OHIO LEARNING STANDARDS FOR MATHEMATICS

Algebra 1

Program Overview and Sampler

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OHIO LEARNING STANDARDS FOR MATHEMATICS

Algebra 1

Preparing for College and Career

The ***Ohio Learning Standards for Mathematics*** program provides the foundation for Algebra 1 success. Students learn through direct instruction, discovery-based learning, and guided practice, allowing them to transfer skills to real-world situations, problem-solving activities, and the Ohio Standards Algebra 1 Test. Through active discourse and collaborative activities, students learn to communicate effectively and gain the perseverance necessary to solve difficult problems.

Learning Through Multiple Approaches

Discovery-Based Learning	Application
• Guided Instruction • Guided Practice • Connect to Testing	• Concepts in the Real World • Extension and Interactive Activities • Authentic OST Practice
Personalized Practice	**Direct Instruction**
• *i-Practice* Personalized Assignments (Digital) • Video Model Problems (QR Codes, Digital) • Multiple Problem Help Options (Digital)	• Lesson Introduction • Words to Know • Remediation Activities

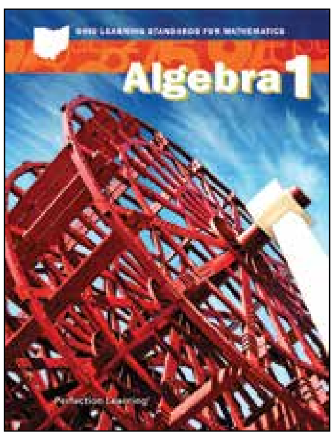
Student-Centered Approach to Algebra 1

The ***Ohio Learning Standards for Mathematics*** program focuses on active learning. Engage students as they explore concepts, learn through guided instruction, and apply their knowledge in the extension and assessment activities.

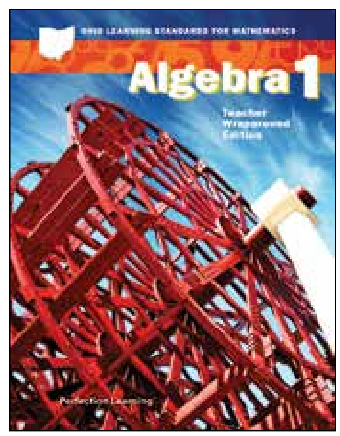
Prepare Students for Success

Designed specifically for the Ohio Learning Standards, the curriculum ensures that students will have the knowledge and skills that matter for both the Ohio Standards Algebra 1 Test and their college and career paths. The Ohio Learning Standards are addressed in each lesson and are listed at point of use.

Program Components

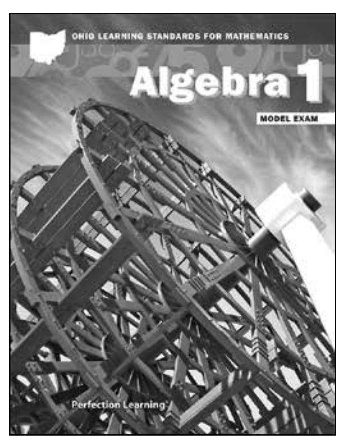


Student Worktext



Teacher Wraparound Edition

Ohio Algebra 1 Digital



Model Exam

PERSONALIZED LEARNING

- Lesson videos, accessed through QR codes, provide students with model problems on demand.
- Digital assignments can be customized and delivered individually, to small groups, or to the whole class.
- Through *i-Practice*, each student can practice skills to mastery.

ACTIVE DISCOURSE AND MATH LITERACY

Throughout each lesson, students and teachers engage in whole class, small group, and peer discussions. Students develop communication skills and math literacy as they work with others to understand concepts, build skills, and tackle more complex problems.

DEPTH OF KNOWLEDGE (DOK)

Concepts, questions, and activities are carefully designed to meet the full range of Webb's task complexity. All practice and assessment items are tagged with DOK levels. Independent practice and chapter tests prepare students for the rigor of the Ohio Standards Algebra 1 Test as well as other complex tasks and projects.

4. Which of the following equations is not equivalent to the rest?

A. $y=\frac{1}{3}x-7$

B. $y+5=\frac{1}{3}(x-6)$

C. $x-3y=21$

D. $3x-y=21$

(DOK 3)

ASSESSMENT

Each chapter and lesson focuses on specific learning outcomes with aligned formative and summative assessments. Items mirror those on high-stakes assessments with an emphasis on the Ohio standards.

• Connect to Testing • independent practice • chapter-level and comprehensive OST practice • chapter tests	• diagnostic tests • digital assignments, quizzes, and tests • teacher-built assignments and tests using an extensive item bank and online assignment builder

DIFFERENTIATION

Support for ELLs, ESEs, and advanced students helps all students succeed and be challenged.

- **Point-of-use vocabulary and math literacy support, remediation suggestions, and videos ensure content is accessible.**
- **Extension activities and a rich problem item bank ensure students remain challenged.**

ELL

Provide the following sentence frames to help students respond to the RECAP question.

Beginning/Intermediate:

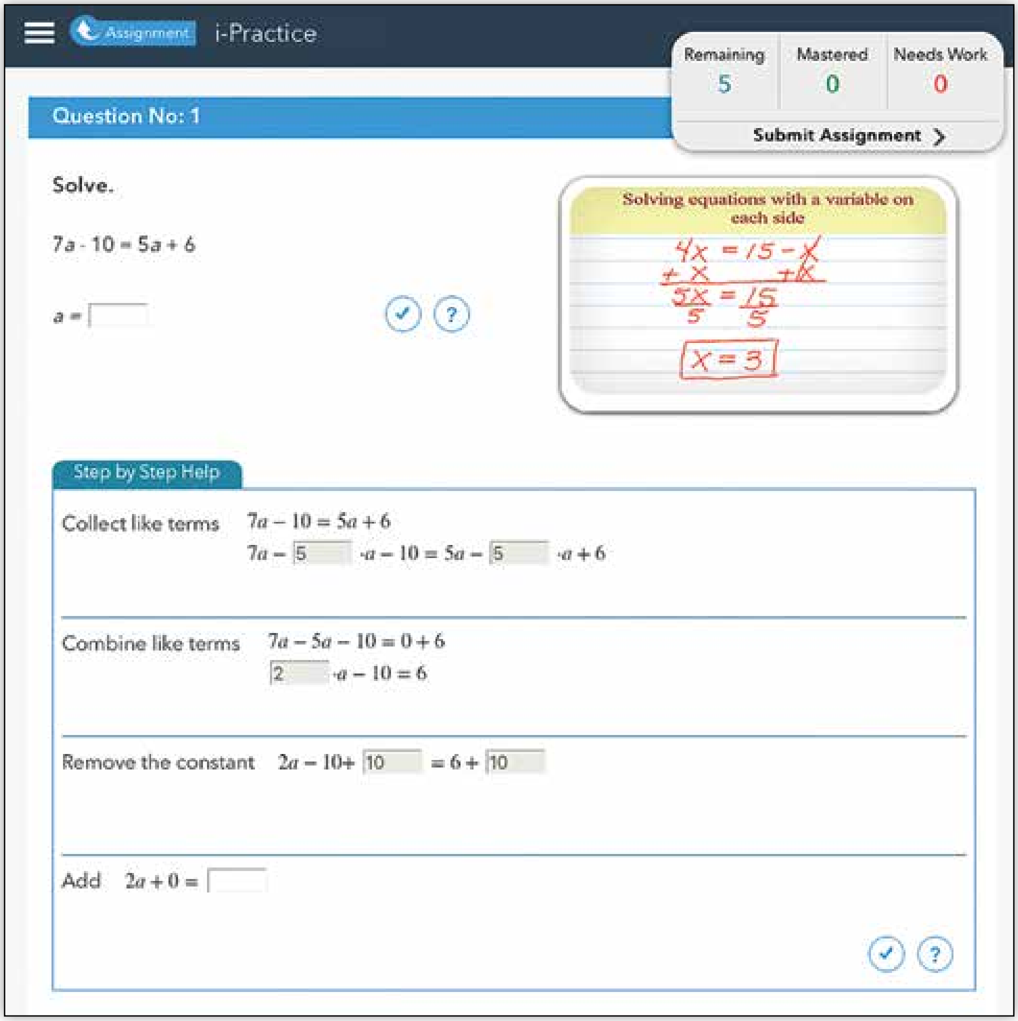
- *One way to find slope is* _______.
- *This way is best for* _______.
- *Another way to find slope is* _______.
- *This way is best for* _______.

Intermediate/Advanced:

- *One way to find slope is* _______.
- *This way is most appropriate for* _______.
- *Another way to find slope is* _______.
- *This way is most appropriate for* _______.

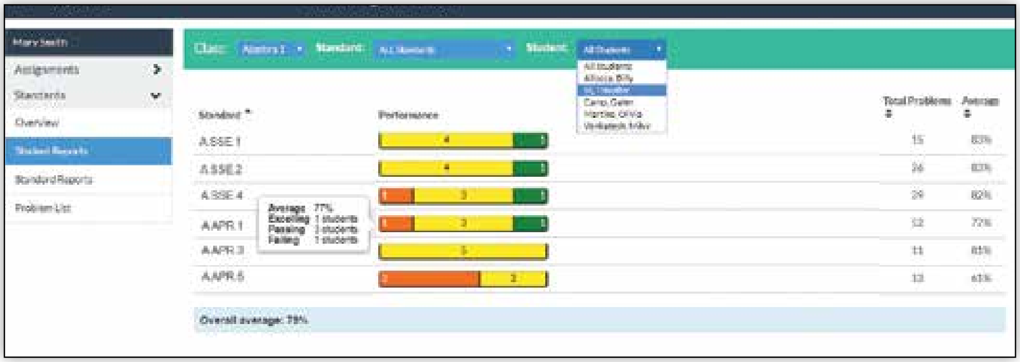
DIGITAL ASSIGNMENTS, QUIZZES, AND TESTS

- *i-Practice* personalized assignments
- point-of-use support (videos, hints, step-by-step help) and smart feedback
- pre-built diagnostic, chapter, and summative tests
- OST practice
- technology-enhanced items (equation editor, multi-select, drag and drop, matching, and much more)
- multiple attempts allowed for homework and *i-Practice*
- print capability for offline assignments



CLASS AND STUDENT ANALYTICS

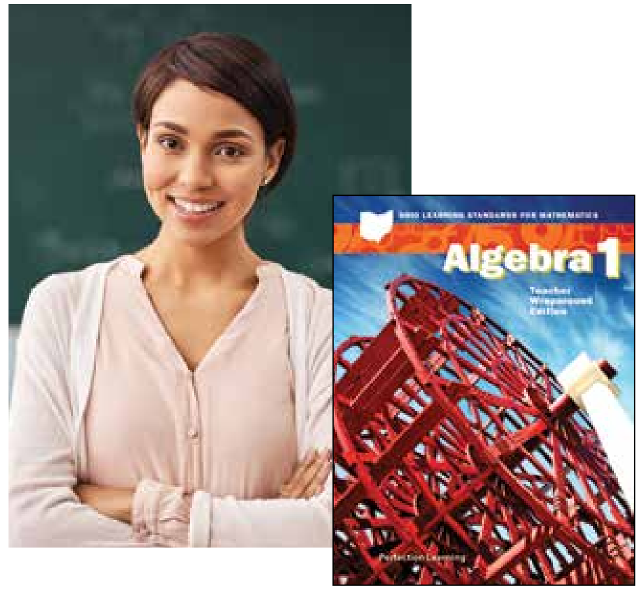
- performance measures by skill and Ohio Mathematics Standard
- extensive drill down capabilities (class, student, item)
- visual highlighting of strengths and performance gaps



LESSON PLANNING AND INSTRUCTIONAL SUPPORT

The teacher wraparound edition, available in both print and digital formats, provides planning guidance for each chapter and lesson, including

- Chapter Planner
- chapter goals with sample problems
- lesson prerequisites and suggested pacing
- discussion questions and suggested answers
- guided practice objectives with implementation ideas to encourage active discourse



OPEN EDUCATIONAL RESOURCES

No more searching the internet for lessons and videos! Open educational resources are provided at point of use.

- reviewed and vetted by math educators to ensure usefulness and appropriateness
- videos, interactive activities, and lesson-specific activities using programs such as **Desmos** and **GeoGebra**
- one-click access to all suggested resources via the digital teacher edition

DIGITAL COURSE MANAGEMENT

Teachers can easily create, modify, and share digital assignments, quizzes, and tests.
In addition, teachers can

- automate grading with instant feedback
- customize assignments
- create individual, group, and whole class assignments
- review answers and modify grades
- modify assignments and due dates

CHAPTER INTRODUCTION

- **Chapter Planner** includes standards, lesson prerequisites, sequencing, and representative sample problems. Lesson pacing suggestions are also available.
- **Lesson alignment** with Ohio Learning Standards for Mathematics is identified in the Chapter Planner and at the beginning of each lesson in the Student Worktext.
- **Chapter Overview** and **Chapter Goals** clearly state the learning objectives.
- **Concepts in the Real World** provides students insight into how chapter concepts are applied outside the classroom.
- **Connect to Testing** engages students in chapter concepts using a OST-style example problem. Guided instruction and active discourse promotes student discovery of new concepts and their application.
- **Words to Know** introduces chapter concept vocabulary.

Chapter Planner

The lessons in this chapter focus on writing, graphing, and solving systems of linear equations and systems of linear inequalities.

Lesson Alignment	When Do I Teach This Lesson?
Lesson 1 Graphing Linear Systems of Equations (A.CED.2a, A.REI.6a, A.REI.11)	Students should know how to rewrite linear equations into slope-intercept form and how to graph linear equations.
Lesson 2 Solving Linear Systems by Elimination or Substitution (A.REI.6a)	This lesson could be split into two parts (substitution, elimination) if your students benefit from having more time to practice new skills.
Lesson 3 Creating Systems of Linear Equations (N.Q.2, A.CED.2a, A.CED.3, A.REI.5, A.REI.6a)	Teach this lesson after demonstrating all methods of solving systems of linear equations.
Lesson 4 Systems of Linear Inequalities in the *xy*-Plane (A.CED.3, A.REI.12)	Prior to this lesson, discuss how to determine if an ordered pair is a solution to a linear inequality and how to graph linear inequalities including those with vertical and horizontal boundaries.

Chapter Sample Problems

1. Which system of equations listed below has infinitely many solutions?

   A. $\begin{cases} y=-\frac{1}{2}x+5 \\ x+2y=-6 \end{cases}$ **C.** $\begin{cases} 2x-3y=9 \\ y=\frac{2}{3}x-3 \end{cases}$

   B. $\begin{cases} y=-2 \\ x=5 \end{cases}$ **D.** $\begin{cases} y=-3x+2 \\ y=\frac{-1}{2}x-3 \end{cases}$

2. Write two equations that, when paired with $3x - 4y = 8$ in a system of equations, would result in no solution. How do you know there is no solution?

3. Edita and Janina are buying school supplies. Edita buys 5 notebooks and 6 binders for a total of $25.45. Janina buys 4 notebooks and 8 binders for $30.60. Boipelo later goes to the same store and buys 3 notebooks and 2 binders. What is his total?

4. Which of the following points are solutions to $\begin{cases} y<4x-3 \\ x-5y\le 10 \end{cases}$? Select all that apply.

   A. (1, 1) **D.** (–3, 1)
   B. (5, –1) **E.** (–6, –6)
   C. (4, 2)

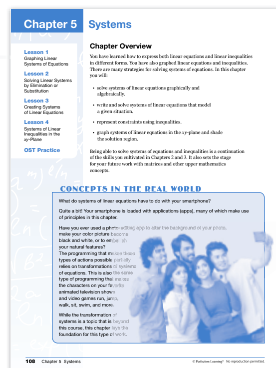
Introduction

Chapter 5 Systems

Chapter Goals:

At the end of this chapter, students should be able to:

- graphically solve a system of two linear equations.
- algebraically solve a system of two linear equations using elimination and substitution.
- write a system of linear equations to model a given situation.
- represent constraints using inequalities.
- graph systems of linear inequalities in the *xy*-plane and shade the solution region.

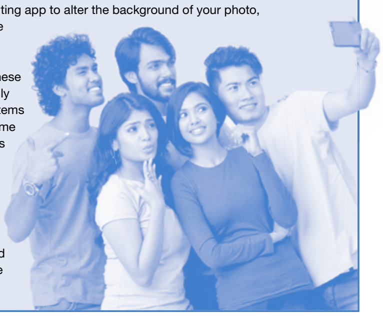


CONCEPTS IN THE REAL WORLD

What do systems of linear equations have to do with your smartphone?

Quite a bit! Your smartphone is loaded with applications (apps), many of which make use of principles in this chapter.

Have you ever used a photo-editing app to alter the background of your photo, make your color picture become black and white, or to embellish your natural features? The programming that makes these types of actions possible partially relies on transformations of systems of equations. This is also the same type of programming that makes the characters on your favorite animated television shows and video games run, jump, walk, sit, swim, and more.



While the transformation of systems is a topic that is beyond this course, this chapter lays the foundation for this type of work.

CONNECT TO TESTING (DOK 3)

Directions: *Read the questions and work through the solution steps with a partner.*

Mustafa buys ham and turkey sandwiches for an office event. Each ham sandwich costs $4.50 and each turkey sandwich costs $5.50. If he buys a total of 5 sandwiches and spends $24.50, how many turkey sandwiches did he buy? 2

Understand It: To solve this problem, you need to write and solve a system of equations from the information provided.

Visualize It: This situation can be represented by a system of linear equations. A system of linear equations can have one of three different types of solutions: one solution, infinitely many solutions, and no solution. Sketch a graph of each type of solution in the space below.

Student sketches will vary.

Solve It: Use the questions below to help you write the system of equations.

Let x = the number of ham sandwiches purchased and let y = the number of turkey sandwiches purchased.

Write an equation to represent the total number of sandwiches Mustafa purchased in the space below.

$x + y = 5$

Write a second equation to represent the cost of the sandwiches. Use the space below.

$4.50x + 5.50y = 24.50$

Solve the system and answer the question:

$x + y = 5$

$x = 5 - y$

Substitute:

$4.50(5 - y) + 5.50y = 24.50$

$22.50 - 4.50y + 5.50y = 24.50$

$22.50 + y = 24.50$

$y = 2$

Mustafa bought 2 turkey sandwiches.

WORDS TO KNOW

coinciding lines	elimination	substitution	system of linear inequalities
constraints	parallel	system of linear equations	

CONNECT TO TESTING

Use these questions to help your students engage with the process of solving a simulated state test question.

1. **What methods can you use to solve a system of linear equations?**

   Systems of equations can be solved algebraically using the substitution or elimination methods. Systems can also be solved graphically, either by hand or by using a graphing calculator. Certain systems would lend themselves to being solved by creating a table to test values.

2. **Why can the elimination or substitution method be an easier way to solve systems?**

   Student answers will vary. One possible answer: Using these methods, it is sometimes easier to see if the system has one solution, many solutions, or no solutions. Additionally, systems with decimal solutions can be difficult to determine on a graph without the use of technology.

3. **How would the solution to a system change if the system consisted of inequalities instead of equations?**

   Generally, a system of inequalities has many solutions that lie in the solution region, whereas a system of equations usually has a single solution point.

4. **Summarize the process of writing a system of linear equations from a context. Why is it important to keep track of all of your information from the problem?**

   Student answers will vary. One possible answer: When working from a context, it is best to read the problem multiple times and then highlight or underline information that is relevant. Examine the types of information given in the problem to identify categories for the equations. Finally, write the equations using the values from the problem. Be

LESSON: INTRODUCTION

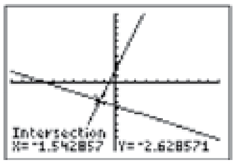
- Each lesson begins with short, direct instruction and transitions to guided instruction.
- Discussion questions and interactive activities prompt active discourse and student discovery.
- Extension activities promote visualization and application of concepts.
- ELL activities such as sentence frames, vocabulary notebooks, and graphic organizers help build math literacy.
- Videos give learners additional support.

LESSON 2 Solving Linear Systems by Elimination or Substitution

In this lesson you will solve systems of linear equations by elimination and substitution.

INTRODUCTION Elimination and Substitution

Sometimes it's hard to find the solution to a graphed system. Look at the system $\begin{cases} y = 3x + 2 \\ y = -\frac{1}{2}x - 3\frac{2}{5} \end{cases}$ shown at the right.



The lines intersect and have a single solution at approximately (–1.54, –2.63). Because this point does not have integer coordinates, you cannot find an exact solution by graphing unless you use a graphing calculator. Luckily, there are two additional methods for solving systems of equations—**elimination** and **substitution**.

Elimination	Substitution
Main Idea: • Add the two equations together so that one variable is eliminated. When to Use: • Often easiest to use when the equations are in standard form, $Ax + By = C$.	Main Idea: • Substitute an expression for one variable into the other equation. When to Use: • Often easiest to use when one or both equations have one variable isolated or are in $y = mx + b$ form.

• Solving by elimination:

Solve the system $\begin{cases} 2x - 5y = 7 \\ 3x + 5y = 13 \end{cases}$. The equations are both in standard form, where the like terms are stacked vertically. Add the equations in the space to the right. What happens to the y terms? They are eliminated.	$\begin{cases} 2x - 5y = 7 \\ 3x + 5y = 13 \end{cases}$ $5x + 0y = 20$	
Solve the resulting equation for x.	$5x = 20$ $x = 4$	
The system solution will be a coordinate point. Substitute $x = 4$ into one of the original equations to find y. Either equation will give the same value. You finish solving in the cells to the right.	$2x - 5y = 7$ $2(4) - 5y = 7$ $8 - 5y = 7$ $-5y = -1$ $y = \frac{1}{5}$	$3x + 5y = 13$ $3(4) + 5y = 13$ $12 + 5y = 13$ $5y = 1$ $y = \frac{1}{5}$
The solution is the coordinate point $\left(4, \frac{1}{5}\right)$.		

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INTRODUCTION

How do you determine when to use substitution and when to use elimination to solve a system of equations?

Student answers will vary. One possible answer: Examine how the system is presented. If both equations are in slope-intercept form and don't have any fractions or decimals, I would use the substitution method. I would also use this method if one of the equations was solved for x or y. If both equations were in standard form, I would use the elimination method.

How does solving by elimination compare with solving by the substitution method?

The elimination method is used when both equations are in standard form. In this method you eliminate either the x or the y variable by first adding the equations. In the substitution method, you substitute one equation into the other in order to solve for one of the variables.

Why is it sometimes important to use the elimination or substitution method rather than the graphing method to solve a system of equations?

It is not always easy to graph systems of equations accurately by hand. Additionally, if the solution is fractional, it can be difficult to read from the graph.

EXTENSION ACTIVITIES

Activity

Solving Linear Systems Algebraically

In this activity, students will algebraically solve linear systems of equations. If there is one ordered pair solution, they will then drag the point to the intersection on the graph. (Approximately 20 minutes)

https://www.geogebra.org/m/NHYqDPnS

• Ohio Learning Standards for Mathematics are clearly identified.

A.REI.6a **LESSON 2**

• Solving using substitution:

Solve the system $\begin{cases} y = \frac{2}{3}x \\ 2x + 3y = 4 \end{cases}$. Substitute the expression $\frac{2}{3}x$ for y in the second equation. Then simplify and solve the equation for x.	$2x + 3y = 4$ $2x + 3\left(\frac{2}{3}x\right) = 4$	$2x + \frac{6}{3}x = 4$ $2x + 2x = 4$ $4x = 4$ $x = 1$
Now substitute the value found for x into one of the original equations to find y.	$y = \frac{2}{3}(1) = y = \frac{2}{3}$	$2(1) + 3y = 4$ $2 + 3y = 4$ $3y = 2$ $y = \frac{2}{3}$
The solution is the coordinate point $\left(1, \frac{2}{3}\right)$.		

GUIDED INSTRUCTION **Other System Solutions**

When solving a system using elimination or substitution, all the variables will disappear when there is no solution or infinitely many solutions.

A System with No Solution	A System with Infinitely Many Solutions
$\begin{cases} y = 2x - 1 \\ -2x + y = -5 \end{cases}$ • Substitute $2x - 1$ in for y in the second equation. Then simplify and solve. Use the space below. $-2x + (2x - 1) = -5$ $-2x + 2x - 1 = -5$ $0 - 1 = -5$ $-1 = -5$ The variables are gone and you are left with the statement $-1 = -5$, which is false. When the variables cancel and the statement is false, there is no solution.	$\begin{cases} 4x + y = 7 \\ 8x + 2y = 14 \end{cases}$ • No variables are eliminated when the equations are added. You need to multiply the first equation by -2. $-2(4x + y) = -2(7) \rightarrow -8x - 2y = -14$ Add this to the second equation. Then simplify and solve. Use the space below. $-8x - 2y = -14$ $+\ 8x + 2y = 14$ $0x + 0y = 0$ $0 = 0$ The variables are gone and you are left with the statement $0 = 0$, which is true. When the variables disappear and the statement is true, there are infinitely many solutions.

RECAP

1. Describe a situation in which each solving method would be preferable.
Student answers will vary. Generally, graphing would be a useful method when the solution is a point with small integer coordinates and whose equations are easy to graph in slope-intercept form. Elimination is a useful method when the equations are both in standard form so the x, y, and constant terms are in the same order in each equation. Substitution is a useful method when one of the equations has one of the variables already isolated, or if both equations are in slope-intercept form.

 Lesson 2 Solving Linear Systems by Elimination or Substitution 117

Instruction

ELL VOCABULARY

• Ask students to record the following academic vocabulary and definitions in their Vocabulary Notebook: *additional** (another), *stacked* (placed on top of each other), *either* (one or another), *neither* (not one or the other), *description* (a statement/sentence that tells what something is like), *paired* (joined in groups of two), *individually* (one at a time, alone), *exact* (fully or completely accurate, correct).

ELL

Provide the following sentence frames to help students respond to the RECAP question.

Beginning/Intermediate:

• *Graphing is a useful method when_____.*
• *Elimination is a useful method when_____.*
• *Substitution is a useful method when_____.*

Video

Solving Systems of Equations Using Elimination By Addition

This video explains how to solve systems of linear equations using the elimination method. (Length: 9:59)

https://www.youtube.com/watch?v=ej25myhYcSg

- Each activity has a clearly stated purpose and stepped-out support.
- Scaffolded practice provides opportunities for small group and peer-to-peer discussions.
- Remediation activities provide reteaching and reinforcement opportunities.
- All guided practice activities include DOK levels.

GUIDED PRACTICE

1. Solve the system $\begin{cases} y = 3x + 2 \\ y = -\frac{1}{2}x - 3\frac{2}{5} \end{cases}$ using substitution. Give your answers as fractions. (DOK 2)

Step 1 Both equations are solved for y, so substitute $3x + 2$ into the second equation for y. Solve the resulting equation for x.

$$3x + 2 = -\frac{1}{2}x - 3\frac{2}{5}$$
$$3x + 2 = -\frac{1}{2}x - \frac{17}{5}$$
$$10(3x + 2) = 10\left(-\frac{1}{2}x - \frac{17}{5}\right)$$
$$35x = -54$$
$$x = -\frac{54}{35}$$

Step 2 Substitute the value found for x into either of the original equations. Solve for y.

$$y = 3\left(-\frac{54}{35}\right) + 2 \qquad y = -\frac{162}{35} + \frac{70}{35}$$
$$y = -\frac{162}{35} + 2 \qquad y = -\frac{92}{35}$$

Step 3 Give the solution to the system as a coordinate point. $\left(-\frac{54}{35}, -\frac{92}{35}\right)$

2. In the system $\begin{cases} -2x + 3y = 5 \\ 5x + 5y = 25 \end{cases}$, neither the x nor the y variables eliminate when the equations are added together. (DOK 2)

   a Multiply one or both equations by a constant so that one of the variables will be eliminated when added.

   b Solve the system of equations.

Step 1 Choose a variable, x or y, to eliminate.

- If choosing x, what number is the least common multiple of both -2 and 5? -10 or 10
- If choosing y, what number is the least common multiple of both 3 and 5? 15

Step 2 Choose to eliminate x. The coefficients -2 and 5 both are factors of 10. If one of the x terms is negative and the other is its opposite, the x-terms will eliminate when added. Multiply the first equation by 5 and the second equation by 2.

$$5(-2x + 3y) = 5(5) \rightarrow -10x + 15y = 25$$

$$2(5x + 5y) = 2(25) \rightarrow 10x + 10y = 50$$

GUIDED PRACTICE

Question 2 Remediation: Table Activity

Purpose

This activity gives students more practice with solving by elimination.

Implementation

- Copy the table below, without answers, onto the board, or display using projection equipment with the answers covered.
- Have the students complete the chart individually or in pairs, placing a check mark in the column "Elimination" or "Substitution" to show which method would be best for solving the given system.
- Students can solve the systems or you can lead the class in solving each of them, discussing why certain methods are preferable.

System	Elimination	Substitution	Solution
$\begin{cases} 2x + 3y = 12 \\ 2x - 3y = -6 \end{cases}$	✓		$\left(\frac{3}{2}, 3\right)$
$\begin{cases} 6x - 2y = 14 \\ y = -\frac{1}{2}x \end{cases}$		✓	$(2, -1)$
$\begin{cases} 5x + 3y = 14 \\ 3x - 3y = 18 \end{cases}$	✓		$(4, -2)$
$\begin{cases} 4x - 3y = 19 \\ 5x + 3y = 17 \end{cases}$	✓		$(4, -1)$

Step 3 Add the equations and solve for the variable in the space below.

$-10x + 15y = 25$
$\underline{+10x + 10y = 50}$
$25y = 75$
$y = 3$

Step 4 Substitute the variable value into either original equation to solve for the other variable.

$-2x + 3(3) = 5$
$-2x + 9 = 5$
$-2x = -4$
$x = 2$

Step 5 Write the solution as a coordinate point. (2, 3)

3. Hamburgers cost \$1.79 and an order of fries costs \$0.99. A couple orders 5 items and spends \$7.35. The solution to the system $\begin{cases} 1.79x + 0.99y = 7.35 \\ x + y = 5 \end{cases}$ is (3, 2). Match the number in the solution with the correct description. (DOK 1)

$x = 3$ represents Number of Hamburgers

$y = 2$ represents Number of Fries

Number of Hamburgers	Cost of Hamburgers	Total Items
Number of Fries	Cost of Fries	Total Cost

Step 1 Consider what each variable means in the system. When you solve for x, what are you solving for in context of the problem? What about y? Answer these questions below.
x represents the number of hamburgers and y represents the number of fries.

ELL VOCABULARY

- For Guided Practice #3, use images or sketches to explain the words: *hamburgers, fries*.

LESSON: PRACTICE

- Practice activities cover a range of DOK levels.
- QR codes link to instructional videos supporting the assignment.
- Full solution explanations are provided at point of use.

PRACTICE

Multiple-Choice Questions

Use the information provided in each question to determine your answer(s). Diagrams are not necessarily drawn to scale.

1. Solve $\begin{cases} y = 3x + 2 \\ y = \frac{1}{2}x - 3 \end{cases}$. (DOK 2)

A. $\left(\frac{2}{5}, -\frac{14}{5}\right)$ C. $(-2, -4)$

B. $(0, -3)$ D. No solution

2. Solve the system $\begin{cases} 2x - 3y = 18 \\ x = 2y + 8 \end{cases}$. (DOK 2)

A. Infinitely many solutions

B. $(12, 2)$

C. $(2, 12)$

D. No solution

3. Which of the following systems has infinitely many solutions? Select all that apply. (DOK 2)

A. $\begin{cases} y = \frac{1}{2}x - 4 \\ y = \frac{1}{2}x + 2 \end{cases}$ D. $\begin{cases} y = \frac{2}{3}x - 3 \\ 4x - 6y = 9 \end{cases}$

B. $\begin{cases} 3x + 2y = 8 \\ y = \frac{-3}{2}x + 4 \end{cases}$ E. $\begin{cases} y = 3x + 4 \\ y - 2 = 3(x - 1) \end{cases}$

C. $\begin{cases} x = \frac{-1}{4}y + \frac{3}{4} \\ -8x - 2y = -6 \end{cases}$

Open-Response Questions

Use the information provided to answer the questions in this part. Clearly indicate all your steps, and include substitutions, diagrams, graphs, charts, etc., as needed. Diagrams are not necessarily drawn to scale.

4. Write two equations that, when paired with $3x - 4y = 8$ in a system of equations, would result in no solution. How do you know there is no solution? (DOK 3)

Student answers will vary. See below.

5. Solve the system $\begin{cases} x - y = 9 \\ 3x + 2y = 7 \end{cases}$. (DOK 2)

$(5, -4)$

6. Solve the system: $\begin{cases} 4x - 5y = 10 \\ y = \frac{2}{5}x - 4 \end{cases}$. (DOK 2)

$(-5, -6)$

2. Use the substitution method. Solution steps are shown.

$$2(2y + 8) - 3y = 18$$
$$4y + 16 - 3y = 18$$
$$y = 2$$

Then $x = 2(2) + 8 = 12$.

3. Eliminate answer choice A as the lines are parallel. Check answer choice B:

$$3x + 2\left(\frac{-3}{2}x + 4\right) = 8$$
$$8 = 8$$

A true statement results so this system has infinitely many solutions. Do the same for answer choice C:

$$-8\left(\frac{-1}{4}y + \frac{3}{4}\right) - 2y = -6$$
$$-6 = -6$$

Again, this system has infinitely many solutions.

For answer choice D,

$$4x - 6\left(\frac{2}{3}x - 3\right) = 9$$
$$18 \neq 9$$

This is a false statement, so this system has no solution and is not a correct choice. For answer choice E simplify the equation in point-slope form. It becomes $y = 3x - 1$. These lines are parallel.

4. Rewrite the equation $3x - 4y = 8$ in slope-intercept form: $y = \frac{3}{4}x - 2$. Any equation with the same slope but different y-intercept will have no solution when paired with it in a system.

5. Use the elimination method. Solution steps are shown.

$$\begin{aligned} 2[x - y = 9] &\rightarrow \quad 2x - 2y = 18 \\ +3x + 2y = 7 &\rightarrow +3x + 2y = 7 \\ \hline & \quad 5x = 25 \\ & \quad x = 5 \end{aligned}$$

Solve for y.

$$5 - y = 9$$
$$y = -4$$

6. Use the substitution method. Solution steps are shown.

$$4x - 5\left(\frac{2}{5}x - 4\right) = 10$$
$$2x = -10$$
$$x = -5$$

Solve for y.

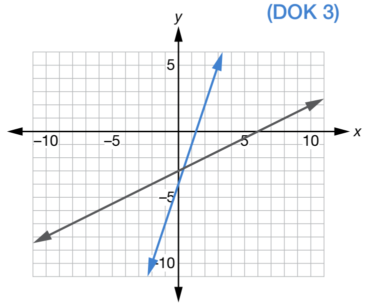
$$y = \frac{2}{5}(-5) - 4$$
$$y = -6$$

7. Suppose that each of the given equations, below, were individually placed in a system with the equation $2x+5y=5$. What would be the solution for each system? Match each equation with its system solution. (DOK 3)

i. $-6x-15y=-15$	b.	a. No solution
ii. $3x-y=16$	d.	b. Infinitely many solutions
iii. $y=-\frac{2}{5}x+4$	a.	c. (0, 1)
iv. $3x-4y=-4$	c.	d. (5, −1)

8. Find the exact coordinates of the solution to the system graphed below. Express your final coordinates as fractions. (Hint: You will need to start by finding the slope-intercept form of each line graphed.) (DOK 3)

The system is $\begin{cases} y=3x-4 \\ y=\frac{1}{2}x-3 \end{cases}$; solution: $\left(\frac{2}{5}, \frac{-14}{5}\right)$



9. Kweku solved the system $\begin{cases} 2x+4y=9 \\ -3x-6y=2 \end{cases}$, but made a mistake. His work is shown below. At which step did he first make a mistake? What is the actual answer? (DOK 2)

Step 1: $\begin{cases} -3(2x+4y=9) \\ 2(-3x-6y=2) \end{cases}$	**Step 4:** $y=\frac{23}{24}$
Step 2: $\begin{cases} 6x-12y=-27 \\ -6x-12y=4 \end{cases}$	**Step 5:** $2x+4\left(\frac{23}{24}\right)=9$; $2x+\frac{23}{6}=9$; $2x=\frac{31}{6}$; $x=\frac{31}{12}$
Step 3: $-24y=-23$	

The mistake is in Step 1. There is no solution to this system.

Review

7. Consider each potential system.

$\begin{cases} 2x+5y=5 \\ -6x-15y=-15 \end{cases}$	$\begin{cases} 2x+5y=5 \\ 3x-y=16 \end{cases}$
These equations are the same; the second is equivalent to the first equation multiplied through by a factor of −3.	Use elimination to solve. $2x+5y=5$ $15x-5y=80$ $17x=85$ $x=5$ There is only one answer choice with an x-value of 5.
Infinitely Many Solutions (b)	(5, -1) (d)
$\begin{cases} 2x+5y=5 \\ y=-\frac{2}{5}x+4 \end{cases}$	$\begin{cases} 2x+5y=5 \\ 3x-4y=-4 \end{cases}$
Use substitution to solve. $2x+5\left(-\frac{2}{5}x+4\right)=5$ $2x-2x+20=5$ $20\neq 5$ This is a false statement.	Use elimination to solve. Multiply the first equation by −2 and the second by 3. Then $-6x+8y=8$ $6x+15y=15$ $23y=23$ $y=1$ There is only one answer choice with a y-value of 1.
No Solution (a)	(0, 1) (c)

8. Write the system using the y-intercepts and a second point on each line. The system is

$$\begin{cases} y=3x-4 \\ y=\frac{1}{2}x-3 \end{cases}.$$

Solve by substitution.

$$\frac{1}{2}x-3=3x-4$$

$$x=\frac{2}{5}$$

Substitute this value for x in either equation and solve for y:

$$y=3\left(\frac{2}{5}\right)-4=\frac{-14}{5}.$$

9. If Kweku wanted to eliminate the x-variable, he should have multiplied the equations by +3 and +2, since the x terms already had opposite signs. If he had, the system would have become $\begin{cases} 6x+12y=27 \\ -6x-12y=4 \end{cases}$. Summing these equations eliminates both x and y, resulting in 0 = 31, which is not true. The system has no solution.

OPEN EDUCATIONAL RESOURCES

- Save time with carefully curated open resources.
- Open resources include interactive activities, simulations, videos, and digital tools.
- Time estimates and activity synopses are provided to assist in planning and usage.

INTRODUCTION

Give an example of a problem that could be solved using a system of linear equations.

Student answers will vary. Any situation that relates two variables using two linear equations is appropriate.

Explain how to write a system of equations from a word problem.

Student answers will vary. One possible answer: To write a system of equations from a word problem, I must first determine how many variables are in the problem. The number of unknown variables tells me how many equations I will need in order to solve my unknowns. Then I need to look at the context for clues, breaking down the problem sentence by sentence.

GUIDED INSTRUCTION

How can you determine if two given systems of equations are equivalent?

Student answers will vary. One possible answer: I can determine if two systems of equations are equivalent by transforming each equation into slope-intercept form. If they are equivalent, the equations will be the same for both systems.

LESSON 3 Creating Systems of Linear Equations

In this lesson you will practice writing systems of linear equations.

INTRODUCTION Writing Linear Systems

- A gym sells day passes for use of its pool and racquetball court. In one month, Alida spends \$53.50 on passes and goes to the gym 14 times. If day passes for the pool cost \$3.50 and day passes for the racquetball court cost \$4.00, how many times did Alida use each facility? Write and solve a system of equations.

Determine what is being asked: *how many times did Alida go to the pool and racquetball court?* • Define two variables for the two unknowns in the box to the right.	x = number of visits to the pool y = number of visits to the racquetball court
There is information about the cost and number of passes in the sentence. *In one month, Alida spends \$53.50 on passes and goes to the gym 14 times.* • Use x, y, and the information above to write two equations.	Write an equation for the cost of the passes: $3.5x + 4y = 53.50$ Write an equation for the number of passes: $x + y = 14$
Solve the system. The equation $x + y = 14$ can be easily solved for y. Solve this equation to the right.	Solve the equation $x + y = 14$ for y. $y = 14 - x$
Solve the system using substitution in the space below. $3.5x + 4(14 - x) = 53.5$ $3.5x + 56 - 4x = 53.5$ $-0.5x + 56 = 53.5$ $-0.5x = -2.5$ $x = 5$ $x + y = 14$ $5 + y = 14$ $y = 9$	
Answer the following questions in the box to the right. • How many times did Alida go to the pool? • How many times did Alida go to the racquetball court?	Pool visits: 5 Racquetball court visits: 9

GUIDED INSTRUCTION Choosing the Correct System

Tycho is 2 years younger than 3 times his cousin Murtaza's age. The sum of Tycho's and Murtaza's ages is 50.

Consider the systems of equations shown in the table. To choose the correct system, check the following questions.

- Does the system have a variable to represent the age of each person?
- Do the equations match the given information?
- Does the solution to the system make sense given the information in the problem?

EXTENSION ACTIVITIES

Activities

Linear Systems: Gym Membership

This is an extension you can use after students are comfortable creating linear equations. (Approximately 40 minutes)

https://teacher.desmos.com/activitybuilder/custom/561d6a790784861e06c3a6dc#

Systems of Linear Equations

Here students will write systems of equations from word problems and then graph the equations on the *xy*-plane. (Approximately 20 minutes)

https://www.geogebra.org/m/Vtd7Xaas

System 1	System 2	System 3
$T + 3M - 2 = 50$ $2 + 3 = M + T$	$T = 3M - 2$ $T + M = 50$	$M = 3T - 2$ $T + M = 50$

What do the variables in the systems represent?

M = the age of Murtaza

T = the age of Tycho

Consider the first sentence: *Tycho is 2 years younger than 3 times his cousin Murtaza's age.* Which equation listed above best describes this relationship?

$T = 3M - 2$

Consider the second sentence: *The sum of Tycho's and Murtaza's ages is 50.* Which equation listed above best describes this relationship?

$T + M = 50$

Which is the correct system? System 2 is the correct system

Solve the correct system in the box below, checking your answer as shown.

$4M - 2 + 2 = 50 + 2$
$4M = 52$
$M = 13$
Substitute $M = 13$.
$T = 3(13) - 2$
$T = 39 - 2$
$T = 37$
Murtaza is 13 and Tycho is 37.

Check:
- If you multiply Murtaza's age by 3 and subtract 2, do you get Tycho's age?
- Do the ages of Murtaza and Tycho add up to 50?

RECAP

1. Generally, which part of a problem helps you to determine what the variables are? Use examples from the lesson to explain your answer.
Student answers will vary. Generally, the question at the end of a problem tells what is unknown, such as the ages of people, or the number of times visited to the pool or court.

Instruction

ELL VOCABULARY

- For the introduction problem, use images or sketches to explain the words: *gym, pool, racquetball, passes*.
- Ask students to record the following academic vocabulary and definitions in their Vocabulary Notebook: *real world* (in life, not just in the classroom), *make sense* (to be clear or correct), *justify** (give reasons for), *verbal* (with words), *corresponding** (matching, being the same as), *interpret** (to explain, to figure out), *exceed** (to be greater or more than, to go over), *state* (to say).
- Have students review the following math vocabulary: *system of equations*, substitution*, elimination*, coordinates*, sum*, equation*, variable*, multiplying*, equivalent, solution**.

Video

Systems of Linear Equations in Two Variables

This animation Reiterates the importance of the intersection point by walking students through a problem and solution. (Length: 6:37)

https://www.youtube.com/watch?v=75m60SxFfJg&t=190s

VISUALIZATION AND MODELING

- Modeling and visualization activities help students deepen understanding.
- Comparing models promotes discovery and stimulates active discourse.

GUIDED PRACTICE

1. Two numbers have a sum of 34 and a difference of 18. What are the numbers? Write a system of equations and solve the problem using elimination. (DOK 2)

Step 1 Define the variables.
- Let x = the first number
- Let y = the second number

Step 2 Write one of the equations using the statement, *Two numbers have a sum of 34.*
$x + y = 34$

Step 3 Write the second equation using the statement *and a difference of 18.*
$x - y = 18$

Step 4 Use the elimination method to solve the system in the space below.
$x + y = 34$ $\quad$ $26 + y = 34$
$\underline{x - y = 18}$ $\quad$ $y = 8$
$2x = 52$
$x = 26$

Step 5 Check your answer below. Do your two numbers have a sum of 34 and a difference of 18?
Yes.
$26 + 8 = 34$ and $26 - 8 = 18$

2. Recall that equivalent equations are equations that have the same solutions. Are the two systems of equations below equivalent? How do you know? (DOK 3)

System 1	System 2
$3x + 2y = 12$	$-3x - 2y = -12$
$y = x + 1$	$2x + 3y = 13$

Step 1 Examine the equations in the systems.
- What similarities are there between the equations in System 1 and System 2?
The first equations in each system are different only by a multiple of -1.

Step 2 Can you produce any of the equations in System 2 by multiplying any of the equations in System 1 by a constant? Justify your answer below.
Yes, multiplying $3x + 2y = 12$ by -1 results in $-3x - 2y = -12$.

GUIDED PRACTICE

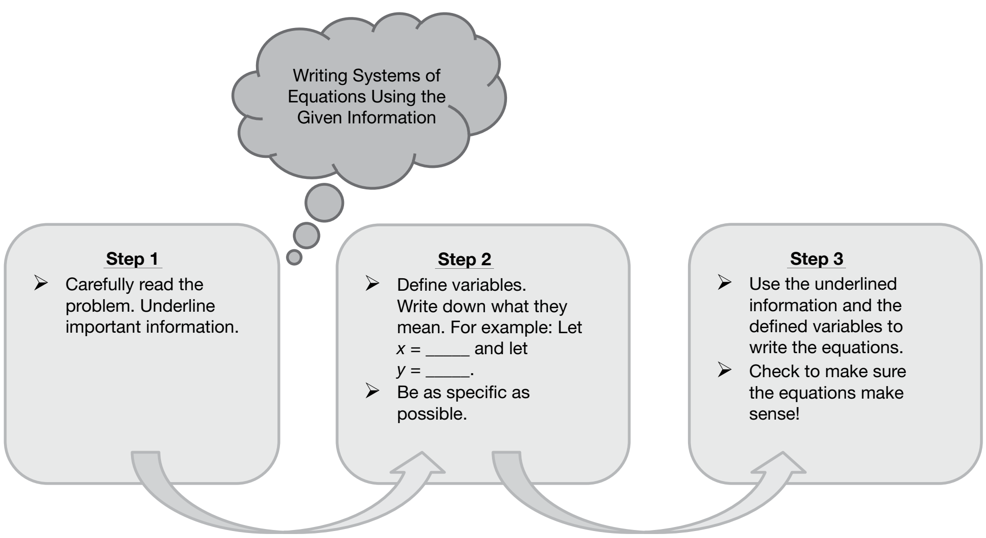
Question 1: Visual Summary

Purpose

In this activity, students create their own visual summary of a process to help them translate word problems into systems of equations.

Implementation

- Divide students into pairs or have them complete this task individually.
- Consider providing a framework for the visual summary, or allow students to create their own. A sample is shown below.
- Once students have completed their visual summary, select a few to share, or complete a class visual summary to be displayed on the classroom wall for reference.



OHIO STANDARDS ASSESSMENT OST PRACTICE

- Each chapter concludes with OST practice.
- Each chapter test item is tagged with a DOK level.

Step 3 Solve each system in the boxes below.

System 1	System 2
$3x + 2y = 12$ $y = x + 1$ $3x + 2(x + 1) = 12$ $3x + 2x + 2 = 12$ $5x + 2 = 12$ $5x = 10$ $x = 2$ $y = 2 + 1$ $y = 3$ $(2, 3)$	$2(-3x - 2y = -12) \rightarrow -6x - 4y = -24$ $3(2x + 3y = 13) \rightarrow + 6x + 9y = 39$ $5y = 15$ $y = 3$ $-3x - 2(3) = -12$ $-3x - 6 = -12$ $-3x = -6$ $x = 2$ $(2, 3)$
• Are the solutions the same? Yes	
• Are the systems equivalent? Yes	

3. The table shows data from a system of two equations, Y_1 and Y_2. Write the two equations that form the system. What is the solution to the system? (DOK 3)

X	Y_1	Y_2
0	2	4
1	2.3333	3.6667
2	2.6667	3.3333
3	3	3
4	3.3333	2.6667
5	3.6667	2.3333
6	4	2

Step 1 Write the equation for Y_1.

- Use two points to calculate the slope.
  $(0, 2)$ and $(3, 3)$
  $m = \frac{3-2}{3-0} = \frac{1}{3}$
- Find the y-intercept. It is $(0, 2)$.
- Write the equation of the line in slope intercept form. $y = \frac{1}{3}x + 2$

Step 2 Write the equation for Y_2 below. Use the same process as in Step 1.

$(0, 4)$ and $(3, 3)$

$m = \frac{3-4}{3-0} = -\frac{1}{3}$

$y = -\frac{1}{3}x + 4$

Step 3 In the table above, find the x-coordinate where the y-values are the same for both Y_1 and Y_2. What does this mean about the solution to the system?

This means that when $x = 3$, $y = 3$ for both equations and $(3, 3)$ is the solution to the system.

Step 4 Verify your solution from Step 3 by solving the system.

$\frac{1}{3}x + 2 = -\frac{1}{3}x + 4$

$\frac{2}{3}x = 2$

$x = 3$

$y = \frac{1}{3}(3) + 2$ $\quad$ $y = -\frac{1}{3}(3) + 4$

$y = 3$ $\quad$ $y = 3$

PRACTICE

1. Define s as the number of senior/student tickets sold and c as the number of community member tickets sold. The equations are

$$\begin{cases} 10s + 15c = 9500 \\ s + c = 700 \end{cases}$$

2. Solve the system from Practice 1, using either elimination or substitution. By substitution,

$$s = 700 - c$$
$$10(700 - c) + 15c = 9500$$
$$700 - c + 1.5c = 950$$
$$700 + 0.5c = 950$$
$$0.5c = 250$$
$$c = 500$$

Since $c = 500$ tickets, $s = 200$ tickets.

PRACTICE

Multiple-Choice Questions

Use the information provided in each question to determine your answer(s). Diagrams are not necessarily drawn to scale.

Use the following information for Questions 1 and 2.

The local school is putting on a play. Tickets cost $10 for senior citizens and students and $15 for community members. The school sells 700 tickets for a total of $9,500.

1. Write a system of equations that models this scenario. (DOK 2)

A. $\begin{cases} 10s + 15c = 9500 \\ 10s + 15c = 700 \end{cases}$

B. $\begin{cases} 10s + 15c = 9500 \\ s + c = 700 \end{cases}$

C. $\begin{cases} 10s + 15c = 700 \\ s + c = 9500 \end{cases}$

D. $\begin{cases} 10s + c = 700 \\ s + 15c = 9500 \end{cases}$

2. How many of each ticket did they sell? (DOK 2)

A. 500 Senior/Student, 200 Community

B. 700 Senior/Student, 0 Community

C. 300 Senior/Student, 400 Community

D. 200 Senior/Student, 500 Community

3. Which of the following systems are equivalent? Select all that apply. (DOK 3)

A. $\begin{cases} 4x + 5y = 8 \\ y = 2x + 3 \end{cases}$

B. $\begin{cases} 8x + 10y = 16 \\ y = 4x + 4 \end{cases}$

C. $\begin{cases} y = 6x + 5 \\ y = 2x + 3 \end{cases}$

D. $\begin{cases} 4x + 5y = 8 \\ -4x + 5y = 12 \end{cases}$

Open-Response Questions

Use the information provided to answer the questions in this part. Clearly indicate all your steps, and include substitutions, diagrams, graphs, charts, etc., as needed. Diagrams are not necessarily drawn

OHIO ALGEBRA 1 DIGITAL

Student Application

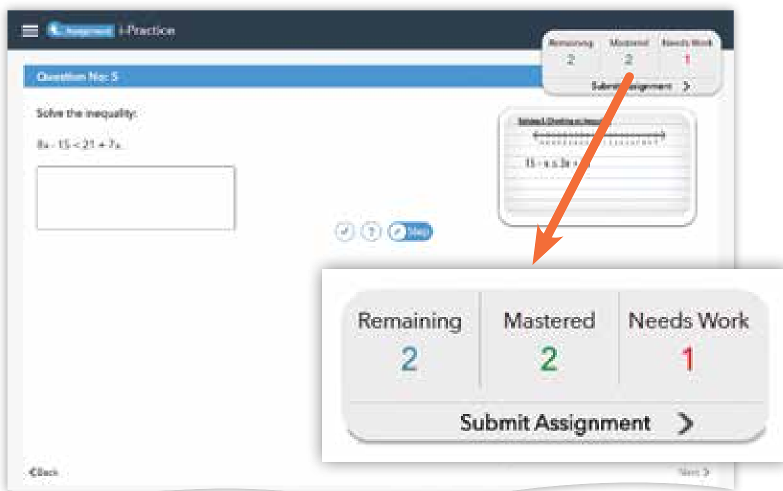
Driven by the powerful *Math*^{X} personalized practice and assessment system, the student application provides a full range of assignments and practice aligned with *Ohio Learning Standards Algebra 1,* including

- *i-Practice* personalized assignments
- online homework assignments
- quizzes and chapter tests
- diagnostic tests
- Ohio Standards Assessment OST practice

i-PRACTICE PERSONALIZED PRACTICE

Each *i-Practice* assignment can be customized to small groups or individual students. By focusing on specific skill areas, students can practice their way to success.

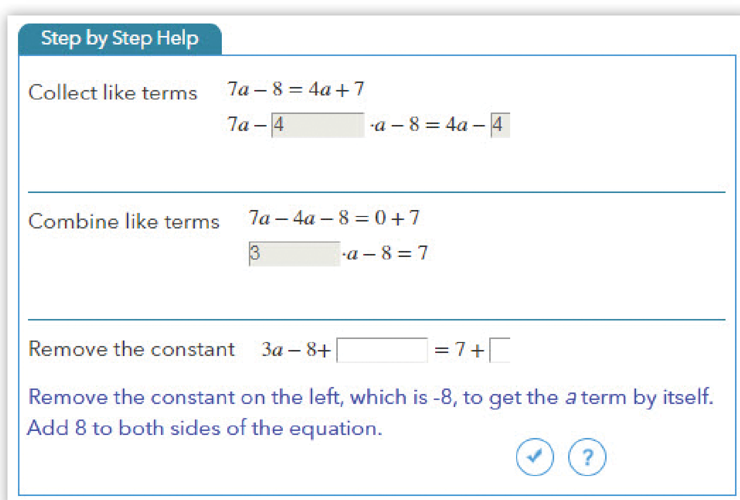
- Incorrect answers automatically generate new problems for students to attempt.
- A scoring counter shows progress on the assignment.
- Guided practice provides point-of-use help.
- Students have the option to stop and return to the assignment at any time.



GUIDED PRACTICE ASSISTANCE

For *i-Practice* and homework assignments, students have a wealth of help accessible next to the problem. By providing multiple help options, the program addresses different learning styles and ability levels.

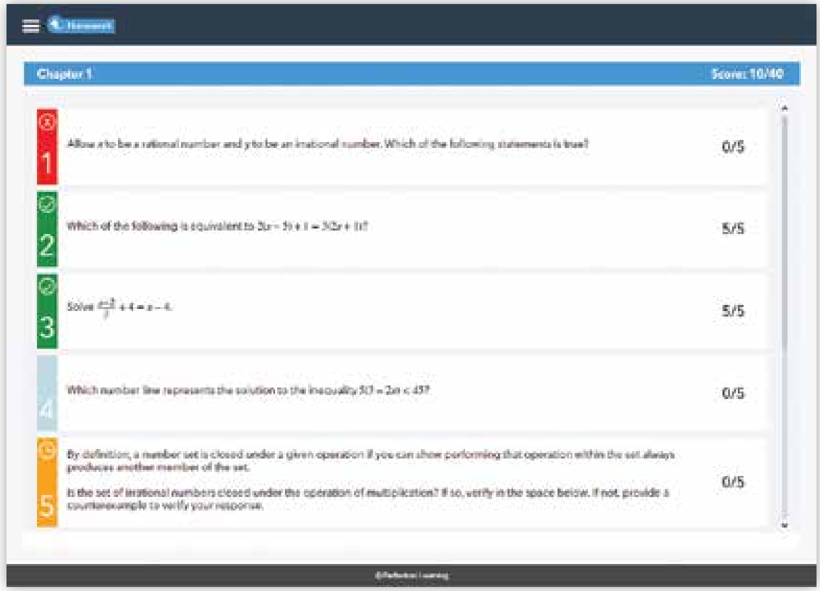
- Video provides step-by-step instruction for a similar problem.
- Step-by-Step Help guides students through each step of a multi-step problem.
- A help button gives problem hints and tips.
- Smart feedback responds to students' incorrect answers with suggestions.



ONLINE HOMEWORK, QUIZZES, AND TESTS

Assignments allow students the flexibility to answer questions in any order and give immediate feedback once an answer is submitted.

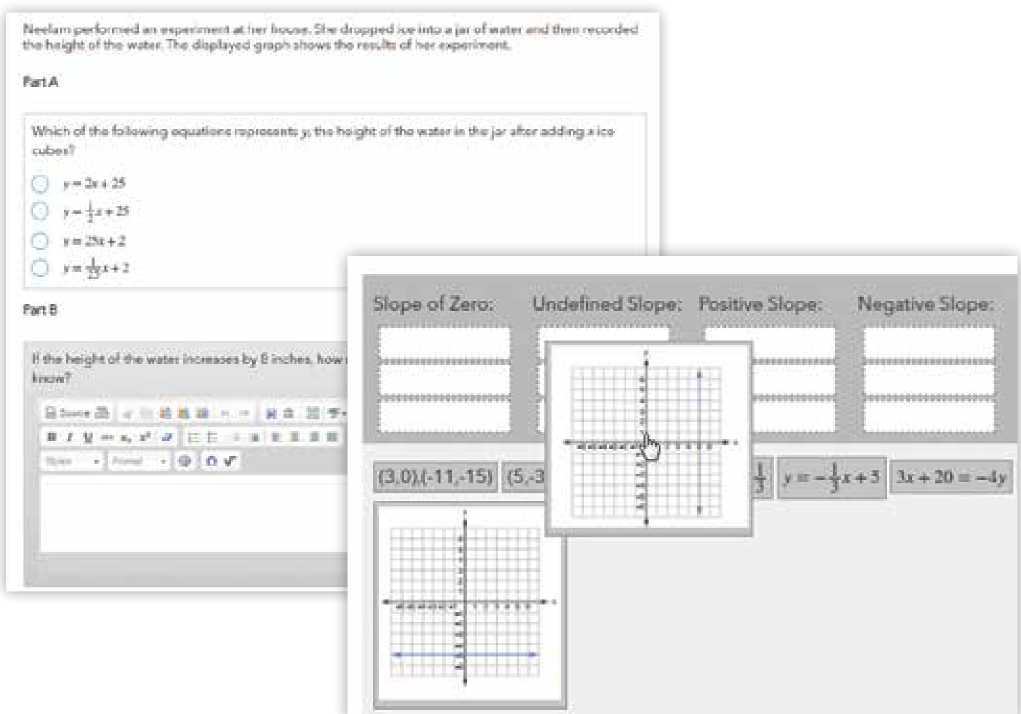
- Homework parameters set by the teacher allow multiple tries.
- Help functions (videos, hints/tips, step-by-step) appear for homework.
- Quizzes and tests eliminate the help functions automatically. Tests allow only one try. Quizzes allow for one or more tries, as set by the teacher.
- Assignment due dates, grades, and teacher communications are all easily visible from the student dashboard.



TECHNOLOGY-ENHANCED ITEMS

Research shows that content mastery requires the ability to respond to a wide range of problem formats. Problem types include

- multi-part problems
- equation input
- graphing
- drag and drop
- multi-select
- open response
- *and much more...*



OHIO ALGEBRA 1 DIGITAL

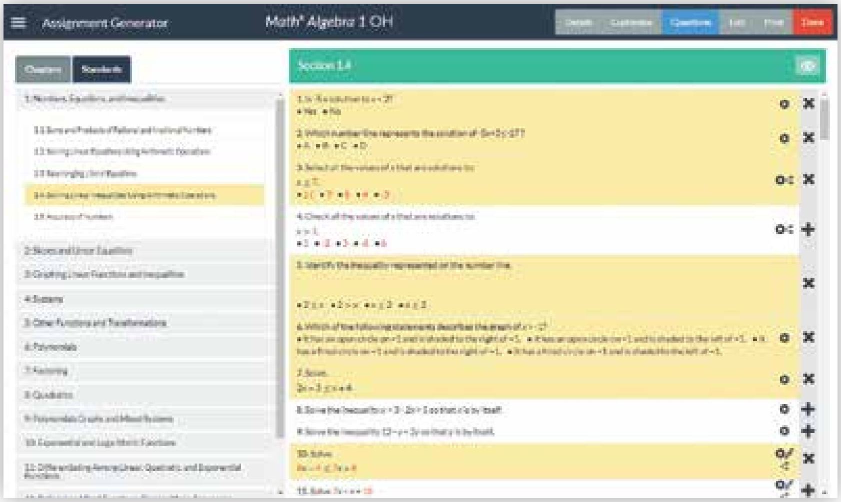
Teacher Application

Driven by the powerful *Math^X* personalized practice and assessment system, the teacher application provides a full range of assignment, reporting, and grading functions. Comprehensive alignment with *Ohio Learning Standards Algebra 1* provides teachers the ability to monitor student progress in real time and customize assignments based on performance. The digital Teacher Package includes access to a projectable version of the Student Edition.

PRE-BUILT ASSIGNMENTS

Each assignment is aligned with the *Ohio Learning Standards Algebra 1* lessons.
Pre-built assignments include

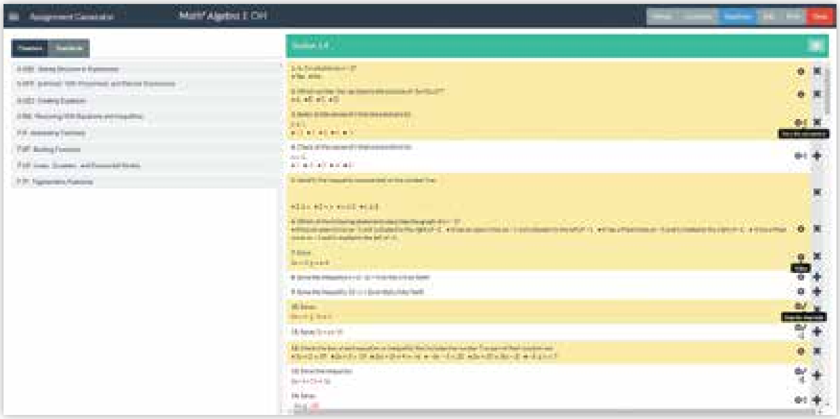
- *i-Practice*, homework, quizzes, chapter tests, model exams, and diagnostic tests
- one-click due date assignment
- standards covered by each lesson with rollover explanations for the standards
- easy assignment modification functionality



CUSTOMIZABLE ASSIGNMENTS AND TESTS

Modify the pre-built assignments or create your own.

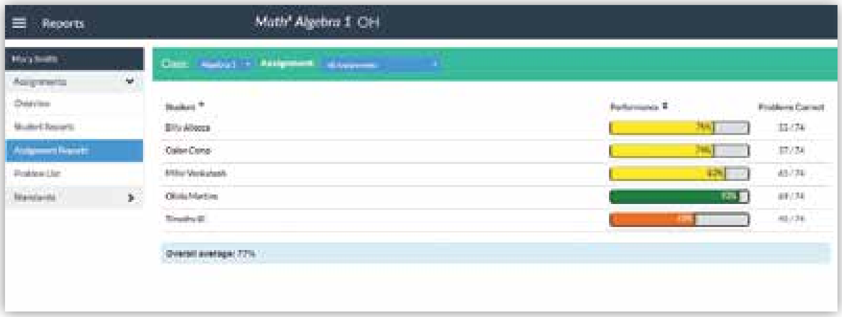
- Choose from thousands of items by standard or by lesson.
- Differentiate assignments for small groups or individuals.
- Create unique assignments for each student using “vary the parameter” technology.
- Print assignments for pencil and paper exercises.



REAL-TIME PROGRESS MONITORING

Grade book functions allow teachers to monitor student progress in real time.

- assignments are automatically graded at time of submission
- at-a-glance look at student and class performance across homework, quizzes, and tests
- one-click access to individual student performance
- manage due dates and late assignments for individual students
- add/drop grades
- export function for district grade books



EXTENSIVE REPORTING CAPABILITY

Reporting and drill-down functions allow teachers to

- assess class and student performance by standard or lesson
- identify students and topics for reteaching and remediation
- group students by ability and performance levels
- evaluate item-level performance by class and by student

OHIO LEARNING STANDARDS FOR MATHEMATICS

Algebra 1

The ***Ohio Learning Standards*** program provides the foundation for Algebra 1 success. Designed specifically for Ohio, each standards-based lesson helps students identify areas of weakness, receive targeted instructional support and practice, and prepare for the Ohio Standards Algebra 1 Test.

Students engage in active discourse to build math literacy through

- discovery-based learning
- direct instruction
- personalized practice
- real-world application, extension activities, and authentic OST practice

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For more information on the Ohio Learning Standards for Mathematics program, visit perfectionlearning.com/oh-algebra-1

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