthened as one means for improving teachers’ effectiveness in the classroom.” — <i>NMAP, 2008</i></p>
<p>Technology-based Learning Technology-based learning is the use of instructional technology to help improve student achievement.</p>	<p>Teacher Guide</p> <ul style="list-style-type: none"> • Interactive Whiteboard Lessons, available online 	<p>“Interactive whiteboards in the classroom result in: increased student engagement and motivation; greater opportunities for participation and collaboration; improved personal and social skills and self-confidence; greater progress in mathematics and science for students in years; accommodation for different learning styles; and improved attainment for students with special needs.” — <i>SETDA, 2009</i></p>
<p>Think Aloud Think aloud is a strategy in which students talk through the decisions they make and the steps they take to solve a problem.</p>	<p>Student Book</p> <ul style="list-style-type: none"> • Part One and Part Two: Let’s Talk and Think It Through 	<p>“The process of encouraging students to verbalize their thinking—by talking, writing, or drawing the steps they used in solving a problem—was consistently effective.” — <i>NCTM, 2007</i></p>

NCTM PROCESS STANDARDS

Process Standards	Examples in STAMS® Series	Research Says
<p>Communication Students use the language of math to accurately express their mathematical ideas to others, and analyze and evaluate the mathematical thinking and strategies of others.</p>	<p>Student Book</p> <ul style="list-style-type: none"> • Part One and Part Two: Let’s Talk • Part Three: Check • Part Four and Part Five: Explanation of solution <p>Teacher Guide</p> <ul style="list-style-type: none"> • ELL Support • School-Home Connection • Vocabulary Activity 	<p>“Encouraging math talk so that students can clarify their strategies to themselves and others, and compare the benefits and limitations of alternate approaches to problem solving.” — <i>National Research Council, 2001</i></p>
<p>Connections Students recognize and use connections among mathematical ideas, such as linking knowledge of the subtraction of whole numbers to the subtraction of decimals or fractions. Students also connect math concepts to their daily lives, and to other subjects, such as science.</p>	<p>Student Book</p> <ul style="list-style-type: none"> • Part One and Part Two: Explore, Think, and Connect <p>Teacher Guide</p> <ul style="list-style-type: none"> • Math Background • Real-World Connection 	<p>“Connections are most useful when they link related concepts and methods in appropriate ways. Appropriate ways include methods of extending the understanding of one math concept to another (using multiple representations). Rote memorization does not lead to understanding and building connections.” — <i>National Research Council, 2001</i></p>

NCTM PROCESS STANDARDS (continued)

Process Standards	Examples in STAMS® Series	Research Says
<p>Problem Solving</p> <p>Students build new math knowledge through problem solving and use various strategies to solve problems in math and in other contexts.</p>	<p>Student Book</p> <ul style="list-style-type: none"> • Part One, Part Two, Part Three, Part Four: Your Turn • Part Five: Independent practice 	<p>“Problem solving is an integral part of all mathematics learning. In everyday life and in the workplace, being able to solve problems can lead to great advantages.”</p> <p>— <i>NCTM, 2000</i></p>
<p>Reasoning and Proof</p> <p>Students recognize, use, and evaluate various types of reasoning and methods of proof. Reasoning enables students to make sense of new mathematical ideas. Proofs build a logical argument based on known facts.</p>	<p>Student Book</p> <ul style="list-style-type: none"> • Part One and Part Two: Let’s Talk and Think It Through • Part Three: Solve and Check • Part Four and Part Five: Explanation of solution <p>Teacher Guide</p> <p>Many teacher tips show how to help students reason through a problem.</p>	<p>“Knowing particular mathematical ideas and procedures as mere fact or routine is insufficient for using those ideas flexibly in diverse cases. Making mathematics reasonable means making it reasoned and, therefore, known in useful and usable ways.”</p> <p>— <i>NCTM, 2003</i></p>
<p>Representations</p> <p>Students communicate, clarify, or extend mathematical ideas through concrete or visual models.</p> <p>A representation may be a number sentence, manipulatives, diagrams or graphs and/or symbols.</p>	<p>Student Book</p> <ul style="list-style-type: none"> • Part One and Part Two: Use of visual models • Part Four and Part Five: Show 	<p>“Intervention materials should include opportunities for students to work with visual representations of mathematical ideas and interventionists should be proficient in the use of visual representations of mathematical ideas.”</p> <p>— <i>Gersten et al, 2009</i></p>

ASSESSMENT AND INTERVENTION

Strategies and Features	Examples in CAMS® and STAMS® Series	Research Says
<p>Data-driven Instruction</p> <p>Data-driven instruction is the use of instructional decisions based on the systematic collection of data that reflects students’ understanding.</p>	<p>CAMS® and CAMS® Online</p> <ul style="list-style-type: none"> • 1 Pretest • 4 Benchmarks • 1 Post Test 	<p>“Districts and schools that are improving generally show a commitment to the use of student assessment data to diagnose weaknesses and guide improvement efforts.”</p> <p>— <i>U.S. Department of Education, 2010</i></p>
<p>Progress Monitoring</p> <p>Progress monitoring is a strategy that involves frequent, in-classroom progress checks of students’ understanding and mastery of math concepts and skills.</p>	<p>Student Book</p> <ul style="list-style-type: none"> • Part One through Part Four: Your Turn • Part Five: Independent practice <p>CAMS® and CAMS® Online</p> <ul style="list-style-type: none"> • 1 Pretest • 4 Benchmarks • 1 Post Test 	<p>“Teachers’ regular use of formative assessments improves their students’ learning, especially if teachers have additional guidance on using the assessment results to design and individualize instruction.”</p> <p>— <i>NMAP, 2008</i></p>

Correlations Charts

NCTM Focal Points and Connections The chart below indicates the lessons in *STAMS® Book H* that provide instruction for the NCTM Focal Points and related Connections for grade 8. (For correlations between the NCTM Process Standards and the *STAMS® Series*, see pages 29 and 30 of the teacher guide.)

NCTM Focal Points and Connections for Grade 8	<i>STAMS® Book H</i>
FOCAL POINTS	
Algebra: Students analyze and represent linear functions and solve linear equations and systems of linear equations.	Lessons 3, 4, 5, 6, 7, 8, 9
Geometry and Measurement: Students analyze two- and three-dimensional space and figures using distance and angles.	Lessons 10, 11, 12, 13, 14
Data Analysis and Number and Operations and Algebra: Students analyze and summarize data sets.	Lessons 15, 16
CONNECTIONS	
Algebra: Students identify linear and nonlinear equations.	Lesson 5
Geometry: Students develop an understanding that all slope triangles created on a given line in a coordinate plane are similar.	Lesson 12
Data Analysis: Students use scatter plots to display bivariate data and estimate lines of best fit to make and test conjectures.	Lesson 16
Number and Operations: Students use exponents and square roots to express quantities.	Lessons 1, 2

Common Core State Standards The chart below correlates the lessons in *STAMS® Book H* with Common Core State Standards for grade 8 mathematics.

Common Core State Standards for Grade 8 Mathematics	<i>STAMS® Book H</i>	Common Core State Standards for Grade 8 Mathematics	<i>STAMS® Book H</i>
The Number System		Geometry	
8.NS.1	Lesson 4	8.G.5	Lessons 10, 11, 12
8.NS.2	Lesson 2	8.G.6	Lesson 13
Expressions and Equations		8.G.7	Lesson 13
8.EE.1	Lesson 1	8.G.8	Lesson 14
8.EE.2	Lesson 2	8.G.9	Lesson 1
8.EE.6	Lesson 12	Statistics and Probability	
8.EE.7	Lessons 3, 4, 5	8.SP.1	Lesson 16
8.EE.8	Lessons 8, 9	8.SP.2	Lesson 16
Functions			
8.F.3	Lessons 5, 7		
8.F.4	Lessons 5, 6, 7		
8.F.5	Lesson 5		

Lesson 8 SOLVE SYSTEMS GRAPHICALLY

LESSON OBJECTIVES

Students will:

- Understand systems of equations.
- Determine the solution of a system of equations by graphing.

PREREQUISITES

Students should be able to:

- Plot points in the coordinate plane.
- Graph equations in two variables.
- Solve equations for given values of x .

RELATED STAMS® LESSON

- **Book H – Lesson 7**

Graph Linear Equations has students plot points as well as use the slope and y -intercept to graph lines.

VOCABULARY

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- **linear equation:** an equation whose graph is a straight line
- **ordered pair:** a pair of numbers used to represent the location of a point in the coordinate plane
- **solution of an equation:** a value of the variable or variables that makes an equation true
- **system of linear equations:** a set of two or more linear equations
- **intersection:** the point at which two or more lines meet

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- **parallel lines:** lines that never meet

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- **coinciding lines:** lines that lie on top of each other

MATH BACKGROUND

A solution of a linear equation in terms of x and y is an ordered pair (x, y) that makes the equation true. Two linear equations form a system, and a solution of the system is an ordered pair that is a solution of both equations. In this lesson, students will learn how to find the solution of a system by graphing. Graphs show that there are three possible cases for solutions of a system of two linear equations.

- The lines intersect and the system has exactly one solution—the ordered pair that corresponds to the point of intersection. This is the case that students will encounter most frequently.
- The lines are parallel and the system has no solution (because the lines do not intersect).
- The lines coincide (they are the same line) and the system has infinitely many solutions. (This case is not explicitly covered in the lesson.)

This lesson uses the most basic method of graphing equations—plotting points. Encourage students to use what they learned in Lesson 7 about the slope-intercept form, $y = mx + b$, to check their graphs.



Interactive Whiteboard

Visualize Solving Systems of Equations by Graphing

Go to the *Interactive Whiteboard Lessons* to bring Parts One and Two to life. Use features such as sliding screens with additional practice to deepen students' understanding of solving systems of equations graphically.

Modeled Instruction

Lesson 8 SOLVE SYSTEMS GRAPHICALLY

PART ONE: Learn About Systems of Equations

How can you find the solution of a system of equations from a graph?

Explore

The graph of a linear equation is a line formed by the ordered pairs (x, y) that are solutions of the equation.

$(2, 3): 3 = \frac{1}{2}(2) + 2$ $(4, 4): 4 = \frac{1}{2}(4) + 2$

$3 = 1 + 2$ $4 = 2 + 2$

A system of linear equations is a set of two or more linear equations.

How can you use a graph to find the solution of a system of equations?

Think

This system shows the costs of a pizza at two pizza shops; $y =$ cost in dollars and $x =$ number of toppings.

① $y = x + 6$
② $y = 0.5x + 8$

Graph both equations by plotting points. Choose values for x , and then use the equation to find the corresponding y -values.

$(2, \underline{8})$ and $(6, \underline{12})$ are solutions of equation ①.
 $(2, \underline{9})$ and $(6, \underline{11})$ are solutions of equation ②.

Connect

The solution of a system is an ordered pair (x, y) that is a solution of each equation. To find the solution using a graph, find the point where the lines intersect, or meet.

The solution of the system is $(4, 10)$.

So, a pizza with 4 toppings costs \$10 at both pizza shops.

Let's Talk How could you use the graph to decide which pizza shop to choose?

74 Solve Systems Graphically
Algebra

Guided Instruction

Think It Through

Fill in the blanks as you solve the problem.

One gym charges a \$60 initiation fee, plus \$20 per month. Another gym charges \$40 per month with no initiation fee. This system shows the membership fees at the two gyms, where x represents the number of months and y represents the cost in dollars.

① $y = 20x + 60$
② $y = 40x$

For how many months of membership is the cost the same at both gyms? What is the cost?

■ Graph both lines by plotting points. Use the equation to find the y -value for each given value of x .

$(2, \underline{100})$ and $(6, \underline{180})$ are solutions of equation ①.
 $(2, \underline{80})$ and $(6, \underline{240})$ are solutions of equation ②.

■ Find the point where the lines intersect. The solution of the system is $(\underline{3}, \underline{120})$.

Solution: A 3-month membership costs \$120 at both gyms.

Check your solution by substituting the coordinates of the point of intersection into each equation. If both equations are true, then the solution is correct.

Your Turn Now, use what you know to solve this problem.

1. What is the solution of the system of equations shown in the graph?

Solution of system: $(\underline{3}, \underline{4})$

How do you know?
The lines intersect at this point.

Check your solution.

$y = x + 1$ $y = -x + 7$
 $4 = 3 + 1$ $4 = -3 + 7$
 $4 = 4$ $4 = 4$

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AT A GLANCE

Students activate their background knowledge about linear equations and then learn about graphing a system of linear equations.

STEP BY STEP

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- Introduce the **Question** at the top of the page.
- Have students study the graph shown in **Explore** and connect the points shown with how they satisfy the equation: $3 = \frac{1}{2}(2) + 2$ and $4 = \frac{1}{2}(4) + 2$.
- Read **Think** with students. Emphasize that the x -values of the points are randomly chosen, and the y -values are calculated by substituting the x -values into the equations.
- Discuss **Connect** with students. Help them understand that the point where the lines intersect is a solution of both lines because it lies on both lines.

Tip: Have students substitute 4 for x and 10 for y in both equations. Students should see that $(4, 10)$ is a solution of both equations.

- Organize students in pairs or groups for **Let's Talk** and monitor their discussions.
- Help students interpret the graphs. Be sure they understand that their choice depends on their preferred number of toppings. Place ① is cheaper for 0–3 toppings; ② is cheaper for more than 4 toppings.

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- Read the **Think It Through** problem with students.
- Help students determine that the x -value of the intersection point is the number of months at which the gyms will cost the same amount and the y -value is the total cost.

ELL Support: Help students connect *intersect* with a traffic intersection, which is where roads *meet* or *cross*.

- Monitor students as they complete **Your Turn**. Then discuss the correct answer.

Error Alert: Students who answered $(4, 3)$ have reversed the coordinates.



ADDITIONAL ACTIVITY

See **Hands-on Activity** (page 97).